

MINDS, MEALS AND MOTIVATIONS

Understanding lifestyle change for cognitive health: insights from research and everyday practice

Rebecca Terlouw-Otte

Propositions

1. Lifestyle advice that ignores people's non-health priorities is doomed to fail over time.
   (this thesis)

2. Fear is a wise advisor.
   (this thesis)

3. Qualitative data is the reality-check of quantitative measures.

4. If publishing research takes two years, the system is not safeguarding quality but blocking progress.

5. In practice-based research, universities of applied sciences and universities are not competitors but complementary partners.

6. Spending time in the mountains fosters perspective on life's challenges more effectively than time spent in any other natural environment.

Propositions belonging to the thesis, entitled

Minds, Meals and Motivations - *Understanding lifestyle change for cognitive health: insights from research and everyday practice*

Rebecca Terlouw – Otte
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Minds, meals and motivations

Understanding lifestyle change for cognitive health: insights from research and everyday practice

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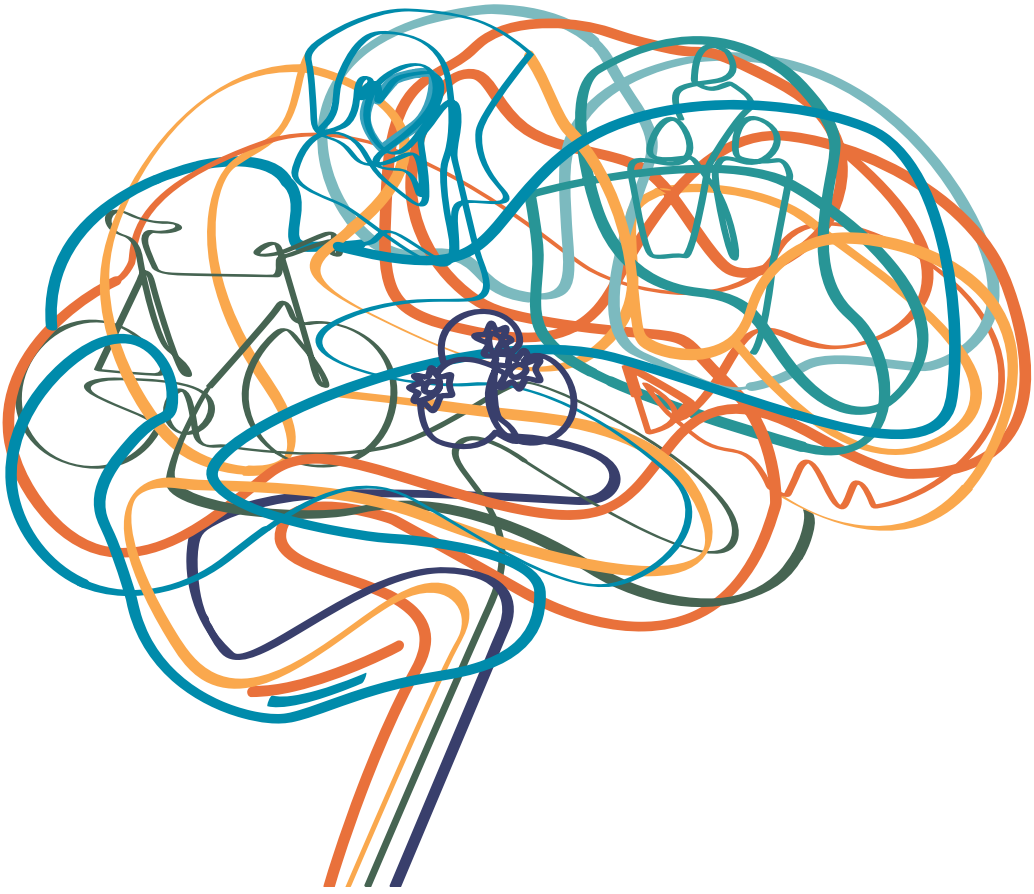
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CHAPTER 1

General introduction

Introduction

Health, both for yourself and your loved ones, is often what matters most in a human life. It is evident from widely reported statistics that maintaining good health is far from easy. Even as scientists, we do not always know what the exact 'recipe' is for maintaining good health, and one may even ask whether such a recipe truly exists. Even when scientifically grounded guidelines for a healthy lifestyle are available, consisting of, among others, healthy nutrition, sufficient physical activity, and adequate sleep (1-3), it remains a challenge for individuals to adhere to these recommendations and to develop sustainable healthy habits (4, 5).

These challenges are reflected in global epidemiological statistics: the burden of lifestyle-related chronic diseases continues to rise (6). At the same time, people today live longer lives than any generation before them. However, increased longevity also brings new challenges, as longer life expectancy is accompanied by a higher prevalence of age-related conditions. These issues are evident not only at the individual level but also result in challenges in society at large. Rising healthcare costs, growing demands on healthcare professionals, and the higher prevalence of chronic diseases associated with an aging population all point to an urgent need to find effective ways to support healthier lifestyles (7). Although much of this attention has been focused on the prevention and management of physical chronic conditions, there is growing recognition that lifestyle factors also play an important role in cognitive health. In this light, dementia has increasingly come into focus as a condition for which lifestyle-based prevention is receiving growing scientific and public attention (8).

Dementia is an umbrella term used to describe a range of different symptoms related to impaired brain functioning and can arise from different underlying conditions or brain injuries that damage the brain directly or indirectly. Globally, approximately 58 million people are currently living with dementia, and this number is projected to triple by 2050 (9). Alzheimer's disease is the most common form, accounting for around 60–70% of cases, followed by vascular dementia, dementia with Lewy bodies (caused by abnormal protein deposits in nerve cells), and a set of disorders that lead to frontotemporal dementia, which affects the frontal lobes of the brain (10). Many people with dementia show mixed or overlapping pathologies, for example Alzheimer's disease combined with vascular or Lewy body pathology (11). Importantly, the onset of dementia can begin years before clinical symptoms appear. During this preclinical phase, which can last up to 20 years, subtle changes occur in the brain, and mild cognitive symptoms can start to appear, such as a decline in episodic memory (12). This long preclinical period offers a critical window of opportunity for preventive strategies.

The idea of developing dementia later in life is a source of fear for many people (13, 14). Many individuals are familiar with someone in their environment who suffers from dementia

and have seen the impact of the disease, both on those affected and on their loved ones (15). Such experiences may make dementia feel more personally relevant and can influence how people think about prevention and reducing their own risk. To understand how lifestyle changes might help reduce dementia risk, it is useful to first consider the factors that determine a person's likelihood of developing the condition.

Lifestyle change for dementia risk reduction

A person's risk of developing dementia is shaped by a combination of non-modifiable and modifiable factors. Age is the most important risk factor for dementia that cannot be changed. The risk of developing dementia increases steadily as people get older, roughly doubling every 6-7 years after the age of 65 (16). Women generally have a higher risk than men, likely due to a combination of biological, genetic, and social factors (17). Genetics also play an important role: studies show that a substantial proportion of the risk for Alzheimer's disease is influenced by genetic factors (18). At the same time, most cases happen without a clear inherited mutation, meaning people usually develop the disease due to a mix of genetic, lifestyle, and other factors rather than a single inherited gene (19).

While certain risk factors for dementia, such as age, sex, and genetic predisposition, cannot be changed, a substantial part of dementia risk appears to be modifiable. Epidemiological studies suggest that a healthy diet, regular exercise, cognitive stimulation, and social engagement may together reduce the risk of cognitive decline and dementia (20, 21). In this, lifestyle behaviors may affect both the structure and functioning of the brain and, in doing so, contribute to brain and cognitive reserve, which may help people better cope with age-related or disease-related changes in the brain (22).

In the 2024 report of the Lancet Standing Commission (23) an overview is provided of various lifestyle factors that influence the development of dementia across the life course (see Figure 1). The report highlights modifiable risk factors, that can potentially be influenced through interventions, while also recognizing that certain fixed factors, such as genetic predisposition, play an important role. For example, carrying the APOE ε4 allele is one of the strongest known genetic risk factors, but since it cannot be altered, it is viewed more as a background vulnerability that may interact with lifestyle influences (24). In contrast, the modifiable risk factors are distributed across different stages of life: early life, midlife, and later life. Taken together, these potentially modifiable lifestyle factors account for up to 45% of dementia cases that could be prevented or delayed by addressing these risks. Although in practice this may not be entirely achievable, for example, lower education in early life is difficult to address after that stage, there are certainly risk factors in later life where interventions can still make a meaningful difference in preventing or delaying dementia.

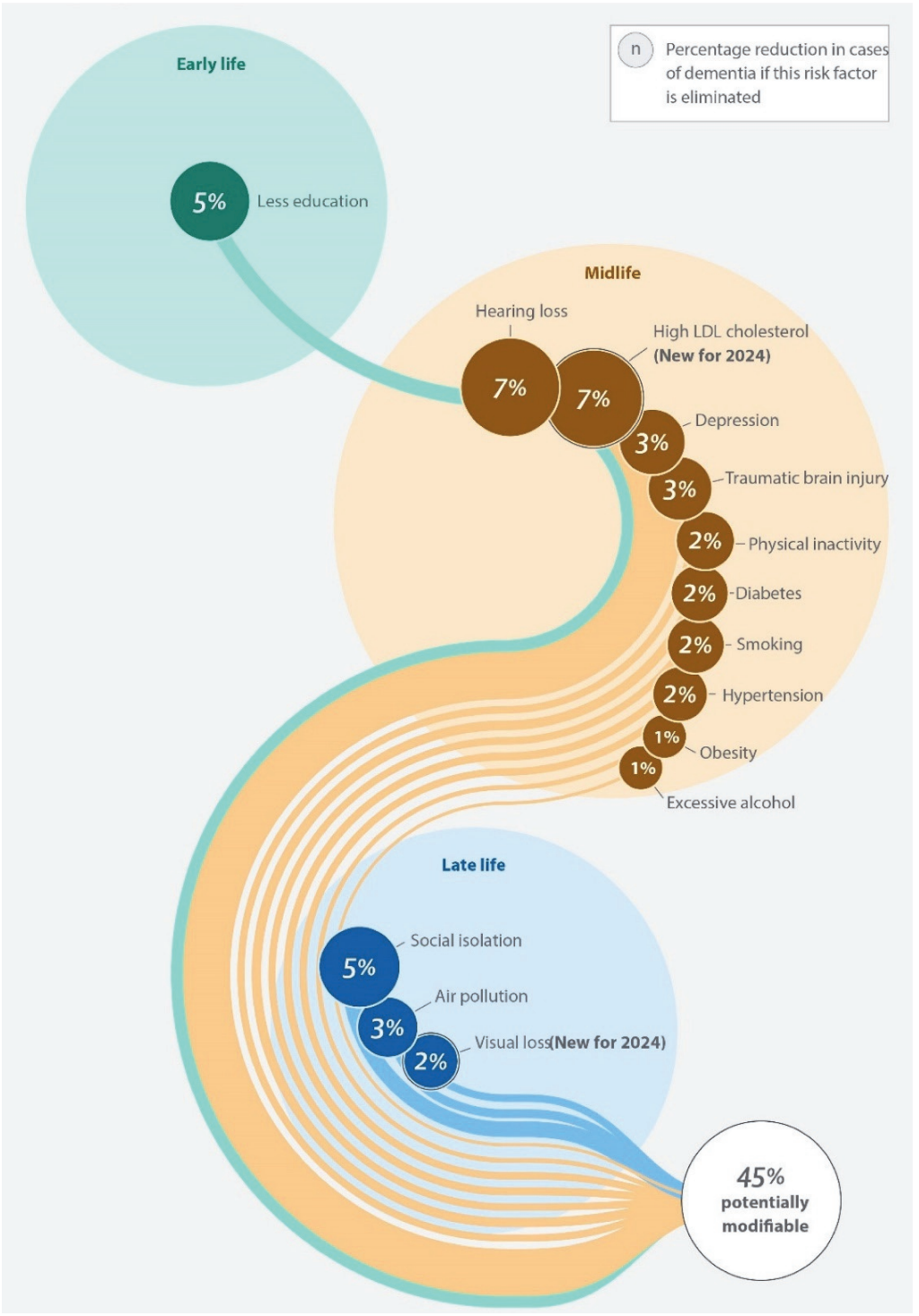


Figure 1. Overview of modifiable and non-modifiable risk factors for dementia as reported by the 2024 Lancet Commission (23).

Evidence from multidomain interventions

A major step forward in dementia prevention research was the Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER), a two-year randomized controlled trial with 1260 participants aged 60-77 years at increased risk of cognitive decline (25). The intervention included dietary guidance, physical exercise, cognitive training, and monitoring of vascular risk factors, while the control group received general health advice. The study found small but statistically significant improvements in overall cognition, particularly in executive functioning and processing speed. This indeed suggested that multidomain lifestyle programs could improve or maintain cognitive functioning in at-risk elderly people from the general population and formed the start of the Worldwide FINGERS network, connecting similar prevention studies across different countries (26).

The observed benefits are supported by several plausible mechanisms. Physical activity, for example, improves blood flow to the brain, which is essential for delivering oxygen and nutrients needed for healthy brain functioning (27). It also supports overall metabolic and vascular health and helps the brain adapt and change (a process known as neuroplasticity) by stimulating the growth of new brain cells (28), strengthening connections between them, and increasing the release of substances such as brain-derived neurotrophic factor that support the survival and functioning of neurons. In addition, exercise may help restore the energy-producing capacity of brain cells and reduce inflammation in the brain, both of which are important in preventing cognitive decline (29). Dietary patterns such as the Mediterranean, Dietary Approaches to Stop Hypertension (DASH), and the Mediterranean-DASH Intervention for Neurodegenerative Delay (MIND) diets are rich in fruits, vegetables, whole grains, and healthy fats, providing antioxidants and anti-inflammatory compounds that help protect the brain (30). These diets also improve heart and metabolic health, lowering risk factors such as high blood pressure and diabetes that are known to increase the risk of cognitive decline (28). Cognitive training may help build what is often called “cognitive reserve; the brain’s ability to cope with age-related changes by strengthening brain networks involved in memory and executive functioning (31). Social engagement adds another layer of protection by providing mental stimulation and emotional support, both of which are associated with better cognitive health (32). Importantly, combining multiple lifestyle components is thought to have additive or even synergistic effects, meaning that addressing several aspects of lifestyle together may be more effective for brain health than focusing on a single factor alone (25, 33).

More recently, the U.S. Study to Protect Brain Health Through Lifestyle Intervention to Reduce Risk (U.S. POINTER), enrolled over 2,000 older adults at risk of cognitive decline and dementia to confirm the effects of the FINGER intervention in a more diverse American population (34). The results showed that adherence to a structured lifestyle, including regular moderate- to high-intensity physical exercise, the MIND diet, cognitive challenges, social engagement, and cardiovascular health monitoring, led to a statistically significant greater improvement in global cognition over two years compared with a lower-intensity,

self-guided intervention. The U.S. POINTER therefore again confirmed that accessible and sustainable healthy lifestyle interventions can protect cognitive function in diverse populations across communities in the United States (35).

Track 1 - Examining older adults' experiences of lifestyle interventions for dementia prevention

Building on the findings of the FINGER study, the Dutch FINGER-NL study was designed as part of the worldwide FINGER initiatives. FINGER-NL is based on the multidomain approach of the original FINGER study but **extends this approach with additional elements**, and is adapted to the Dutch context to examine whether a similar program can benefit older adults in the Netherlands (36). Participants are randomized into two groups: a High-Intensity group (HI-group), following a program with regular, structured sessions and personalized coaching in different health domains, and a Low-Intensity group (LI-group), receiving only general health advice. The lifestyle program in the HI-group addresses nutritional counseling, social activities, cognitive training, physical activity, cardiovascular risk factor management, sleep counseling, and stress management.

Challenges in adherence, engagement and maintenance

Like other multidomain lifestyle trials, FINGER-NL faces challenges related to adherence, engagement, and the maintenance of lifestyle changes over time. The FINGER-NL randomized controlled trial focuses on evaluating the effects of the intervention on clinical and cognitive outcomes, thereby providing important evidence on its potential effectiveness. While these outcomes are essential, they capture only part of the picture. Evidence of efficacy within a controlled trial setting does not necessarily imply that such an intervention can be successfully adopted and sustained in everyday practice. To better understand how scientific findings translate into real-world impact, it is equally important to understand the human side of participation: why older adults decide to take part, what drives them, what obstacles they face, and how their beliefs and expectations shape their involvement. Evidence from FINGER and related studies shows that active participation is linked to better cognitive outcomes: individuals who engaged more fully in the program tended to show improvements in overall cognition, executive function, and other cognitive domains (37).

At the same time, participation is not a straightforward or uniform concept. Quantitative indicators such as attendance do not necessarily reflect whether meaningful lifestyle changes have actually taken place. For example, within FINGER, attending dietary or vascular risk sessions did not automatically translate into lifestyle changes, whereas engagement in physical exercise and cognitive training more directly reflected behavioral change (38). These differences show that participation is more than just attending sessions; it also involves how and to what end people incorporate the program into their daily lives. Understanding these patterns is crucial, as the impact of lifestyle interventions depends not only on the content offered but also on how participants engage with it. These

nuances highlight that, to design interventions that lead to sustained behavior change, the lived experiences of participants are needed to inform the approach of future interventions.

According to Aravena (39) differences in engagement are influenced by both personal or intrinsic factors, such as mental health, trust, motivation, and perceived risk, and extrinsic factors, such as education, social status, support from others, and the presence of a supporting environment. Challenges like health problems, other responsibilities, or limited resources can further influence engagement. As shown in Figure 2, these factors interact to shape how participants manage a healthy lifestyle, including how well they stick to it, for how long, how intense it is, and how many changes they make which ultimately influence their cognitive health.

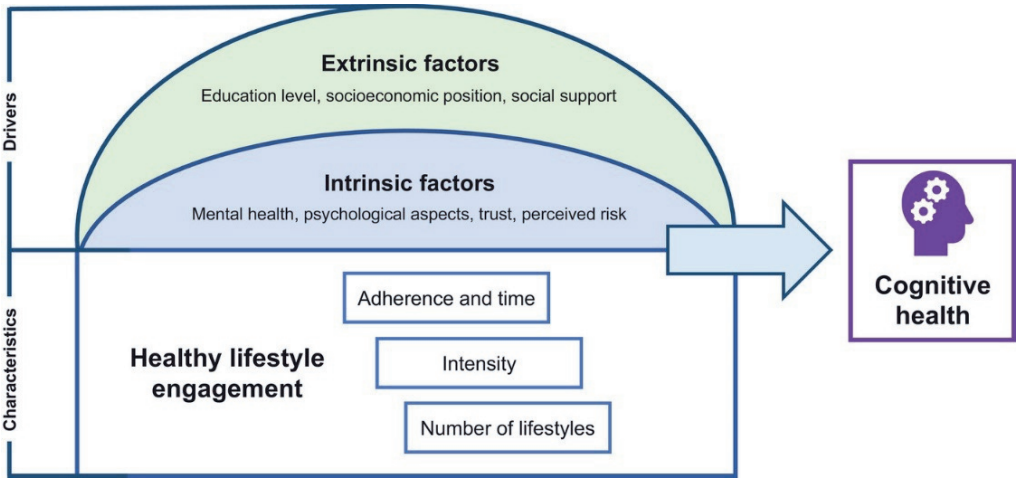


Figure 2. Intrinsic and extrinsic drivers of healthy lifestyle engagement and characteristics of healthy lifestyle participation for promoting cognitive health. Adapted from Aravena et al. (39).

The importance of examining participants' experiences and perspectives is further underscored by recommendations from the original FINGER team to conduct in-depth qualitative analyses focusing on motivation, as well as barriers and facilitators of lifestyle change. In one of their publications, the FINGER team noted that previous research had focused on healthcare professionals' perspectives and emphasized the need for similar qualitative studies among older adults receiving the intervention. While earlier reports indicated that participants evaluated the intervention positively, in-depth qualitative analyses targeting motivational factors, facilitators, and barriers were still lacking (40). Building on this recommendation, the present dissertation addresses this gap within FINGER-NL by examining participants' perspectives and providing insights specific to the Dutch context.

Track 2 - Exploring lifestyle change beyond the research setting: dietitian and patient perspectives

Research on lifestyle changes to prevent dementia, or more broadly cognitive decline, is a relatively young field that gained more momentum following the FINGER study. Because this area of research is still developing, it is both possible and necessary to draw on insights from other fields of behavior change and to learn from practical experience. Dietetic practice provides a clear example of this. In the Netherlands, dietitians are the recognized experts in nutrition and behavior change. They are often the first professionals patients turn to when struggling with weight management or making lifestyle changes (41). Dietitians use a wide range of behavior change strategies in their treatment, often combining multiple strategies together. These strategies may include fostering a strong dietitian–client relationship, applying specific conversational techniques, and providing educational support materials (42). Evidence shows that dietetic consultations in primary care are effective in improving diet quality, diabetes outcomes (including blood glucose and HbA1c), and achieving weight-loss-related outcomes such as reductions in weight and waist circumference. They can even help limit gestational weight gain (43). Moreover, general lifestyle programs targeting chronic conditions such as diabetes, cardiovascular diseases, or obesity have resulted in relevant insights into adherence, sustained behavior change, and the challenges people face when trying to adopt healthier habits (44).

Despite clear evidence that dietary treatment can be effective under controlled conditions, data from daily practice in obesity management show a different picture: dropout rates are high, and up to half of the patients do not reach the intended outcomes. Successful dietetic treatment requires people to adopt and maintain several lifestyle behaviors at the same time, which is not straightforward (41). To support this process effectively, dietitians have to deal with practical questions such as: what works, for whom, why, and under which conditions? Tailored dietetic care is, by definition, complex. It consists of different components that can be used in various ways and at different moments. For example, a dietitian may focus first on small changes in eating habits for one patient, while with another patient the priority may be increasing physical activity, depending on their readiness, preferences, and personal circumstances. All these pieces need to come together in configurations that fit the person sitting in front of the dietitian.

At the same time, research into what actually constitutes effective dietetic treatment, both from the perspective of the dietitian and from the patient, is still limited. Gaining more insight into this is important for improving everyday dietetic care, as we aim to do within the Dietetics, Building the Future project, of which this track of the dissertation is a part. These insights are also relevant when considering how interventions such as FINGER-NL can be translated from highly structured research settings to daily life. Although multidomain lifestyle interventions aimed at people at increased risk have shown promise in terms of cost-effectiveness when the target group is well defined (45), there remains room to improve how such programs are organized and delivered in practice. The intensive and resource-demanding setups that work within research contexts are not always feasible or sustainable in real-world care. They show the value of understanding not only whether an intervention works, but how people experience it, and what they need to make lasting

changes possible. Therefore, in the second track of this PhD dissertation, we draw on the expertise of dietitians to explore effective treatment techniques and investigate patients' experiences with care, particularly in relation to behavior change.

Dissertation aim and outline

The overall aim of this dissertation is to identify the key factors that influence whether lifestyle interventions successfully support behavior change, feasibility, and maintenance with a focus on cognitive health in adults. By combining evidence from FINGER-NL as a structured prevention trial with practical insights from everyday dietetic care, this study links scientific research with real-world experience from the world of dietetics.

To achieve this, the dissertation is divided into two complementary tracks. The first track focuses on dementia prevention, drawing on the Dutch FINGER-NL study to explore how older adults experience and engage with a multidomain lifestyle program. The second track focuses on dietetic practice, using the expertise of dietitians and the experiences of their patients to gain insight into the dynamics of behavior change in everyday care. For clarity, the research objectives for both tracks are set out below.

Track 1 - Examining older adults' experiences of lifestyle interventions for dementia prevention

What is already known (and studied):

- Lifestyle factors matter for dementia prevention.
- FINGER and U.S. POINTER provide quantitative evidence that multidomain lifestyle interventions can preserve or improve cognition.
- These trials show that clinical effects exist, but they primarily report average effects at the group level

What is less clear or missing:

- The human side of participation: why do older adults decide to participate in these lifestyle interventions, what motivates them, which barriers do they face, and how do they actually incorporate lifestyle changes into their daily life?
- Participation is not the same as attendance and adherence: it is about involvement and quality and depth of engagement, which is not easily captured by quantitative measures alone.
- The original FINGER team explicitly called for in-depth qualitative analysis on motivation, barriers and facilitators.
- The link between motivation and actual behavior is complex, and in the context of dementia prevention interventions it has received little attention so far.

Research objectives track 1

1. To explore why older adults choose to take part in the FINGER-NL lifestyle program and what motivates them to engage.
2. To identify the factors that help or hinder attendance, engagement and adherence to the intervention and the maintenance of lifestyle changes.
3. To examine how participants implement the program in their daily lives across different lifestyle areas, such as diet, physical exercise, cognitive training, social engagement, sleep, and stress management.
4. To provide insights that can help improve the design and delivery of multidomain lifestyle interventions for cognitive health in the Dutch context.

Track 2 - Exploring behavior change in daily practice: dietitian and patient perspectives

What is already known (and studied):

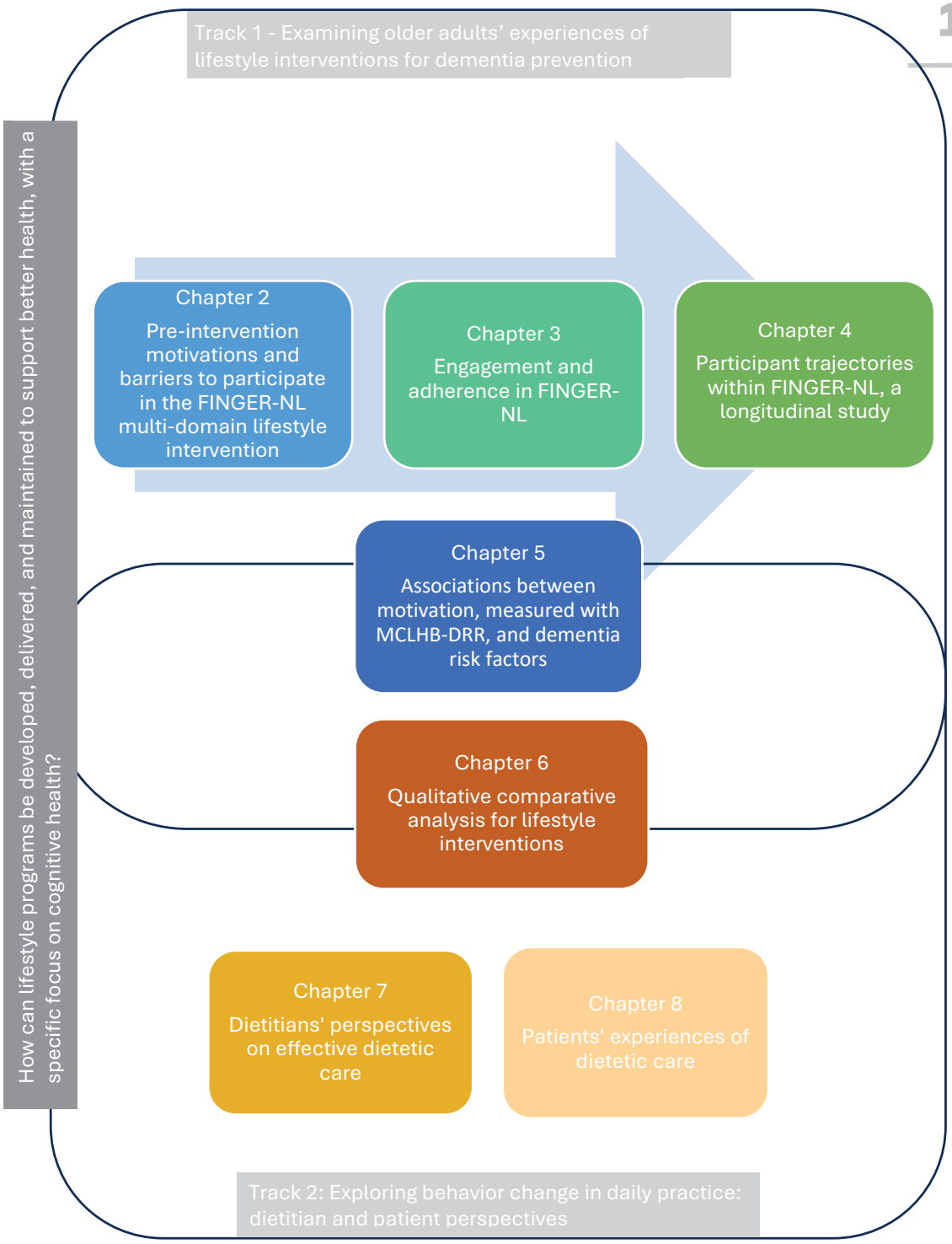
- Dementia prevention research through lifestyle interventions is relatively new.
- There is a rich body of evidence on lifestyle programs in other chronic conditions, many of which are delivered or supported by dietitians. These studies often focus on adherence and the maintenance of behavior change.
- In the Dutch context, dietitians play a key role: they are trained not only in nutrition but also in behavioral counseling, and patients often turn to them first when struggling to change lifestyle behaviors.

What is less clear or missing:

- Dementia prevention research can make use of lessons from other fields, as they face similar challenges with adherence and long-term behavior change, while also taking into account where important distinctions exist.
- Little research has systematically explored dietitians' expertise or patients' lived experiences.

Research objectives track 2:

1. To better understand how lifestyle counseling and treatment techniques can support (sustainable) behavior change in the daily life setting, building on the expertise of dietitians and the experiences of their patients


How can lifestyle programs be developed, delivered, and maintained to support better health, with a specific focus on cognitive health?
Track 1 - Examining older adults' experiences of lifestyle interventions for dementia prevention
Chapter 2
Pre-intervention motivations and barriers to participate in the FINGER-NL multi-domain lifestyle intervention
Chapter 3
Engagement and adherence in FINGER-NL
Chapter 4
Participant trajectories within FINGER-NL, a longitudinal study
Chapter 5
Associations between motivation, measured with MCLHB-DRR, and dementia risk factors
Chapter 6
Qualitative comparative analysis for lifestyle interventions
Chapter 7
Dietitians' perspectives on effective dietetic care
Chapter 8
Patients' experiences of dietetic care
Track 2: Exploring behavior change in daily practice: dietitian and patient perspectives

Overview chapters

Chapter 1	**General Introduction**
	Track 1
Chapter 2	**Exploring older adults' pre-intervention motivations, attitudes, expectations, and barriers to participation in the FINGER-NL lifestyle intervention to maintain optimal cognitive functioning: a qualitative interview study**
Chapter 3	**Engagement and adherence in the FINGER-NL lifestyle trial: qualitative study**
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	Track 2
Chapter 6	**Using Qualitative Comparative Analysis (QCA) to identify components for successful weight loss interventions**
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Chapter 8	**Perspectives and experiences of adult patients with obesity on dietetic primary health care: a qualitative study in the Netherlands**
Chapter 9	**General discussion**

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Intermezzo 1

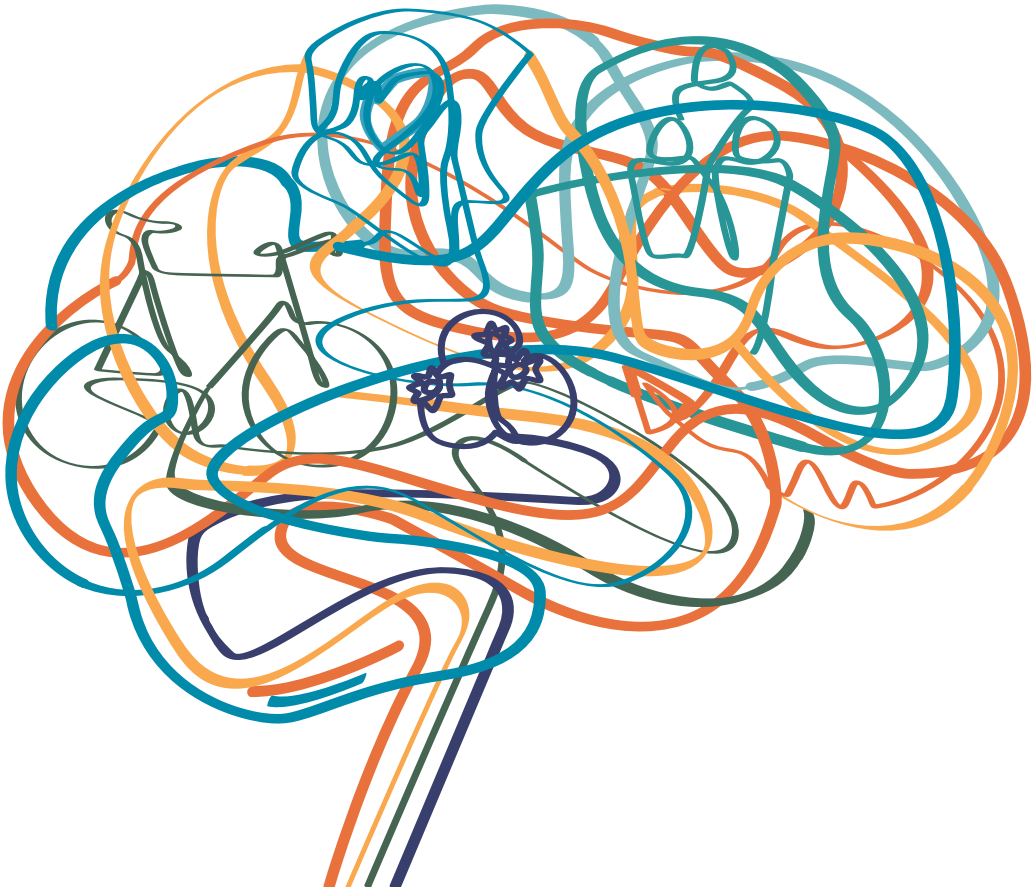
Blue zones

Wie mij ooit eens tot op de bodem heeft uitgehoord over mijn onderzoek en dan nog steeds geïnteresseerd was, heeft dit onderwerp ongetwijfeld eens langs horen komen: blue zones. Deze zones zijn plekken op aarde waar mensen vaker 100 jaar of ouder worden en cognitief fit blijven. Je kunt deze gebieden vinden in onder andere Okinawa (Japan), Sardinië (Italië) en Ikaria (Griekenland).

De term blue zones werd voor het eerst gebruikt door demografen en later door onderzoekers, die deze regio's identificeerde op basis van demografische gegevens en gezondheidspatronen wereldwijd. Hoewel er in de media soms twijfel bestaat over de hoge leeftijden in blue zones, laten recente onderzoeken zien dat deze cijfers betrouwbaar zijn. Onderzoekers hebben de leeftijden zorgvuldig gecontroleerd met geboorte- en overlijdensregistraties, waardoor we zeker weten dat veel inwoners daadwerkelijk 100 jaar of ouder worden; geen mythe dus.

Wat blue zones interessant maakt voor wetenschap en preventieve gezondheid, is dat hun inwoners bepaalde leefstijlkenmerken met elkaar gemeen lijken te hebben die samenhangen met gezonde veroudering. Hier speelt voeding een centrale rol. De meeste van deze gemeenschappen eten overwegend plantaardig, met veel groenten, peulvruchten, volle granen, noten en olijfolie en weinig bewerkte producten of rood vlees, wat vergelijkbaar is met het Mediterrane dieet. Dit dieet, rijk aan antioxidanten, vezels en onverzadigde vetten, is gekoppeld aan een lager risico op hart- en vaatziekten, ontsteking en cognitieve achteruitgang; factoren die allemaal relevant zijn voor hersengezondheid. De kenmerken van de leefstijl in blue zones gaan nog verder dan voeding alleen. Dagelijkse, natuurlijke beweging, zoals lopen, tuinieren en fysiek werk, is sterk aanwezig en draagt bij aan cardiovasculaire gezondheid en het behoud van spiermassa en functionele capaciteit. Sterke sociale netwerken, een gevoel van zingeving en stressverlagende routines lijken ook bij te dragen aan het behoud van cognitieve veerkracht op oudere leeftijd.

Binnen het FINGER-NL-onderzoek gebruiken we het MIND-dieet, een aanpassing van het Mediterrane dieet, dat specifiek gericht is op het beschermen van hersengezondheid. Dit dieet combineert elementen van het Mediterrane en DASH-dieet (specifiek ontwikkeld om de bloeddruk te verlagen). Het bevat voedingsmiddelen die in verband zijn gebracht met vertraagde cognitieve achteruitgang, zoals bladgroenten, bessen en gezonde vetten, terwijl het de inname van verzadigde vetten en bewerkte voeding beperkt. Door deze voedingsaanpak te combineren met andere leefstijlfactoren, zoals fysieke activiteit en sociale betrokkenheid, precies de dingen die we in de blue zones terugzien, kunnen we dus in een gecontroleerde setting testen of deze factoren ook daadwerkelijk bijdragen aan het behoud van cognitieve gezondheid op latere leeftijd.



CHAPTER 2

Exploring older adults' pre-intervention motivations, attitudes, expectations, and barriers to participation in the FINGER-NL lifestyle intervention to maintain optimal cognitive functioning: a qualitative interview study

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Abstract

Multidomain lifestyle interventions hold promise for preventing cognitive decline, but personalized approaches are essential for (maintaining) behaviour change and adherence. The Dutch FINGER-NL trial is based on the Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER) and includes 7 lifestyle intervention components, supported by technological elements. This study describes older adults' motivations and attitudes regarding participation and lifestyle changes at the start of the FINGER-NL trial. This study followed a qualitative descriptive design, using in-depth, semi-structured interviews with 40 purposively selected participants of the FINGER-NL trial. Thematic analysis was applied. For theme (1) 'Reasons to participate', most participants mentioned personal gain, aiming to improve cognitive and physical health. Dementia prevention was a key motivator, driven by concerns about ageing, cognitive decline, and a desire for behavioural change. Public interest and contributing to a broader societal solution were also mentioned. Knowledge about dementia (prevention) was limited, and perceptions were largely shaped by personal experiences of dementia with close ones. In theme (2) 'Contextual factors influencing participation' are discussed, including work, living situation, and health conditions. According to participants, the main 'Lifestyle-related areas for improvement', theme (3), were diet and physical activity, followed to a lesser extent by cognition, sleep, social activities, and stress management. Theme (4) 'Expectations regarding FINGER-NL' discussed barriers to change which included physical health of participants, time constraints, established habits, and financial limitations. Participants emphasized the need for counselling, coaching in diet and exercise, experiencing positive effects of lifestyle change, participation in group setting and practical aspects, such as appointment reminders to support their commitment and adherence to the study. Participants held different experiences and opinions regarding 'Use of technology', theme (5). Personal experiences with dementia strongly influenced the motivation to participate in FINGER-NL, creating urgency for behaviour change. Participants expressed the wish to receive tailored interventions addressing individual needs and circumstances. Longitudinal follow-up within FINGER-NL promises valuable insights for future interventions.

Introduction

Worldwide aging of the population results in an increase in the prevalence of late-life cognitive impairment and dementia. In the last decade, the number of people affected by dementia increased by approximately 9%, from 47 million people living with dementia in 2015 to around 55 million people in 2019 (1). Estimates predict that by 2050, nearly two billion people globally will be aged 60 or older, with dementia prevalence rising from 78 million in 2030 to 139 million in 2050 (2).

The World Health Organization (WHO) has declared dementia a public health priority, focusing on risk reduction and prevention in the absence of curative treatments (1). Multiple longitudinal cohort studies have delineated a group of potentially modifiable risk factors and a second group of non-modifiable risk factors (e.g. age, genetic factors). In the recent publication by Livingston et al., 14 modifiable risk factors were presented, which are hypothesized to collectively account for approximately 45% of dementia cases globally (3). Krivanek and Gale (4) showed that there is growing consensus that behavioural and lifestyle changes focussing on these modifiable risk factors can mitigate cognitive decline and reduce dementia risk.

The Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER) was the first long-term randomized controlled trial (RCT) aimed at assessing a multidomain approach to prevent cognitive decline (5). In this large RCT, participants in the intervention group received an intensive multidomain intervention while participants in the control group received regular health advice (6). Although effect sizes measured were small, findings of the FINGER study suggest that a multidomain lifestyle intervention can indeed improve or maintain cognitive functioning in older adults from the general population who are at risk of developing dementia (7).

Following the promising results of the FINGER study, the World-Wide FINGERS (WW-FINGERS) network was created (8). In the Netherlands, FINGER-NL was established, based on the FINGER principles of the multidomain lifestyle intervention with some extra trial design elements included, including the use of a hybrid intervention components, combining both on site and online meetings (9). The urgency of dementia prevention in the Netherlands is shown by the number of dementia cases in the Netherlands which have increased sixfold; from 50.000 cases in 1950 to 290.000 currently. Dementia, in particular Alzheimer's disease, has become the fastest-growing cause of death and the healthcare expenses for people with dementia have increased accordingly, from 8.6 billion in 2017, to 10.6 billion in 2020 (10). However, research among the Dutch general population indicated that there is insufficient knowledge, beliefs and attitudes towards dementia and its prevention to effectively support dementia risk reduction (11)

While previous multidomain lifestyle interventions have shown promising results in reducing dementia risk, it will not result in substantial difference unless individuals maintain their behavioural change, which is often challenging (4, 12, 13). Motivation is a key factor in adherence to these interventions and influences their overall effectiveness, but the factors influencing motivation are difficult to distinguish and much remains to be explored in understanding its relationship with actual behaviour. One important influence is knowledge about dementia risk reduction and the potential for prevention through modifiable risk factors; understanding that prevention is possible, can influence how individuals adopt and prioritize behaviour change (14).

Personalized interventions, which take into account individual needs and risk factors, are likely more effective compared to general recommendations in promoting sustained preventive health behaviour (15). Specifically for lifestyle interventions focussed on prevention of cognitive decline and dementia, a personalized approach involves tailoring the activities, advice and approach within the intervention to an individuals' specific characteristics and needs (16). Despite the promise of personalized approaches, there is still much to learn about older adults' motivations and expectations regarding such interventions. Understanding their perspectives can help in refining the design and recruitment strategies of future trials. This could, in turn, lead to more valid findings and improve the effectiveness of interventions at an individual and population level (12, 13, 17).

The present qualitative study aims to obtain more insight into older adults' motivations for participating in the FINGER-NL lifestyle trial focused on maintaining optimal cognitive functioning. It also explores their understanding, attitudes, needs and barriers regarding lifestyle and behavioural changes as preventive measures. Additionally, the study discusses participants' lifestyle habits at the start of the intervention, with a focus on the areas they identified for improvement.

Methods

Design

To explore the participants' opinions and narratives, a qualitative design was chosen, in which semi-structured in-depth interviews were planned with selected participants from the Dutch FINGER-NL study (see Box 1). This qualitative design provided the opportunity to explore topics and directions by using the participants' own words to give meaning to their point of view (18). The interview study was conducted independently and parallel with participation in the FINGER-NL study; dropout from the interviews did not have any consequences for participation in the FINGER-NL study and vice versa.

Study population

During the baseline visit for FINGER-NL, participants were informed about the qualitative interview study and asked for permission to be contacted by one of the researchers. Almost all participants gave their consent to be contacted for the qualitative study. Purposive

sampling was conducted among those who had consented, with regard to gender, age, study site and time of registration in the FINGER-NL trial. Study site was considered, as trial sites span across the Netherlands, potentially resulting in varying participant experiences and backgrounds depending on place of residence. Because the recruitment phase of the FINGER-NL trial spanned approximately a year, sampling ensured that participants from various registration periods were included in the interview study as moment of registration might have influence on their reasons for participation and motivation.

FINGER-NL

FINGER-NL is a multi-center, multidomain lifestyle intervention trial among 1,210 adults at risk of cognitive decline. The intervention study takes place at five different sites spread out over the Netherlands: Maastricht University (MU), Radboud University Medical Center (RUMC), University Medical Center Groningen (UMCG), Amsterdam University Medical Center location VUmc, Wageningen University & Research (WUR). This study received ethical approval from the Medical Ethical Committee at Amsterdam University Medical Center (UMC) (METC number NL77242.029.21)

Recruitment took place in 2022–2023 through the Dutch Brain Research Registry (DBRR, in Dutch "Hersenonderzoek.nl"), using methods such as Facebook advertisements and appearances on national television. Registrants complete a basic questionnaire regarding personal, health, and lifestyle information. Based on this, DBRR automatically prescreens for eligibility and sends a nonbinding study invitation via email. Interested individuals can respond directly, after which researchers contact them for further screening by phone to verify study-specific inclusion and exclusion criteria (19). The participant pools from the different study sites were also used, in addition to recruitment through local databases and (local) newspapers. The inclusion criteria were as follows: 1) age between 60 and 79 years at pre-screening; 2) adequate fluency in Dutch to understand the informed consent and complete study questionnaires; 3) informed consent to all study procedures; 4) Internet access at home; 5) presence of at least three self-reported risk factors for cognitive decline, including a minimum of two modifiable risk factors and one non-modifiable risk factor. Modifiable risk factors were based on self-reported presence (from a single question), while non-modifiable factors included items like family history and subjective cognitive decline (9).

Eligibility was verified during a telephonic prescreening and after the baseline visit, participants were randomized in a 1:1 ratio to two groups: the high-intensity group (HI-group) versus low-intensity group (LI-group). Double-blinding was pursued: group allocation was not disclosed to participants. Participants of the HI-group received a personalized, supervised multidomain intervention for 24 months, consisting of hybrid (online and at study site) group meetings and individual sessions focused on a combination of seven lifestyle components; physical activity, cognitive training, cardiovascular risk factor management, nutritional counseling, sleep counseling, stress management, and social activities and a nutritional product (Souvenaid®) that was designed to help maintain cognitive functioning. Furthermore, the HI-group participated in individual sessions guided by a trained lifestyle coach and had access to a digital intervention platform (Ivido) offering custom-made training materials and selected lifestyle apps. The LI-group received monthly online lifestyle-related health advice via the digital intervention platform, Ivido. Primary outcome is 2-year change on a cognitive composite score covering processing speed, executive function, and memory (9).

Box 1 Study design of FINGER-NL based on Deckers et al., (10)

Data collection

Of all FINGER-NL participants who provided permission to be contacted, a total of 41 were invited for semi-structured interviews within a month of their baseline visit. It is important to note that the interviews took place after the baseline measurements but before the start of the FINGER-NL intervention programme. Participants from different groups had not yet received study information and therefore the perceptions of the participants could not have been influenced by the randomization process. All participants agreed to take part in this qualitative study and were interviewed by one of the researchers. Out of these 41 interviews, 26 interviews were conducted with participants from the structured intervention group (high-intensity group) and 15 interviews with participants of the self-guided control group (low intensity group).

Semi-structured interviews were conducted using a topic guide based on existing knowledge and literature research (20). Topics covered various areas of interest, including the reasons for participation in the FINGER-NL trial, general perspectives on health, knowledge, attitudes and beliefs towards prevention of cognitive decline, and barriers and needs with regard to participation in FINGER-NL. Moreover, one of the topics specifically explored the use of digital aids and technology within the intervention, as this was one of the differences between FINGER-NL and the original FINGER study. The interview guide was reviewed by a team of researchers with expertise in nutrition, health and qualitative research. After conducting 10 interviews, the topic list in the interview guide was reviewed, and no adjustments were deemed necessary. Sample and probing questions were developed for the topics to guide the interview, allowing probing for further information and clarification when appropriate. Examples of some of the topics and probing questions can be found in Table 1. A more elaborate topic guide was used during the interviews. Before each interview, participants were provided with a brief explanation of the research's purpose and nature.

Table 1. Example questions interview

Topic	Example question interview guide
Enrolment	How did you hear about the FINGER-NL study? What are the reasons for you wanting to participate?
Lifestyle	What entails 'lifestyle' for you in daily life? Are there things in your current lifestyle that you would want to
Prevention	In your opinion, what do you think can contribute to cognitive
Ageing	What is important to you when you get older?
Participation	What are your expectations of the FINGER-NL study? Do you see any barriers to your participation in the coming two years? What would help you during your participation in the FINGER-NL study?
Digital aids	How do you make use of technology in your daily life? Do you use technology to support your health-related behaviours?

Topics were explored by open-ended questions. Participants were encouraged to freely develop the conversation, while the researcher kept the interview in-topic and ensured that all topics from the topic list were sufficiently covered during the interview. Based on the preference of the participant, the interviews were conducted either at the participant's home or at the research department of the university. One participant preferred an online interview.

Data analysis

The interviews were recorded using a digital audio recorder with the permission of the participants and stored on a secured research drive, only accessible by the research team. All interviews were transcribed verbatim using AmberScript (transcription tool) and coded in Atlas.ti (version 23). A thematic approach was used to analyse the transcripts of the interviews. Transcripts were analysed by 2 researchers (RO and AdK) based on the thematic analysis approach of Braun and Clarke (21), and Braun and Clarke (22). To increase validity, RO and AdK independently familiarized themselves with the data, closely reading and conducting open coding the same two transcripts to develop a shared understanding and an initial coding framework. This initial coding framework was used to code the remaining interviews, meanwhile extending the code list with additional codes when needed. Through axial coding the related codes were grouped into clusters, forming potential themes, which were organised into a mind map. After checking the potential themes in relation to the coded excerpts and transcripts and refining the essence of each theme, the researchers agreed upon clear definitions and names for each theme. Furthermore, through constant comparison, similarities and differences within and across respondents were identified through selective coding. Finally, the themes and preliminary conclusions were discussed by the researchers and underpinned by relevant examples and quotes from the transcripts (23).

Ethical approval

Ethical approval specifically for this qualitative study was granted by the Ethical Research Committee (ECO) of the HAN University of Applied Sciences, Nijmegen, the Netherlands, (ECO 310.12/21). The study was declared not to be subject to the Medical Research Involving Human Subjects Act (WMO), and it underwent examination to ensure compliance with scientific and ethical standards. Potential participants were informed about the aim and procedures of the interview and their right to withdraw from the interview study before, during and after data collection. All participants signed informed consent before the start of the interview and were aware that their anonymized quotes would be used for this publication.

Table 2 Participant characteristics

Characteristics	N	Mean/Count
Age (years)	40	66.6 (range 61–78 years)

Group	40	High intensity: 24 Low intensity: 16
Sex	40	Male: 14 Female: 26
Working situation	40	Retired (not working): 25 Working: 15
Relationship status	40	Married/in a relationship: 29 Living alone: 11

Results

Participant characteristics

Participants' characteristics are summarized in Table 2. Interviews lasted between approximately 30 min and 75 min; the average interview duration was around one hour. Forty-one participants were interviewed, however, one of the interview audio recordings was of insufficient quality, rendering it unsuitable for transcription and analysis; data from this particular participant were excluded from the final analysis.

Themes and subthemes

Thematic analysis revealed four main themes important in relation to the research aim. Theme (1) Reasons to Participate discusses the two main reasons participants gave for joining the trial: personal gain, focused on beneficial effects on physical and mental (brain) health. Theme (2) Contextual Factors Influencing Participation explores participants' working and living situations, as well as their health conditions and the perceived impact on their participation. In Theme (3) Lifestyle-Related Areas for Improvement, participants mainly focused on diet and physical activity, which were mentioned by almost all participants, while other lifestyle factors—cognition, stress, social activities, and sleep—were mentioned less frequently. Theme (4) Expectations Regarding FINGER-NL captures participants' hopes for potential effects, as well as their perceived barriers and needs. Theme (5) Technology involves participants 'opinions, experiences and need for assistance regarding the use of technology within a lifestyle intervention aimed at preventing cognitive decline. Figure 1 provides an overview of all themes, sub-themes and sub-subthemes.

Reasons to participate

The theme discussed two subthemes, each representing distinct reasons participants gave for their motivation to participate: first, personal gain, where participants expressed a desire to improve their health, influenced by their perceptions of ageing and anxiety about cognitive decline; and second, public interest, where participants felt motivated by the opportunity to contribute to research and help others.

Personal gain

When asked about their reasons for joining the FINGER-NL trial, the majority of participants

indicated that their primary motivation to participate was driven by personal gain; they hoped that participation would bring benefits for themselves, like improving their health.

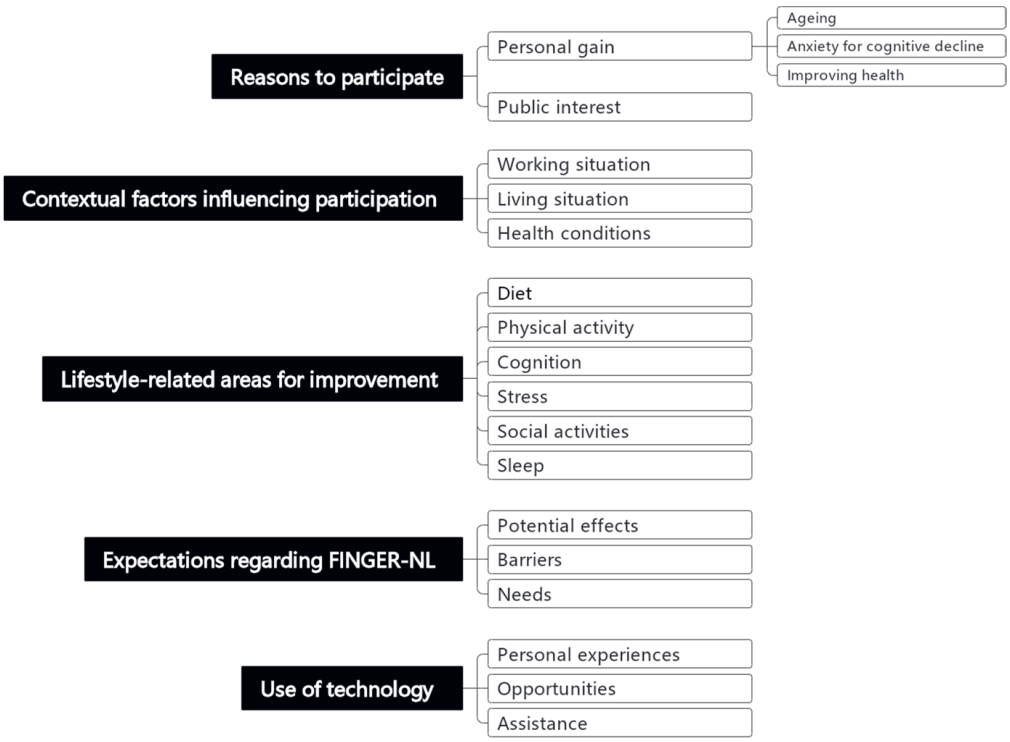


Figure 1. Overview of all themes, subthemes and sub-subthemes

Ageing

When discussing their participation in the FINGER-NL trial, many participants mentioned ageing as a central consideration, with several expressing the hope that the trial would assist them in managing the challenges of getting older. 'Ageing' includes a range of considerations expressed by the participants. Most were in a phase of acceptance and indicated that ageing was a natural process in life. Some experienced life differently now they were older; they mentioned being more able to reflect and putting things into perspective. The majority of the participants indicated that they noticed experiencing various declines, both physical and mental, in recent years as part of their ageing process.

> *'And that, I can already feel that, you know, but then I think: well, I still feel fit and want to keep it that way. But if I start going downhill, well, then I'll have to accept it. It's part of life, it's part of, well, getting older.'* (female, aged 63)

Additionally, some participants were aware that their condition might not improve anymore and did not look forward to the future.

> *'And I have this idea myself, but it may not be nice to say it, but due to my age, I*

actually start to live towards my death (...) And I don't find that very pleasant. Well, I'm declining more and more, physically as well I notice it now. So, but it never gets better. Yes, maybe it gets a little better, but then something else comes up. So, I don't find the future very appealing.' (female, aged 71)

Participants preferred to focus on the present and not think about the future. However, around half consciously engaged with the practical aspects of end-of-life issues. For instance, a few participants mentioned recently moving to an apartment in which in-house care was available if needed, others were sorting personal belongings, making preparations such as creating a living will or discussing euthanasia statements with their general practitioner. Participants emphasized the importance of maintaining control throughout the process of ageing.

'But I am working on that, and that is a change because I never thought about it [becoming older] *before. It never crossed my mind. I mean, everyone will eventually die, but now I think: yes, everyone will eventually die, but I do want to have some control over it. So that is, that is indeed a change.'* (female, aged 72)

Anxiety for cognitive decline

Within the context of ageing, the majority of the participants focused on brain health and cognitive state. A relatively high number of participants reported experiencing memory loss recently. This worried them as they were concerned that this might be the first sign of developing dementia, and some participants indicated that this made them realise the need to take action to prevent this from going further. The factual knowledge of participants about the onset of dementia and cognitive decline was limited. Participants indicated that they did not know exactly what the first signs of dementia or Alzheimer's disease are, and they generally had limited knowledge about the physiology and development of the disease, sometimes resulting in misconceptions thereof. A vast majority of the participants reported having a close family member diagnosed with dementia, specifically Alzheimer's disease. Many of these participants were actively involved in the care for their parent(s) with dementia. Their firsthand emotional experiences with dementia very much shaped their perspective and concerns. One participant took a commercial DNA test to check her risk of dementia. The results showed a high genetic risk, which made her feel both thankful for her current health and worried about the future. The majority of participants expressed concerns about their own risk of developing dementia, describing it as a source of anxiety for themselves and worries for the potential effects on their partners and/or children. These concerns were often mentioned as a driving factor in their decision to participate in the trial.

'Well, I think, I find it really the scariest prospect when you grow old is that you will, and yes, there are other things of which I think: well, I hope I don't have to experience that. But dementia, that seems truly terrible to me. Especially that phase when you're heading towards it, when you start to notice.' (female, aged 67)

'I honestly hope that this [diagnose of dementia] *doesn't happen to me, specifically that my mind remains healthy. I would prefer to face any other condition, but not this.'*

(female, aged 64)

Not all participants shared this concern. Some participants indicated that they thought that development of dementia is hereditary and they perceived having no influence over it. Others were resigned and preferred to let the future unfold rather than worry about it.

'Well, maybe it is already in my DNA, but then I think: what's the use of knowing all of that? If I end up getting as old as my mother? And in that case, I think, I'll sign up for it. Yes, I don't need to know it yet.' (female, aged 63)

Improving health

Participants indicated that they aimed to specifically improve their brain health and physical health by participating. They hoped that by making the necessary adaptations and following the recommendations within FINGER-NL they could enhance their (brain) health, or at least sustain their current level, with a strong focus on the prevention of development of dementia.

'Yes, and I also expect that with the FINGER-NL study, it's like things that you already know, but where you just need, in a Dutch expression 'a kick in the butt', to actually start doing them, because it is clear that it works positively. Yes, that motivates because it is good. My mother is 87, has dementia, and is currently deteriorating rapidly. So yes, you just want to prevent that for yourself.' (female, aged 61)

'So because I think that by living differently now in a simple way, it can prevent it [the onset of dementia]*, then I will definitely do that. Yes, so being alert, doing the little quirky things like solving puzzles from the newspaper or whatever.'* (female, aged 61)

This motivation was also especially strong in interviews with participants struggling with health issues such as diabetes or high blood pressure, as well as those who were overweight and sought to lose weight to achieve a lower BMI. Approximately half of the participants acknowledged being overweight, and even more expressed a desire to lose weight. Some of them already started with a diet or programme to lose weight, others awaited the start of FINGER-NL.

'*Well, let me put it this way; I could still lose some weight. I don't think I'm overweight, but I always have... I think, but that argument is used more often, I also have quite a bit of weight because of the muscles I have, but I haven't been able to lose those extra pounds, but I am not very strict about it. But if I could lose a few more pounds, that would be good.'* (male, aged 63)

Almost all participants were aware that participating in the FINGER-NL trial meant that they probably would (have to) change their behaviour particularly with regard to their lifestyle, to obtain effect.

'I still want to live for another 30 years or so. Yes, maybe that's exaggerated, but well, I always say 94, so something needs to change, I think.' (female, aged 67)

Public interest

A minority of participants mentioned that their decision to participate was mainly motivated by their desire to contribute to public interest. They hoped that their involvement in FINGER-NL would ultimately lead to results which would have broader societal implications by advancing the understanding of dementia prevention. Through their participation, they hope to contribute to the well-being of future generations.

> *'Well, I do want to make a difference for society.'* (male, aged 70)

The participants' motivations for personal gain and public interest are not mutually exclusive and some participants also indicate that the two factors both played a role:

> *'Well, I mean, if you can help... Ultimately you hope that you can make a difference, and let's be very honest, then you especially hope, I think, mainly for my own children and grandchildren. Overall, the general interest is quite important and the grief* [caused by dementia] *is immense for everyone involved.'* (female, aged 64)

Contextual factors influencing participation

This theme discusses, from the viewpoint of participants, how contextual factors influence their ability to take part in the FINGER-NL trial. It includes subthemes such as their working and living situation, including employment and relationships, as well as their health conditions.

Working situation

The current working and living conditions of participants impact their lifestyle and participation in FINGER-NL. Out of the 40 participants included in this interview study, 25 were retired or not working, while 15 participants were still employed. Among the retired participants, six participants had been declared unfit to work, either temporarily or placed on early retirement. Participants emphasized that their current working situation has an impact on their participation in the FINGER-NL trial. Each participant viewed retirement differently. For some participants, retirement was a recent transition; one participant mentioned having retired just a month ago, while others, like one participant of 78, were already accustomed to the retired lifestyle. Participants shared contrasting experiences regarding retirement. Some expressed a sense of nostalgia and missed the purpose that working provided;

> '*Sometimes I do miss working, Yeah, just missing, missing of being active and engaged and now no one is waiting for you. You don't have to do anything anymore.'* (female, aged 67)

> *'When I stopped working, yeah, I simply worked my entire life and then, um, so I fell, I fell into a void and actually, that void is still there.'* (female, aged 71)

On the other hand, participants enjoyed the freedom and relaxation in their retirement. Participants indicated that they spend their free time differently; some embraced new

hobbies, such as community gardening, beekeeping, sports, or voluntary work, including initiatives like the food bank. Some found their retirement days just as busy as before, with all kinds of activities. Some participants decided to go traveling, for example by camper, for longer periods of time and others were involved in babysitting their grandchildren. Several participants indicated that, thanks to their retirement, they now had the time and flexibility to participate in the FINGER-NL trial.

'*I have always worked with pleasure, well, almost always, I must say, but truly, I have worked with great pleasure 99 percent of the time. But it's also very nice when you don't have to work anymore.'* (female, aged 67)

For the participants who still have a working life, this was experienced a little differently. The majority of these participants work part-time in diverse fields, such as healthcare and consultancy. Most participants indicated that they were happy with their jobs and found challenge and energy in their work. Some participants mentioned contemplating (early) retirement, while others expressed a desire to continue working as long as possible.

'Next year I will work a little less, and then the year after that, when I will be 65, then I'll stop working.' (male, aged 63)

'As long as I am able to work, I want to keep working.' (male, aged 63)

However, these participants were generally somewhat uncertain about whether they could combine work with participation in FINGER-NL. Those with less flexibility in their jobs, in particular, worried that the appointments within the trial might interfere with their work obligations.

Living situation

The majority of the participants were in a relationship, most of them being married and living together with their partners. Some participants had experienced the loss of their spouse, while others were not in a relationship at the time of the interview. When asked about their partner's opinion regarding their participation in FINGER-NL, nearly all participants indicated that their partners were involved and supportive of their decision to enrol. In terms of meal preparation, female participants in relationships indicated that they were generally responsible for cooking dinner, while male participants indicated that their partners primarily provided dinner and they did the grocery shopping. Many participants mentioned having children and grand-children, generally describing good relationships with them.

Health conditions

Participants generally perceived their current health as good, though some experienced age-related issues like arthritis, that limited daily activities. Many shared past health challenges, including cancer, irritable bowel syndrome, Type II diabetes, or heart problems. Common risk factors, such as high blood pressure or cholesterol, were often

acknowledged and cited as motivations for joining the FINGER-NL trial, as mentioned under the theme discussing personal gain. A few participants also reported mental health struggles, including depression, PTSD, or burnout. While participants recognised a connection between physical health and dementia, they found it difficult to explain the relationship. One participant also linked mental health challenges to cognitive decline.

> *'Yes, depression shows up in sleep disturbances and losing interest in activities, you end up just watching TV, so yeah, it doesn't motivate your brain to learn or engage in things. So yeah, over a number of years, it has just gotten worse for me.'* (female, aged 61)

Lifestyle-related areas for improvement

This theme focuses on participants' perspectives on aspects of their current lifestyle that could be improved within the FINGER-NL trial.

During the interviews, participants were asked how they defined lifestyle. While responses varied, the majority of the participants mentioned two key facets: diet and physical activity. Additionally, there was considerable variation, with some participants mentioning sleep or social activities, while others focused on their current lifestyle choices.

> *'What do you mean by lifestyle…? Well, the way of living, and of course, that's different for everyone, depending where your cradle was, where your bed is and how you live; whether you can live in a healthy environment or an unhealthy environment. Yes, that's lifestyle, and personally, well, I'm fortunate to have the space, maybe some pollution from traffic, so it may affect my lungs. But where don't you have that in the world? (…) Yes, when it comes to lifestyle, I believe it means being able to live in a non-stressful, peaceful environment.'* (male, aged 63)

> *'Lifestyle is simply how you live, whether you eat healthy, sleep well, get enough rest, receive sufficient social input, and engage in regular physical activity.'* (female, aged 64)

Diet was consistently seen as a key aspect of lifestyle, often discussed throughout the interviews. While most participants believed they had a generally good diet, they indicated that they would like assistance in making dietary changes. Participants with type II diabetes were aware of the impact of carbohydrates on their health, while those with high blood pressure aimed to reduce salt intake. Some linked their diet to weight loss and hoped dietary changes would help achieve this. Around half of those who saw a need for improvement mentioned specific areas, such as reducing snacks or treats between meals.

> '*I have a sweet tooth, there shouldn't be any chocolate near me.'* (male, aged 72).

Sustainability was brought up by several participants; some mentioned making the switch to using (more) meat replacers or plant-based dairy. Interestingly, participants frequently

mentioned their alcohol consumption, recognizing the possible negative impact on their health.

> *'Well, I'm curious about what I can still improve. I always want to continuously improve everything. Honestly, I think I'm doing quite well, but one thing I know, for example, is that I haven't made the switch to eating less meat and consuming less milk, especially for the sake of sustainability. And yes, for instance, I do enjoy a glass of wine. So, overall, I do have around ten glasses of wine per week. That can be reduced, so I'm trying to do that as well. But well... I also enjoy it.'* (male, aged 63)

Physical activity

Physical activity was frequently discussed during the interviews as having potential for improvement. Participants unanimously recognised the necessity of maintaining regular physical activity as beneficial for their health and well-being. The majority of participants demonstrated conscious decision-making in their approach to physical activity and exercise; some participants walked a lot, alone or in a group, others went grocery shopping by (electrical) bicycle and others engaged in sports such as tennis, yoga, badminton, and swimming. Daily dog walking was commonly mentioned. However, some participants acknowledged a decline in their physical activity levels, particularly after retirement. A few expressed feelings of inactivity or self-described 'laziness', but one participant with a background as a personal trainer noted the need to schedule rest periods alongside exercise. Most participants acknowledged that physical activity was less effortless than in their younger years due to increased physical complaints, making movement and motivation more challenging. Participants hoped the FINGER-NL trial would help them become more active, emphasizing the need for tailored approaches, such as outdoor activities, while avoiding activities they dislike, such as indoor gym settings.

'And exercise, I have done a lot of sports, and I actually don't enjoy it at all. But I do hear around me that it is actually very important. When I came across this [FINGER-NL], I thought to myself, well, there's still room for improvement in that aspect for me. So, in that sense, yes, I think and hope that there's something I could do about it.' (female, aged 64)

Cognition

Participants indicated that they discuss their cognition with friends and family members to check if what they experience is 'normal'. A small minority of participants were specifically doing activities that were believed to be beneficial for brain health and cognition.

> *'Well, lifestyle is about trying to eat healthy, exercising a lot, especially when you're retired, and also training my memory, for example, by joining a pop choir.'* (female, aged 69)

However, the majority of participants indicated that they have little knowledge on the topic and are looking for tools and activities that could effectively stimulate and enhance their cognitive abilities.

Stress

Stress was mostly mentioned by participants still working, with many reporting it stemmed from a busy schedule or the demands of their job. Some wanted advice on managing stress, while others had accepted it as part of their work responsibilities.

> *'Well, that* [stress] *mostly comes from my work when certain issues escalate and need to be resolved.'* (male, aged 63)

Only one retired participant mentioned experiencing stress, attributing it to her personality trait of being prone to stress.

Social Activities

Social activities were part of participants' weekly routines, including group sports, book clubs, and volunteering. However, some participants, particularly those living alone or without a wide social network, experienced loneliness. These participants indicated that they often chose simpler, less nutritious meals, like soup and bread, instead of more balanced options, because it was 'no fun' to prepare meals for yourself.

Sleep

Sleep was frequently mentioned as an element of lifestyle participants would like to improve, as it impacted many aspects of their lives. Many noted that keeping a sleep diary during baseline measurements made them more aware of their night-time awakenings. Specifically, several female participants reported a decline in sleep quality during and after menopause, while other participants noted that they needed to go to the toilet more often now that they become older. For some participants, the challenges they face with insomnia left them feeling helpless, as they had made numerous attempts to improve their sleep quality.

> *'I am not a good sleeper, you know. (...) I hope that in this study, they can give me some tips to improve my sleep. I don't have much confidence in that, though. But well.'* (female, aged 67)

According to participants, the different aspects of lifestyle are interconnected and influenced each other. Participants emphasized that stress could have a negative effect on their sleep quality. As a result, participants who experienced fatigue and low energy were less likely to engage in physical activity or make healthy food choices.

> '*When I haven't slept well, then it is important to eat well, but I often lack the energy to pay a lot of attention to that then.'* (female, aged 63)

Expectations regarding FINGER-NL

Participants were asked about their expectations regarding the FINGER-NL trial, which resulted in the following subthemes: the potential effects of the lifestyle intervention on the behaviour and health outcomes, and the identification of both barriers and motivators within the FINGER-NL trial.

Potential effects

The participants expressed expectations about the effects of their participation in FINGER-NL, primarily focusing on improvements in mental and physical health. Some specified certain health goals, such as weight loss, lower blood pressure, or reduced cholesterol levels. At the same time, they emphasized the importance of being realistic about the potential effects of the intervention.

> *'Oh, that's a fun question! Well, I hope that I will be sitting here in two years in the same way. While being in the same condition (...) I won't become a young girl anymore. But just being able to do everything I'm doing now. (...) Yes, I actually hope to be sitting here in the same way, just two years older, two years further in age.'* (female, aged 67)

Barriers

Participants discussed barriers; factors that they perceived as potential challenges or obstacles to implementing lifestyle changes in general. The most frequently mentioned barrier was physical health. Participants indicated that pain, such as back injuries, rheumatoid arthritis or nerve issues affecting their arm and leg movements, significantly hindered their daily activities. Others struggled with balance issues, respiratory problems, fatigue, or the effects of a COVID- 19 infection. A few participants also mentioned that their mental health, particularly depression, could pose challenges to their active participation in the trial. While physical health was the biggest barrier for most participants, they also identified other barriers. Those with jobs or volunteer work expressed concerns about balancing responsibilities and finding enough time and energy to actively engage in the FINGER-NL trial. Practical challenges, such as planning vacations, were also mentioned. Additionally, participants identified their own old habits as obstacles and were worried that they had to make 'too big' adjustments.

> *'What I am afraid of, for example, is having to let go of few small unhealthy eating habits. I try to moderate my alcohol consumption (...) but yes, if in those two years I then also have to stop drinking, I'm a bit afraid that I won't be able to stick to that.'* (female, aged 69)

Financial barriers were raised by a few participants, such as the costs of healthy foods, gym memberships, and the reimbursement process for travelling expenses, which could take some time due to administrative reasons. To minimize any potential barriers, participants highlighted the importance of considering the needs of the (elderly) target group in the trial design, such as suitable start times for on-site meetings. They also suggested accounting for personal preferences, like offering options for Non-Western dietary habits in the food diary used to track diets.

Needs

Participants pointed out the need for advice and guidance to support lifestyle changes. While they valued knowledge, they felt that it wasn't enough on its own and that they lacked

the skills to make changes. They emphasized the importance of active coaching and support for successful engagement and adherence to the intervention.

> *'And I'm someone who wants to do things right. So, if I know that I have to do something, then I'll do so. And if that accountability is missing, then I think, oh yes, I know myself, so I know I need a 'big stick.'* (female, aged 67)

Participants also wanted more insight into the positive effects of their behaviour change, like improvements in blood pressure, to stay motivated. Many would prefer a group setting for the support, possibility to share experiences, and friendly competition it provided.

> *'Yes, and that's what I'm curious about because I believe that staying in contact with each other also provides more encouragement and motivation.'* (female, aged 70)

Participants also mentioned practical aspects to meet their needs, such as appointment reminders, providing information on paper for those who prefer it, and the ability to easily contact the research team for assistance when needed. Regular check-ins with the FINGER-NL team and setting small, short-term goals would be beneficial for their motivation, as well as receiving feedback on their progress and efforts.

Use of technology

The use of technology was included in the interviews because of its relevance to the FINGER-NL trial in which different technological elements are incorporated. Participants shared their personal experiences with general technology and e-health, as well as the opportunities to use technology in the context of the FINGER-NL trial to change their lifestyle. Also, participants expressed both confidence and uncertainties about their ability to effectively use technology.

Personal experiences

Participants' experiences with (e-health) technology were very diverse, ranging from no experience at all to daily use of technology. Some participants indicated that they didn't find technology of added value, finding it challenging to see its benefits or relevance in their lives.

> *'Something like a pedometer, for example; it could help, but I don't see myself constantly paying attention to how many steps I take. Or how much I move, or how much I sit or uhm... No, I believe it would even irritate me after a while.'* (male, aged 68)

> *'Oh, I don't want to think about that. No, I got one of those* [smartwatch] *from my children once, but I returned it. That constant monitoring throughout the day, no I really don't want to think about it. And that you will be monitoring it, what's happening, or things like that, constantly checking how many steps I take and whether I .... I have a sister-in-law who always says, "I still need to take another 1000 steps" or something like that. I don't want to think about it. Meddling, no.'* (female,

aged 67)

On the other hand, a smaller group of participants showed enthusiasm for the latest technological developments and considered it a personal challenge to keep up with the technological elements included in the trial.

'The developments go really, really fast, and I think that especially my generation has gone from very little to incredible developments. So, what we have experienced is truly enormous, and I realise that I really have to make an effort to keep up with all these things. (...) but I think if you don't do it and you don't achieve that, you can't retrieve it anymore. If older people stop cycling for a long time, they no longer dare to cycle anymore.' (female, aged 64)

Opportunities

When participants were asked about it, they came up with different opportunities they saw in the use of technology within a lifestyle intervention like FINGER-NL. About half already used apps like pedometers, 'Ommetje' app which stimulates exercising (24) and Strava to track activities. Additionally, some participants used the 'Eetwijzer' app from the Dutch Nutrition Centre to track their dietary habits.

'*Yes, because keeping track has a huge advantage. A) you are aware of what you eat, and B) you are also aware if it when you go way over the line once in a while.'* (female, aged 62)

Although participants recognised opportunities, some participants expressed concerns about privacy and potential third-party access to their data. Others saw its potential but personally felt that it was not suitable for them.

Assistance

During the interviews, it was clear that participants had different levels of uncertainty regarding their digital skills. Some participants expressed a need for assistance and found it important that they would have access to help when needed. Others relied on the knowledge and skills of their partners or (grand)children when it came to using technology.

'We also have a laptop, but I never use it, my husband always does, so I don't know, I can use it too. But they will surely tell me how to do it, right?' (female, aged 67)

Discussion

Summary of main findings

The present study, conducted through semi-structured interviews with a selection of participants at the beginning of the FINGER-NL trial, aimed to (1) gain insights into older adults' motivation for participating in the FINGER-NL trial, (2) investigate their perspectives on lifestyle and behavioural changes as preventive measures for cognitive decline, including needs and barriers, and (3) explore the pre-trial habits of participants related to various

lifestyle domains, focusing on areas they aimed to improve.

Participants were strongly motivated to participate in the FINGER-NL study, driven by personal gain and, to a lesser extent, public interest. They aim to improve their mental and physical health, preventing cognitive decline while addressing concerns about ageing and dementia, especially when witnessing dementia in close relatives. Most participants recognised the need for behaviour change, noting the increasing difficulty of behaviour change with age. The working and living conditions of the participants, including retirement status, different daily activities and family relationships, influence their lifestyle and ability to engage in the trial. Participants discussed different aspects of their lifestyle habits, identifying areas for improvement. Lifestyle was primarily defined as encompassing diet and physical activity, with some participants mentioning sleep and social activities. Participants expressed a need for dietary improvements, particularly regarding snacks, treats, and alcohol consumption.'

Participants in the FINGER-NL trial expressed their expectations regarding the intervention's effects on their mental and physical health, including weight loss and improved well-being, while acknowledging the importance of realistic expectations. They also identified barriers like physical health issues, time constraints, and old habits, and motivators such as guidance, feedback on progress, group support, and practical assistance to facilitate lifestyle changes and adherence to the trial. Lastly, participants varied in their experiences with technology and digital skills, with some seeking assistance and relying on family members for technological support.

Motivation for participation

Participants indicated that personal benefits were the main reasons for their participation, such as preventing cognitive decline, improving health, and changing behaviour. These motives were stronger than altruistic reasons, like contributing to science or society. This aligns with a previous study of FINGER and the Multidomain Alzheimer Preventive Trial (MAPT) participants, where improving lifestyle was focused on maintaining functional independence, a theme also reflected in our interviews (12, 13).

Most participants in our study reported in the interviews that they have or had a family member with dementia, usually a parent, but sometimes also siblings. Family history and hereditary predisposition were profound recurring themes in the interviews emphasized the importance thereof for the participants. Additionally, the prevention of these issues was a key focus for many. This is in line with the research with earlier research (25, 26) which emphasized that family history plays a vital role in shaping what people know and how they feel about cognitive decline and related disorders. Other studies support the findings that indirect experiences, such as having a family member with dementia, are linked to greater awareness and a better understanding of modifiable risk factors, such as the domains addressed in the FINGER-NL trial (27).

Within the FINGER-NL trial, both modifiable dementia risk factors and non-modifiable risk factors, such as family history and concerns about cognitive decline, are used as inclusion criteria (9). Therefore, the study population might not be fully representative of the general population as most participants had firsthand experience with dementia in their family. Motivation to participate in similar trials or to modify one's lifestyle may vary within a population without direct dementia experience. Nevertheless, the prevalence of dementia suggests that many people in the Netherlands have experienced dementia in their social environment (10).

Understanding of and attitudes towards lifestyle and behavioural changes, needs and barriers

Participants indicated that diet and exercise were the main pillars for lifestyle changes, highlighting their importance in the participants' awareness. Regarding diet, participants acknowledged that alcohol consumption is not beneficial for their health. The use of alcohol at certain times, such as in the afternoon or after dinner, seemed to be a generational habit (28), which is further explained by Kersey and Lyons (29), who suggest that drinking is influenced by various social and cultural identities. The other domains, such as metabolic and vascular health, sleep, stress, cognition, and social activities, were less directly linked to overall health and cognitive decline. Participants indicated that they mainly lacked knowledge on these topics.

Participants were generally aware of risk factors such as high blood pressure and high cholesterol levels that increased their perceived susceptibility to diseases, but often did not mention the relationship between these factors and their cognitive health. Previous research supports the findings of this study, emphasizing that knowledge about dementia, including (modifiable) risk factors, is generally low, even among individuals with a higher level of education (30, 31).

Compared to the original FINGER study, the FINGER-NL trial also incorporates online elements and technological support (apps, dietary journals, online coaching). During the interviews, we specifically asked about participants' views on using technology in a lifestyle intervention. Digital experience was not solely age-dependent. Some older participants (75+) were comfortable using computers, smartphones, and smartwatches, while others in their 60s struggled with technology. In general, research shows that online lifestyle programs have the potential to enhance brain health outcomes and may play a role in dementia prevention (32).

Strengths and limitations

The qualitative design used in this interview study facilitated an in-depth exploration of the experiences and expectations of older adults just before the start of the FINGER-NL trial. Utilizing semi-structured interviews allowed for in-depth discussions of relevant topics (20). Participant recruitment included four different sites where the FINGER-NL trial is conducted, encompassing the whole of the Netherlands, from the northern site in

Groningen (University of Groningen) to the southern site in Maastricht (Maastricht University). Although there were no striking disparities among participants from the different sites, subtle regional and cultural differences were noticeable, which are characteristic for different parts of the Netherlands (33), like the more 'bourgeois lifestyle' as described by the participants from the south of the Netherlands. These distinctions could potentially influence aspects of lifestyle, including dietary choices and alcohol use.

Considerations regarding intervention design and further research

Lifestyle interventions have gained increasing attention as effective strategies for addressing a wide range of health conditions, particularly for the prevention of cognitive decline, with multiple global studies currently investigating their effect (25, 26, 34). However, the challenge lies in sustaining long-term lifestyle changes, during, but also after the trial. Therefore, gaining deeper and more nuanced understanding of the factors driving participation in lifestyle related RCT's is necessary for enhancing the design and recruitment strategies of coming trials. The findings in this study showed the diversity in participants' levels of knowledge and their practical application of this knowledge in lifestyle related behaviour change. While some participants showed gaps in their knowledge of specific lifestyle domains, others emphasized their need for support in effectively applying the knowledge they had gained or already had. Furthermore, individual differences, for example, in working and living situation, can influence the participation in lifestyle intervention. For example, this research shows that employment status influences the amount of time participants have available for participation, where retired people are less likely to face this time constraint. These differences in knowledge acquisition and individual circumstances highlight the need for tailored interventions that address specific needs and challenges to support healthy ageing (12, 13, 25, 26, 35).

To gain a deeper understanding of the changing perspectives of participants in a lifestyle intervention, specifically in the FINGER-NL trial, and to capture their evolving experiences, reflections, and opinions over time, it is necessary to follow participants throughout the two-year trial using a longitudinal study design. This enables us to keep track of participants over the course of the trial by employing semi-structured interviews at different pre-defined timepoints. The participants from our current study will continue to be involved in the interview study as they progress through the FINGER-NL trial, either in the structured intervention group (high-intensity group) or the self-guided control group (low-intensity group), enabling us to examine how group allocation influences their experiences and outcomes in the trial.

Statements and declarations

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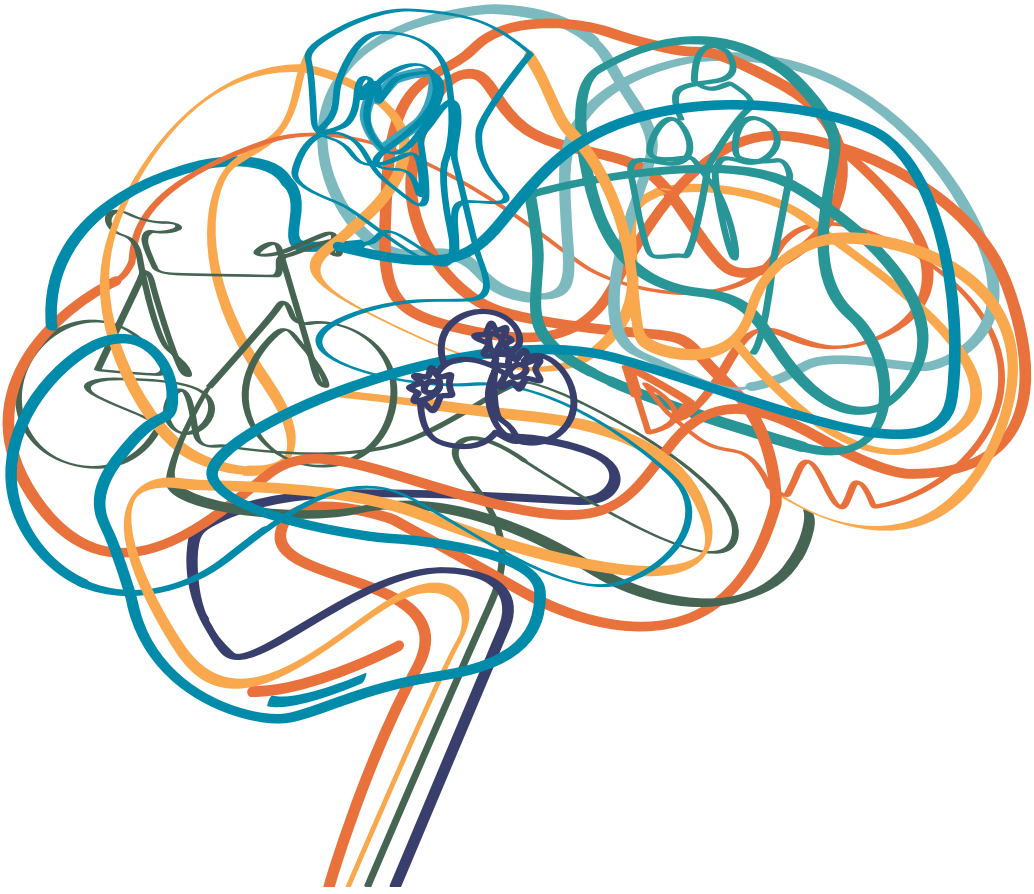
Informed consent and ethical considerations

Informed consent was obtained from all individual participants included in this inter-view study. Ethical Treatment of Experimental Subjects (Animal and Human) Ethical approval specifically for this qualitative study was granted by the Ethical Research Committee (ECO) of the HAN University of Applied Sciences, Nijmegen, the Netherlands (ECO 310.12/21). The study was declared not to be subject to the Medical Research Involving Human Subjects Act (WMO), and it underwent examination to ensure compliance with scientific and ethical standards.

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CHAPTER 3

Engagement and adherence in the FINGER-NL lifestyle trial: qualitative study

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Abstract

This qualitative study explores the experiences of participants in the two intervention arms (HI: high-intensity and LI: low-intensity) of the FINGER-NL lifestyle intervention aimed at maintaining cognitive functioning. The study aimed to understand engagement and adherence, including facilitators and barriers, refining these concepts based on participant experiences. Semi-structured interviews with 41 participants, conducted halfway the 2-year intervention, identified three key themes: (1) Engagement, influenced by group allocation, involvement levels, and technology; (2) Adherence, exploring motivations, selective adherence choices, facilitators, barriers, and non-adherence; and (3) Perseverance, reflecting sustained commitment and future expectations. HI-participants showed varying motivation levels, increasing when they noticed positive effects and developed new habits. They often made selective adherence choices, supported by lifestyle coaches, fostering autonomy. LI-participants often expressed disappointment with their allocation, but sometimes initiated self-guided changes, motivated by advice or their goal to prevent cognitive decline. Insights from both groups show that engagement differed, influenced by group allocation, personal motivation, and available support. The findings show that adherence is not all-or-nothing, and that a flexible, personalized approach may help participants stay committed over time.

Introduction

Lifestyle interventions designed to delay or prevent pathological cognitive decline and the onset of dementia, including Alzheimer's disease, are increasingly gaining attention (1). The overall number of people living with dementia keeps rising with the global ageing of the population, underscoring the importance of identifying preventive factors that can be targeted by such interventions (2). Up to 45% of dementia cases could potentially be delayed or prevented by addressing 14 modifiable factors such as midlife hypertension, obesity, and physical inactivity over the lifespan through targeted interventions at the individual and population level (2), with recent research identifying additional modifiable risk factors such as poor sleep quality and psychological stress (3). Next to promising developments in the field of disease-modifying treatments, it seems possible that large-scale implementation of such preventive lifestyle interventions could significantly reduce dementia incidence (4).

The Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER) was the first large-scale randomized controlled trial to show that targeting four lifestyle domains, physical activity, cognitive training, nutrition, and cardiovascular risk management, had small, but significant, benefits for global cognitive performance in older adults at risk for dementia (5), although direct evidence on dementia incidence is not yet available. Further analysis suggests that FINGER could be a cost-effective approach due to its large potential population impact (6). Building on these findings, the FINGER-NL trial in the Netherlands is designed as a two-year intervention including two groups: the intervention arm (referred to as the high-intensity (HI) group) and the control arm (referred to as the (LI) low-intensity group). This is followed by a two-year follow-up period, during which retention activities to support sustained behavior change and promote long-term health benefits. FINGER-NL uses an optimized multidomain intervention that includes a combination of seven modifiable lifestyle domains: physical activity, cognitive training, cardiovascular risk factor management, nutritional counseling, sleep counseling, stress management, and social activities. Additionally, a nutritional product that could help maintain cognitive functioning (Souvenaid®, 125 mL) (7) is also included in the intervention (8). To enhance accessibility and flexibility, the study was designed to feature both online and on-site intervention components.

Interviews with participants of FINGER-NL at baseline, before the start of the trial, showed that participants mainly joined to improve their health, driven by concerns about ageing and personal experiences with dementia in close family members. Participants highlighted the need for support in making lifestyle changes, including coaching and practical guidance (9). Ensuring this support is important, as generally, the success of lifestyle interventions in terms of health benefits depends on its potential to stimulate and sustain participant adherence over time, focusing on long-term effects (10, 11). Even if older adults are aware of the benefits of changing their behavior for brain health, maintaining consistent

adherence to lifestyle intervention programs proves to be very challenging (10). Changing behavior means breaking with long-standing habits that have developed over years and decades, and simply providing health knowledge is often not enough to accomplish this (12). In this context, adherence entails a more active role from participants following the recommended lifestyle changes, in comparison to mere compliance (13). Adherence and compliance are often used interchangeably by healthcare professionals, but while these terms may seem similar, they differ in key ways. Adherence refers to the extent to which a person's behavior, such as taking medication, following a diet, or implementing lifestyle changes, aligns with recommendations that have been mutually agreed upon with a healthcare provider (14). Thus, adherence is a proactive and positive behavior that leads to lasting lifestyle changes, like doing daily exercising (15).

Adherence is influenced by various factors. For example, self-efficacy seems to play a key role in initiating and maintaining lifestyle changes over the long term, and lifestyle interventions therefore benefit from addressing and training this (16). Furthermore, previous lifestyle interventions have used various methods to facilitate behavioral change, such as goal setting, feedback and rewards, educational components and the incorporation of a group element (17, 18). Moreover, not only the content of the intervention plays a role, but also contextual factors around the intervention, such as the involvement of a lifestyle coach and participant interaction and group dynamics (19).

While the primary goal of FINGER-NL is to assess the efficacy of the intervention in maintaining optimal cognitive functioning, slowing down cognitive decline, it is equally important to understand the experiences of the participants to identify factors that influence engagement, motivation, and adherence. In this regard, multi-method research, where qualitative research is conducted alongside quantitative methods in randomized controlled trials, provides the potential to explore reasons behind quantitative findings and help explain variations in the interventions' effectiveness (20, 21). Next to the experiences of participants in the intervention arm (the high-intensity group), which are crucial for designing effective interventions, the experiences of participants in the control or placebo groups (the low-intensity group) are equally important, although they are often overlooked in scientific research. The experiences of participants in low intervention groups are supposed to reflect the 'normal' behavior of individuals who are at risk but not involved in the intervention, and to account for the placebo effect, as their awareness of participating in an intervention study may influence their behavior. Considering both perspectives provides valuable insights into participants' opinions, potential behavior changes, and help identify potential confounding variables that might influence study outcomes.

The aim of this qualitative study, conducted after the first year of the two-year intervention, is to explore the experiences of both high-intensity intervention (HI) and low-intensity intervention (LI) participant groups in the FINGER-NL lifestyle intervention. We strive to better understand factors that influence participant motivation, engagement and

adherence, and to identify facilitators and barriers to participation, with these concepts being refined through participants' lived experiences and perspectives.

Methods

Study design and participant characteristics

This qualitative research study is conducted alongside the FINGER-NL trial, involving participants from both the HI- and LI- groups, using semi-structured interviews based on an interview guide and reported using the Standards for Reporting Qualitative Research (SRQR). An overview of the FINGER-NL trial and its design is depicted in Box 1 and described by Deckers and Zwan (8).

Research aim:	Investigating the effectiveness of a personalized, 2-year (24 months) multi-domain lifestyle intervention compared to online lifestyle-related health education information on change in cognition in older adults at risk of cognitive decline.
Participants:	*N* = 1210, aged between 60-79, participated equally distributed across five study sites in the Netherlands (Amsterdam, Groningen, Maastricht, Nijmegen, Wageningen). Participants were eligible if they exhibited ≥ two modifiable (based on LIifestyle for BRAin health (LIBRA) score) and ≥ one non-modifiable risk factors for cognitive decline (including family history of dementia, and concerns about subjective cognitive decline).
Intervention groups:	Participants were allocated randomly into the HI-group or the LI-group. The High-intensity (HI)-group: receives a personalized hybrid intervention targeting seven lifestyle components through an informative reader, online meetings and on-site group sessions, personal individual coaching by a trained lifestyle coach and the daily consumption of Souvenaid®. The Low-intensity (LI)- group: receives general lifestyle-related health information covering all seven lifestyle components through occasional online information leaflets, without the inclusion of Souvenaid® consumption. Participants of both the HI-and LI-group had access to 'Ivido', a digital communication platform designed for careful handling of medical data, for information exchange and data registration between researchers and participants. Participants in the HI-group and LI-group received different content through Ivido.
Primary outcome:	Two-year change from baseline in a global cognitive composite score derived from subtest scores from the neuropsychological test battery covering processing speed, executive function and attention, and memory.

Figure 3. Overview of the FINGER-NL trial and its study design.

Secondary outcomes:	Two-year changes will be assessed in test-specific cognitive performance, daily functioning, quality of life, and LIBRA scores. Outcomes further include change in individual lifestyle components such as cardiovascular health, nutrition, sleep, stress, social factors, physical activity, sedentary behavior, sarcopenia, and fatigability. Furthermore, blood biomarkers for Alzheimer's, neuronal damage, astrocyte activity and brain plasticity will also be analyzed.

Figure 3 (continued). Overview of the FINGER-NL trial and its study design.

For the qualitative study, only participants who explicitly gave consent to be contacted were selected at baseline using purposive sampling from the FINGER-NL participant pool. Purposeful sampling was used to include participants with different characteristics, with regard to gender, age group, and residential area, so that they broadly reflected the entire participant group within FINGER-NL. The first interviews were conducted at baseline (T0), just before the start of the intervention. This current study specifically focuses on data collected through interviews approximately 1 year (between 11 and 13 months) after start of the intervention (T1), between April 2023 and February 2024. Only one interview was planned after 14 months, due to a participant's vacation.

Data collection

To schedule an appointment for their T1 interview participants were contacted by phone by the researchers doing the interviews. The interviews were conducted by two authors (RO and KvdS), as well as last-year MSc Nutrition and Health students and students in Dietetics. None of these researchers were involved in the FINGER-NL intervention, nor did they have any contact with the participants during the intervention. Depending on the participants' preference, interviews were conducted either at their homes or at one of the four FINGER-NL locations participating in the qualitative study (Groningen, Maastricht, Nijmegen, Wageningen). Two interviews were conducted via phone or Teams with participants who had dropped out of the intervention, upon their request. The interviewers re-read the T0 interviews conducted at baseline before the interviews to familiarize themselves with the participant's context. All interviews followed the semi-structured interview guides, which were structured around topics with example questions for both the HI-group and the LI-group. The most important topics covered included updates and reflections on the past year, experiences related to both general and brain health, participants' opinions on their involvement in FINGER-NL, their knowledge of the different lifestyle elements (such as diet, physical activity, sleep, etc.), and the behavioral changes participants made in these areas, along with the obstacles they encountered as well as the facilitators that played a role. Moreover, the relation between lifestyle and dementia was discussed, as well as participants' experiences with dementia, technology, their social environment (e.g. family and friends), and future expectations in general and specifically regarding the remaining year of FINGER-NL. Additionally, the interview guide for the HI-group contained more in-

depth and specific questions regarding the design elements of FINGER-NL, including the role of the lifestyle coach, group and individual meetings, cognitive training, Souvenaid®, cardiovascular health, relaxation, physical activity, sleep, and the intervention setting, such as location and delivery method.

To encourage a natural conversation, closed questions were minimized, and the order of open-ended questions was flexible. The interviewer made sure all topics were covered by referring to topics that needed further clarification. Interviews were recorded with an audio recorder (Olympus aLS-P1 Hi), with the permission of the participants and overall impressions were documented in a memo immediately after the interviews. Transcriptions were completed using Amberscript (a paid automatic speech recognition software), reviewed manually, pseudonymized, and securely stored on a research drive for data analysis.

Data analysis

The data from the interviews was analyzed in ATLAS.ti (version 23.2.1), following reflexive thematic analysis (RTA) by Braun and Clarke (22). Relevant data fragments were then coded with concise codes that captured their meaning. Two authors (RO and KvdS) independently coded two different transcripts, discussing their coding decisions and functioning as critical friends (Braun & Clarke, 2024). The first author (RO), who has a background in nutritional and health sciences and experience in qualitative research, coded 27 transcripts, while the third author (KvdS), also with a background in nutrition and health, coded 14 transcripts. Rather than aiming for agreement on all aspects, differences in coding were used as a starting point to reflect on the data and discuss differing interpretations, often leading to refinement of codes, for example by breaking down broader codes into more specific ones. Throughout the analysis, RO and KvdS were supported by co-authors with complementary expertise, including a senior researcher and lecturer in qualitative and mixed-methods research (AdK) and a professor of dietetics and registered dietitian (MdvdS). Their input was mainly in iterative discussions, in which themes were questioned, refined, and checked against the interview data, helping to ensure that interpretations stayed closely connected to what participants actually said. The other co-authors were part of the broader FINGER-NL research team and were not directly involved in the data analysis, but provided feedback on the interpretation and presentation of the results.

A codebook was composed, which was adapted and expanded as the analysis progressed. Subsequent phases of data analysis were conducted by the first author (RO) who used all transcripts to finalize the analysis. Codes were grouped into subcategories, which were further organized into overarching themes and subthemes, continuously being refined and interpreted in an iterative process, including ongoing reflexivity from the first author and the other co-authors (including an experienced qualitative researcher on lifestyle (AdK) and an expert on nutrition (MdvdS) to ensure that the analysis remained grounded in the data,

while being aware of their own positionality, perspective and influence on the interpretation of the data as emphasized in Braun and Clarke (22). In the process, continuous modifications were made until the themes were finalized and used to describe the results section of the study. Consistent with RTA, we did not aim for data saturation, as this concept is not compatible with RTA. Instead, we focused on gathering sufficient data to support the development of meaningful, well-supported themes (23).

Results

A total of 41 interviews were conducted; 25 with participants of the HI-group, 16 with participant of the LI-group. The interviews lasted an average of 46 minutes (range: 19–82 minutes). In total, 4 participants from the HI-group stopped with the FINGER-NL lifestyle program but still participated in the follow-up outcome measurements and interviews at T1. General characteristics of participants can be found in Table 1.

Table 1. Participant characteristics

Characteristics	High-intensity group	Low-intensity group
Number of participants	25	16
Participants who discontinued	4	
Age at interview T1, mean (range)	66.7 (62-79)	68.2 (62-79)
Gender, n (%)		
Male	11 (44%)	3 (19%)
Female	14 (66%)	13 (81%)
Study site*,		
Groningen	3	3
Nijmegen	8	6
Maastricht	5	2
Wageningen	9	5

*Amsterdam was not included in this qualitative study

The thematic analysis of the interviews resulted in the generation of three key themes: (1) Engagement, (2) Adherence and (3) Perseverance. An overview of the key themes of the interviews is provided in Figure 2, with illustrative quotes shown in the text.

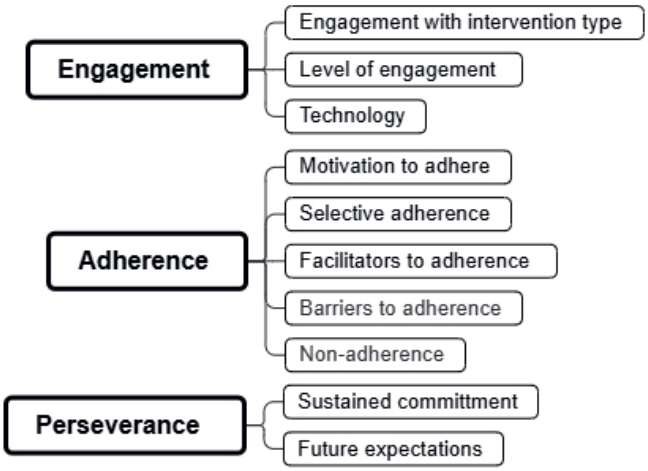


Figure 2. Overview of themes and subthemes

Engagement

Engagement within intervention type

Participants in the HI-group almost never questioned their group allocation and, when discussed by the researchers, mostly had a strong suspicion that they were in the HI-group. The majority expressed satisfaction with their group allocation and the content of the intervention and indicated that this was what they had hoped for when they signed up. Some participants indicated that they were curious about the intervention for the 'other group'. Only one of the participants of the HI-group indicated that she doubted her group allocation.

> *'I'm in the intensive group. Well, if this is the not intensive group, then I feel sorry for the lifestyle coach* [She laughs]. *No, this is definitely the intensive group. I'm actually 95 percent convinced of that.'* (Female, aged 62, HI-group)

> *'I, I am in the intensive group. I know that by coincidence, because my brother is also participating in FINGER-NL, but he is in the non-intensive group (...) Yes, I know it 100% for sure; when I make that comparison, then I think; well, I must be in the intensive group.'* (Male, aged 73, HI-group)

On the other hand, in almost all interviews with LI-group participants, group allocation was brought up by the participants. Most of them indicated that they believed they had been randomized to the 'low-intensity group,' sometimes referring to it as the 'placebo' or 'control' group. Although the interviewer responded neutrally, they were convinced that they were right. Frequently, LI-group participants mentioned that they had higher expectations of the intervention at the start, and when it did not meet those expectations, they expressed disappointment and assumed they must be in the low-intensity group.

> *'I know there are two groups, and one of them has to do more intensive things. I'm not in that group, at least I don't think so. I can't imagine it (...), because then I think; how must the other group be? I hardly have to do anything now.'* (Female, aged 62, LI-group)

> *'No, but it's clear to me that if this is all I get, and I don't have to fill in anything else, like about nutrition and those kinds of things, then I'm in the group where they think: well, not much is happening, let's see how it develops with minimal information.'* (Female, aged 64, LI-group)

Most LI-participants accepted their group allocation as inherent to scientific research, often for altruistic reasons, or were (slightly) disappointed. One LI-participant was particularly angry as her expectations were not met and she felt she received no input from the intervention, while several others found participation pointless due to the lack of personal benefits, having had higher expectations. One participant indicated that she almost forgot that she was even participating in the trial. Only one participant indicated explicit satisfaction with his assigned group and the time commitment.

Level of engagement

Participants in the HI-group shared that they found the intervention program intensive, both in terms of time commitment and mental and physical efforts, but they saw this as a key part of what made the program effective. When asked about the time spent, one participant estimated only 15 minutes per week (although she emphasized that she could have invested more), while others reported spending around one to two hours per week. One participant mentioned participation felt time-consuming at first, but became easier once she got 'the hang of it'. While some participants experienced the intensity as a burden, others did not.

> *'Well, when it comes to cooking, you're not really spending extra time on it. You might use something different, but that time was already being used. I go to the gym for the physical activity. In the mornings, I went from 15 minutes to half an hour, sometimes a little extra. But it's not a burden, because I was already doing it for 15 minutes. So adding just a little more time isn't a big deal.'* (Male, aged 74, HI-group)

The LI-group expressed different levels of engagement. Most participants who engaged with the general health information found that it was largely familiar to them, and they did not learn anything new. Instead, it mainly served as a reminder of good and healthy lifestyle habits. A small number of participants indicated that they never opened the emails with information at all. Some mentioned that they began reading but stopped after a few emails once they realized that it contained no new information:

> *'No, I actually do not come across anything new, nothing where I think, well, that is really something I can use, you know. No, if there was something I thought I*

could use, I am already doing it. (…) then I think, oh, I'm doing well.' (Female, aged 62, LI-group)

One participant mentioned that she never read the information, because she experienced the loss of a loved one in the past year, which took up her energy.

Technology

Participants from both groups noted that technology influenced their engagement in the intervention, though it is used differed. HI-group participants regularly used Ivido, the online platform for assignments, and attended online sessions. Many mentioned both the clear convenience of technology and challenges with accessibility.

'Yes, we can't do without technology anymore, but on the other hand, the older you get, the more difficult it becomes. And I think the whole research is in that dilemma. And yes, I say, bring on the technology, because I think it's really good and improving, and I try to keep up with it and use it as much as possible. But in my group, there are also people who are not familiar with it at all.' (Male, aged 67, HI-group)

In the interviews, participants from the HI-group often indicated that after a year, they had become accustomed to the use of technological elements and had gotten 'the hang of it', particularly logging in for Teams meetings, which had initially been a challenge. However, some participants still struggled with logging in for group sessions and finding things. They appreciated having access to a helpdesk (a local research assistant) from FINGER-NL or assistance from their children. When it came to using e-health technology, for example the 'Ommetje app' (an app to stimulate walking outside), around half of the participants saw it as an added value, while others disliked the idea of being tracked and controlled.

Participants in the LI-group mainly received general health information, with no interactive elements. Their responses on this varied partly due differences in how study sites shared the information. Some LI-participants experienced difficulties accessing the information through Ivido, which required a two-step authentication process and saw login changes during the trial, while others had no trouble, as their study site sent the information as a standard email attachment. LI-participants often felt self-solving of login issues were not worth the effort, especially for information they felt they already knew. One participant expressing strong irritation:

'No, at first, I did read the articles seriously, but then you always think: yeah, come on, you have to live healthy, and I know how to do that. (…) but I especially found the privacy rules [explanation by authors: that necessitate a two-step authentication] around it absolutely annoying. And also because I think, well, I said yes and I'm continuing, but it even caused considerable irritation. I think; fine, I'm in a low-supported group. Fine, shame, but then don't bother me, so to speak.' (Female, aged 63, LI-group)

Adherence

Motivation to adhere

In the interviews before the start of the intervention, participants from both groups often mentioned that their main reason for signing up for FINGER-NL was to slow down aging, prevent cognitive decline, and specifically the onset of dementia. This motivation was particularly strong for those with family members (often a father or mother) affected by dementia. Also, after a year, participants indicated that they continued to draw on this initial motivation.

> *'But yes, the goal of not developing dementia; that's just a really strong motivation.'* (Female, aged 62, HI-group)

> *'I read that the results in Finland were very good or very positive, and that there were already results known in the Netherlands as well. And then I thought: yes, that was motivation to get really fanatically involved in it. Also, in the back of my mind, knowing that both of my parents became demented fairly early, my mother at a younger age, my father a bit later. My father had vascular dementia and my mother, she really went [makes a downward hand motion]. She declined very quickly. Yes, so all of this together made me decide, well, my future doesn't look very positive in that regard.'* (Male, aged 73, HI-group)

The majority of participants in the HI-group were willing and explicitly expressed motivation to follow the guidelines provided by the trained lifestyle coach. Two main reasons for this motivation were often mentioned: some participants wanted to make significant changes in their lives, often triggered by personal events like retirement, seeing the intervention as the 'momentum' to do so. Others who already maintained a relatively healthy lifestyle, were motivated to finetune and perfect it. As they had fewer changes to make, it was easier for them to fully adhere to the guidelines, as many were already part of their daily routine.

> *'And I know myself too, like when it comes to sports, for example, also the training we do* [during the group meeting within FINGER-NL]. *Yeah, for me, that's at a pretty basic level, with very small weights. At home, I work out with five and ten-kilo weights, doing exercises like this and this [makes weightlifting moves above shoulders]. I mean, I'm not going to say, 'Well, I don't need to participate because I already do this myself.' I do want to participate, yeah.'* (Male, aged 65, HI-group)

Next to this intrinsic motivation, participants in the HI-group indicated that they were motivated by the elements within the intervention:

> *'I find the people to be friendly and professional, which I think is very positive. And yes, that makes you look forward to activities. The coaches are also very positive, grounded, and down-to-earth. That feels good to me. When someone is motivated,*

> *I always say, that's perfect, and they really are. I think that's very positive. Keep it up.'* (Male, aged 67, HI-group)

Others indicated that they were motivated by their belief in the effects:

> *'I think those brain games* [e.d. BrainHQ] *are, well, a good workout. I believe that helps too. Combined with the nutrition and the coaching, it really makes a difference.'* (Male, aged 67, HI-group)

For participants in the LI-group, adherence to instructions and guidelines was not a major issue as they received general health information, which was open to interpretation and mainly offered broad knowledge along with a few tips. Despite familiarity with the information provided some participants mentioned they still changed their behavior regarding certain lifestyle domains following the recommendations in the information provided such as eating more vegetables, joining a sports club, or starting swimming again. Some participants indicated that they decided to work on their lifestyle out of own initiative, for example by starting a healthy diet or consulting a dietitian.

> *'I think, well, if I can't do it on my own, then I'll join a club where I'm with more people. So, last week, I started power walking again. It's about moving more because I'm not someone who goes for a walk alone. I always go running with a close friend. So, in that way, I've started building it up again and moving more because I really enjoy it.'* (Female, aged 64, LI-group)

During the interviews, some of these LI-participants mentioned that they had difficulty identifying which changes they had made in their health behaviors over the past year were linked to the information from FINGER-NL. They found it hard to distinguish whether these changes were influenced by the intervention or by other sources they followed out of personal interest and motivation to improve their health habits.

> [Interviewer: 'But do you feel that you have gained new insights through your participation in the research?] *'No, well, I... I don't think so. Let me put it this way: maybe if you really start to dig into it and write it all down, and analyze it completely, like look, here you started doing this, that happens, that it could be the case. But I don't think so.'* (Male, aged 74, LI-group)

Selective adherence

Although participants in the HI-group indicated that they were willing to follow the guidelines of the intervention, they often explained that they made personal choices in the domains they found most relevant or interesting. Throughout this process, they experienced help from the lifestyle coaches in personalizing the intervention to fit with their needs and preferences. They appreciated the freedom, flexibility, and control to make their own choices, while for some, the ability to make choices felt obvious, since participation was voluntary. According to participants in the HI-group, selective adherence was often

driven by their own interests and preferences, but also influenced by barriers they encountered.

> *'I do things that I find important myself. Look, the diet, I do that, I stick to that. I try to exercise properly, to make sure I get half an hour a day. That definitely works, and the social part, I think, well, I really, I think, yeah, guys, I'm not going to start with that. I'm already busy enough and with the cognitive part, yeah, then I also think, that's not necessary, but I did take that module, but I'm not going to do anything extra with that.'* (Female, aged 68, HI-group)

> *'Yes, one part is a bit more interesting than the other.'* (Male, aged 73, HI-group)

In the interviews, various elements of the intervention were discussed. For example, one participant struggled with the nutrition guidelines due to diabetes and felt there was insufficient guidance. Another participant struggled with the idea of exercising for health reasons, as she preferred to be motivated by enjoyment rather than obligation. A third participant mentioned that the logistics of the intervention, such as the timing of the on-site meetings during working hours, were not always practical for the target population, which contributed to their lack of adherence to certain aspects of the intervention.

> *'For me, it actually doesn't work. That's why I have skipped a number of meetings, and yes, I just feel that it doesn't fit with an older target group, whether other people are experiencing issues or not.'* (Male, aged 63, HI-group)

Choices within adherence were influenced by changes in motivation over time, as indicated by participants from the HI-group. Many people started out (very) motivated but noted that their motivation and adherence decreased over time, and some of their old habits started to creep back in. The majority of participants who experienced this decline reported that it occurred after a few months, when the novelty of the intervention wore off and people encountered obstacles.

> *'The only thing is that I'm not as motivated anymore as I was at the beginning. But that's more a matter of mindset. I started off being very strict with myself. No cookies, nothing like that; very strict, just as it was prescribed, both physically and especially regarding food. But gradually, I've slipped a bit; there are a number of things that we still do. We eat a lot of fish, and everything is cooked in olive oil, which we didn't do before. So, there are many points of progress, but I am no longer as stick as at the beginning.'* (Male, aged 73, HI-group)

It is important to note that some participants of the HI-group indicated that they felt limited in their ability to adhere to all components of the intervention due to physical barriers. Several participants indicated that they wanted to follow the, sometimes adapted, guidelines and activities in the physical activity domain, but were hindered by physical complaints, sometimes related to aging, such as osteoporosis or a worn knee or hip.

'Exercise, running, I still try that, but I am too heavy, and at the moment I'm dealing with all kinds of injuries.' (Male, aged 67, HI-group)

This subtheme seemed less relevant for participants in the LI-group, who were not required to adhere to specific guidelines. Nevertheless, these participants also indicated that, when making changes to their health-related behaviors based on the information provided in the intervention, they also selected the health areas they found most relevant to them.

Facilitators to adherence

Participants of both groups often mentioned that it was easier to commit to changes that fitted well into their daily lives, because when they are successfully integrated, they become habits and are easier to sustain. This theme, however, was more elaborately discussed by participants in the HI-group, as they were more stimulated and guided to make behavior changes.

'We've been at it for a year, and then it becomes a bit second nature; it just becomes routine. And if you keep at it for another year, then you don't know any other way.' (Male, aged 74, HI-group)

Participants of the HI-group listed factors incorporated into the intervention that facilitated changes in behavior and routine-making. Different elements of the intervention were often mentioned, especially the involvement of a trained lifestyle coach. This coach was present at on-site group meetings and online group and individual sessions, providing information and coaching participants throughout the intervention to help them make changes in their behavior across the different health domains. HI-participants mainly appreciated the information and advice and also valued that they had a clear point of contact and the opportunity to ask questions. Having a lifestyle coach motivated the participants to stay committed and engaged, as they often indicated that they felt a commitment to the intervention and the need to be accountable (in a positive way) due to their personal relationship with the lifestyle coach.

'Because you can check with her to see if you're on the right track, or if you're doing things the right way.' (Female, aged 62, HI-group)

Overall, HI-group participants were generally positive about the elements of the intervention that they themselves decided to follow and adhere to. For instance, while experiences with the group(setting) varied, with a few participants experiencing it as neutral or 'nice to have', most participants were enthusiastic about the concept. They found that the group acted as a facilitator, allowing them to share their experiences related to lifestyle changes and the challenges, and to receive support from other group members. Others did not really need the support, but enjoyed the group experience.

'I also really like that we are divided into groups of ten, so you get to see each other again. Yes, we don't have much contact, but we meet at the sports hall and

> *occasionally online. It's just nice to have people who are doing the same thing.'* (Male, aged 74, HI-group)

For other participants in the HI-group, seeing the actual 'effect' of the intervention, such as weight loss, reduced blood pressure levels as measured during the on-site group meetings, or lower cholesterol levels, was very motivating. Some participants mentioned that the new knowledge regarding the effect and relationship between different health behaviors and their effect on cognitive functioning helped them to stay motivated.

> *'Another kilo is gone, there's that. You know—it's all motivating.'* (Male, aged 73, HI-group)

In several participants of the LI group, health issues, such as atrial fibrillation or high cholesterol, were identified during the measurements. These individuals indicated that the annual (health) tests provided an additional reason to continue participating in the intervention.

> *'Like, that you can benefit from it in the sense that you learn things early that you might not have known otherwise.'* (Male, aged 69, LI-group)

Barriers to adherence

In the interviews, participants in the HI-group who had a job often indicated that balancing their working life with the FINGER-NL program was challenging. Some participants missed group meetings due to work obligations or found it difficult to find time to eat healthily and exercise regularly:

> *'Yes, exercising more, certainly, especially when you are also working, and they more or less assume that you are already retired. Most people who participate are, so they can just have those Teams meetings and everything during the day. Yes, for me that's just a bit more juggling and doing.'* (Female, aged 62, HI-group)

On the other hand, other participants indicated that being retired did not automatically mean being able to attend all meetings.

> *'I go on holiday a lot, so I have only been to those physical meetings twice, because I was abroad every other time. You see, I do always try online. Yes, sometimes the internet is too poor, and it doesn't work, but otherwise, I do try to participate. But I notice that there are always a lot of people not there (...) Yes, they are active retirees, so they all have other things to do.'* (Female, aged 68, HI-group)

Moreover, participants in the HI-group indicated a wide range of reasons for not changing certain aspects of their daily lives, despite these changes being stimulated by the intervention. One of the biggest barriers cited was the difficulty in translating the advice into concrete actions and incorporate these into a daily routine

> *'Yeah, in terms of time and the fact that you constantly have to think, like, oh yeah, I also need to do that with food today. Have I had legumes this week? Did I eat chicken? Did I have fatty fish? So, you really have to keep track.'* (Female, aged 68, HI-group)

Also, financial barriers played a role. Some participants (from both HI- and LI-group) mentioned that certain recommended food items, such as blueberries and fish, were too expensive:

> *'That's one point, because fish has gotten so expensive, right? I used to eat salmon and such, but now... Well, for me, my budget isn't that big.'* (Female, aged 64, HI-group)

Participants of the HI-group often indicated that adhering to recommendations was harder when they did not like the activity or change. This applied to different domains, but nutrition and specifically alcohol consumption were mentioned relatively often. Participants often mentioned this as reasons for their selective adherence in the intervention. For instance, some participants reported quitting Souvenaid® due to its taste or because they thought it conflicted with the diet they followed to manage diabetes. Others opted out of certain intervention components, such as the on-site meetings that included group physical exercises, because they mentioned that it was 'too easy' or that it took too much time to travel to the location 'just for exercise'.

Non-adherence

Of the 41 participants involved in this sub-study, 4 discontinued their participation in FINGER-NL between the start of the intervention and 1-year follow-up, but still participated in the follow-up measurements scheduled at 12 months (Follow-Up 1). All were in the high-intensity group and were open about their reasons for discontinuing. One participant stopped after a few weeks due to vacation plans, during which Souvenaid® was impractical to bring along, and concerns about joining the group after it had already formed. Another participant discontinued because of physical (back and nerve pain) and mental issues (including memory loss), which made it difficult for her to participate in fitness activities and follow group conversations.

The third participant, who struggled with health issues and a history of memory challenges, found it difficult to keep track of appointments and questionnaires, as well as to manage the technological aspects. The last participant stopped primarily because the commitments of FINGER-NL were incompatible with his work. He felt the lifestyle intervention offered little new information, and he missed a connection with his group, as he was the youngest, most active, and the only non-retired participant.

> *'I think it might be the composition of the group; of course, they're all a bit older. I'm older too, but I found that many people are only now being awakened through this research to the fact that, oh, I need to think about this, which means they*

> *already have quite a physical delay in terms of movement and such. And then here I come, like this young dog, and I don't feel at home there.'* (Male, aged 65, HI-group)

Although participants in the LI-group regularly mentioned that they did not engage much with the intervention or didn't do much with the information provided, none of the LI-group participants officially dropped out. Only one participant seriously considered stopping to make more room for other activities. Participants indicated that, despite receiving limited input from the intervention, they saw no reason to stop participating. They felt that even if they did not change their behavior, they were still contributing to the intervention, or they found it required very little effort to come in for the measurements once a year. A few participants mentioned that taking part in this qualitative study was also a reason to continue, as it gave them an opportunity to share their experiences and feel useful.

Perseverance

Sustained commitment

In both participant groups, perseverance was discussed in regard to future intentions and goals. For the participants in the HI-group, perseverance often came up in the interviews, particularly in relation to how they could sustain their healthy habits over time, both during the coming year of the intervention and after the intervention ends. Some participants even mentioned that they had already noticed positive effects from the intervention, which further motivated them to continue. The majority of the participants indicated that they were motivated to continue following the intervention program and were looking forward to the remainder of the program, such as modules on sleep and relaxation and making adaptations in their lifestyle based on this.

> *'Yes, just continue with the growth it has given, even if it's only a little bit in certain areas. But I remain conscious of eating. I'm also not going to fall back, I mean, that's not good for my health either.'* (Female, aged 65, HI-group)

Moreover, almost all participants in the HI-group mentioned one or two areas they would specifically like to focus on or change in the coming year regarding the health domains discussed. The majority of participants expressed a desire to improve their diet or physical activity, while a smaller group focused on other health areas, such as sleep, cognitive training, or social interactions.

> *'I want to exercise more. I want to pay even more attention to my diet. And next, yeah, just have fun.'* (Male, aged 64, HI-group)

The participants in the LI-group mainly mentioned that they would continue with what they were already doing, having no expectations from the FINGER-NL intervention, realizing that they were enrolled in the LI- group. Only a few participants still hoped for more input from the intervention or indicated that they would want to change some lifestyle-related habits

on their own.

> [Interviewer: 'Do you have any expectations for the upcoming year, for the study or perhaps your personal life?'] *'As for the study, no, because I think it will remain somewhat the same as it is now, so it will be a bit less active.'* (Female, aged 62, LI-group)

In response to the question about their future, participants in the LI-group focused more on upcoming changes in their personal lives, such as a move or impending retirement, rather than discussing the upcoming year of the FINGER-NL intervention. Overall, participants in the LI-group shared that their main motivation to continue in the intervention was that they had started it and felt committed to finishing it.

> *'Well, I think to myself, yeah, I started it, so I'll continue. It's like, I've been at it for so long, and I think it's a waste to quit.'* (Male, aged 69, LI-group)

Future expectations

Some participants in the HI-group expressed concerns about the end of the FINGER-NL intervention, indicating that they would miss the ongoing support from the lifestyle coaches, their group members, and the study team. They also mentioned that they would miss certain elements of the program, such as Souvenaid® and the online cognitive training program. Although these are available outside the intervention, participants noted that they would be too expensive to purchase on their own. Most participants from both groups indicated that they were looking forward to the results of the intervention and the effect on cognitive functioning.

> *'I expect that I will stick with it [the remaining part of the intervention], yes, and I'm actually curious about the final outcome and the result of the study. And I'm curious to what extent I can also maintain the structure I have now adopted in my life after these two years. But yes, that's partly just motivation. I will have to take that on myself, of course.'* (Male, aged 67, HI-group)

> *'It's not that I think, 'Yeah, yeah, yeah I still have a year,' no, but I do feel that I signed up for this very consciously because I want to know what they're saying and doing there. So I have to do it. Two years is manageable, right? The year flies by, so we've already had one, and we're halfway through.'* (Female, aged 68, HI-group)

> *'Yes, because, look, even if it doesn't have an outcome for me, it deepens, in any case, the understanding that all kinds of things are interconnected. And yes, look, things are not really simple, especially not with health and all sorts of related things. So yes, the more research, the better. Whether it's specifically for me or not, well, that would be nice for me, but it doesn't mean anything for someone else. Still, it provides a general understanding. And I think: well, if you know, like, you start becoming forgetful, or you think you have dementia, well, we now know that if you go walking, it slows it down, or it improves it, or it stops it, well... (...) For*

me, every study has value, even if nothing comes out of it—well, something always comes out of it—but even if it's something different than you expect.' (Male, aged 74, LI-group)

Discussion

Insights of the interviews

HI-group

Results from the interviews show that participants expressed a broad variety of engagement levels and adherence. Some participants started out more motivated, but experienced a decline in motivation over time, often when they encountered barriers or lost interest. In contrast, for others, motivation increased as they noticed the positive effects of the intervention or developed new habits that were successfully integrated into their daily lives. Consistent with the earlier findings in the interviews of T0, just before the start of the intervention (9), diet and physical activity remained the most frequently discussed domains, suggesting their importance in participants' experiences. The current study indicated that these were also the areas where participants had made the most changes. However, it is possible that their significance in the current study was influenced by the fact that these are the largest and most intensive modules within the intervention, a factor that could not have played a role in the interviews at T0. In general, participants were motivated to engage in the program and adhere to the guidelines, with some being highly motivated, a broad group maintaining steady motivation, and others expressing more critique and reluctance, with four participants stopping with the intervention.

In the interviews, participants often explained their individual choices for adherence to the intervention components and the factors that influenced these decisions. The HI-group was designed as a partly personalized intervention, with lifestyle coach meetings addressing one or more specific lifestyle domains based on participants' needs and goals, while other intervention elements (e.g., group exercises, online trainings) were highly standardized (8). The results of the interviews indicate that, with the help and guidance of the lifestyle coach, participants were indeed able to tailor the intervention to their personal preferences. The experiences of participants described under the subtheme 'selective adherence' therefore show that adherence in lifestyle interventions is often flexible and not black and white (non-adherence versus adherence), but that there is a broad spectrum in between.

Moreover, participants generally indicated that they felt motivated by the components of the intervention they personally selected, either in terms of content (such as a focus on diet or cognitive activity) or form (such as joining group sessions or focusing on individual sessions). The feeling of autonomy resulted in greater commitment. This is also supported by scientific literature from recent years, emphasizing that there is no one-size-fits-all

solution to health interventions and that tailored and personalized interventions, if done correctly, have the potential to be more effective than generic interventions (24). Overall, participants of the HI-group indicated that they felt engaged and motivated by the possibility to personalize the intervention. However, providing this flexibility poses challenges for lifestyle intervention research in balancing the standardization of interventions to closely adhere to the best available evidence with tailoring the intervention to the activity and lifestyle preferences of the participants (17).

LI-group

Participants from the LI-group often expressed disappointment about their apparent group allocation or the limited information and guidance they received. Nevertheless, some participants in the LI-group also made changes to their lifestyle, often triggered by participation in the trial. Given the participants' motivations, which were often driven by concerns about cognitive decline or a family history of dementia, as noted in the earlier publication on the intervention (9) and confirmed in the current study, it was not unexpected that some participants in the LI-group took the initiative to make lifestyle changes themselves when their needs were not met, even with limited support. The Hawthorne effect may have played a role here, as participants may have been motivated to improve their behavior simply because they were taking part in a study and knew they were being monitored (25). More broadly, this fits within what has been described as research participation effects (RPEs), where being recruited, assessed, and followed up can itself influence behavior, independent of the intervention content. Gunnarsson, Collier (26) note in a recent systematic review of alcohol studies that RPEs remain under-researched and that inconsistent terminology makes it difficult to fully understand how research participation may influence behavior across different study contexts, including ours. In addition, the (limited) information and advice provided to participants in the LI-group may also have had some influence. This pattern is consistent with observations from the original FINGER trial, where the control group also showed cognitive improvements over time. That suggests that the low-intensity group's benefits might be greater than those of a ‘do-nothing’ control group due to the advice and feedback they received for ethical reasons (5). Including participants from the LI-group in this interview study highlights the importance of gaining a deeper understanding of what has occurred in the lives of those not intensively guided and exploring their motivations behind their lifestyle related choices.

General

Although group allocation was not shared with the participants, almost all participants thought they were aware of their group allocation, either high-intensive or low-intensive. This shows that it is nearly impossible to set up a fully blinded lifestyle intervention study, as the intensity level of the intervention is highly predictive of the group assignment. This unblinding might have several implications, as participants’ expectations about the ‘value’ of their group may have influenced motivation and behavior, given that expectancy effects are known to shape engagement and outcomes (27). If so, positive expectations in the HI

group may have amplified adherence, while disappointment in the LI group may have reduced engagement for some or prompted compensatory behavior in others, influencing compliance and dropout. The challenges around proper blinding have also been described in other literature, as active involvement in lifestyle interventions makes participant blinding impractical due to its visible and participatory nature (28). As a result, the use of an active control group that receives general lifestyle advice has become common practice and is considered current best practice in lifestyle intervention studies (29). However, because these interventions focus on voluntary behavior change, full participant blinding remains difficult, and it is therefore more important to ensure that researchers performing the (cognitive) assessments were fully blinded (as done within FINGER-NL), which is arguably more crucial for maintaining the integrity of the outcome measurements than blinding participants themselves (30, 31).

One of the inclusion criteria of the FINGER-NL study was the presence of a family history of dementia and/or concerns about subjective cognitive decline. Previous studies suggest that individuals with a family history of dementia are often more motivated to adopt lifestyle changes to reduce their risk of developing dementia (32). The intentional selection of participants with a family history of dementia and/or concerns about subjective cognitive decline implies that participants in both this qualitative study and the FINGER-NL intervention are not fully representative of the general older population in the Netherlands. In the interviews, the broad range of participants' reactions to the use of technology was discussed. The use of technology in these types of lifestyle interventions offers several advantages, such as cost-effectiveness and logistical convenience, as participants do not need to travel to different study sites to meet the lifestyle coach, interact with group members, or complete their assignments (33). However, the use of technology also has its limitations, and some participants experienced the technology as a barrier. If not implemented correctly, technology can further emphasize disparities in access, participation, and adherence in prevention trials (34) therefore, future studies should carefully consider how technology is used, ensuring it is accessible and effective for all participants, and clearly define the intended outcomes.

Strengths, limitations and practical implications

This qualitative study is unique in that it not only explores the experiences of trial participants from the HI-group, but also includes those in the LI-group. To note, in the LI-group, the gender distribution of participants in this study (81% females) does not exactly match that of the overall FINGER-NL study, where 63.7% of the participants were female (8). Comparisons between the experiences of participants as discussed in the interviews and the quantitative outcomes of these participants cannot yet be made, as the results of the FINGER-NL intervention on the primary outcome are yet still unavailable, with participants currently completing their two-year enrollment. However, quantitative analysis of adherence in the original FINGER study showed that older adults who participated most actively in the intervention activities (measured by completed

intervention sessions) showed greater effects on cognition. In that study, overall lifestyle improvements were seen in both the intervention and control groups, though they were larger in the intervention group and were associated with improvement in total Neuropsychological Test Battery scores (35).
Although generally active participation and adherence are associated with better outcomes (35), many participants of the HI-group indicated that they preferred to selectively adhere to certain aspects of the intervention or required lifestyle changes, rather than following the full intervention program. This selective adherence may be an important indicator for success, earlier research already suggests that, in some cases, full adherence to a structured regimen may not lead to long-term success. Instead, partial adherence and smaller, more realistic lifestyle changes might be a better approach that result in greater long-term adherence to health behaviors (36). This is particularly relevant in multidomain interventions, where adherence tends to decrease as the number of required lifestyle changes increases (37).

From the perspective of the Self-Determination Theory (SDT), three universal psychological needs are important for autonomous motivation in every individual: autonomy (the need to feel ownership of one's behavior), competence (the need to produce desired outcomes and experience mastery), and relatedness (the need to feel connected to others) (38, 39). Within this framework, selective adherence can be understood as a way for participants to maintain autonomy, by actively choosing which elements fit their personal preferences and daily lives. At the same time, focusing on a limited number of lifestyle changes may help participants feel more capable of making and maintaining those changes, especially when the demands of the intervention are perceived as manageable. Lastly, the importance of relatedness was also underscored by participants in the HI-group, who often described support from coaches or group settings as motivating. This interpretation aligns with earlier SDT-based health research showing that autonomy-supportive, competence-enhancing, and socially supportive interventions are associated with more sustained engagement and adherence over time (40, 41). From this perspective, selective adherence is not just incomplete participation, but may actually be a better way of staying engaged, as it helps fulfil the three psychological needs described in SDT and thereby supports sustained motivation. Importantly, the three psychological needs described in SDT did not operate independently in participants' experiences; rather, they appeared to reinforce each other over time. Support from coaches or fellow participants (relatedness) often enhanced participants' confidence in their ability to make changes (competence), which in turn contributed to greater ownership over their lifestyle choices (autonomy).

Because the interviews with participants revealed a wide diversity of adherence and engagement levels, this study provides relevant insights into how motivations evolve over time and how selective adherence plays a role. Building on this, future research could explore whether distinct patterns or subgroups exist within the intervention groups. By combining data from earlier time points with interviews at the end of the intervention,

typology research could identify patterns of adherence and subgroup characteristics. The findings already point to some preliminary considerations, such as the importance of coaching that supports autonomy, allowing flexibility in adherence, and providing ongoing support. Overall, interventions should adopt a personalized approach, recognizing that motivation, adherence, and engagement are not static but fluctuate over time. Therefore, flexible and adaptive strategies are needed that can be adjusted to participants' changing needs throughout the intervention.

Conclusions

This study found varying levels of engagement between the HI- and LI-group, due to the group allocation and the intervention program offered. Participants in the HI-group were generally motivated to prevent cognitive decline and indicated that the design elements of the trial played a motivating role. At the same time, participants in the HI-group explained that motivation fluctuated over time, influenced by facilitators such as integrating new habits and noticing positive effects, as well as barriers like time investment. Personalization, supported by lifestyle coaches, played a key role in (selective) adherence. In the LI-group, some participants were disappointed with their allocation but still made lifestyle changes, often driven by personal motivation. Findings highlight that adherence is not binary and that flexible, tailored interventions may enhance long-term commitment.

Statements and declarations

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Ethical considerations

Ethical approval for this qualitative study was granted by the Ethical Research Committee (ECO) of the HAN University of Applied Sciences, Nijmegen, the Netherlands (ECO 310.12/21). The study was deemed exempt from the Medical Research Involving Human Subjects Act (WMO) and was reviewed to ensure compliance with scientific and ethical standards. The FINGER-NL trial was reviewed and approved by the Medical Ethical Committee VU Medical Center (NL77242.029.21; Amsterdam, The Netherlands) and is registered at ClinicalTrials.gov (ID: NCT05256199) and the Netherlands Trial Register (NL9634).

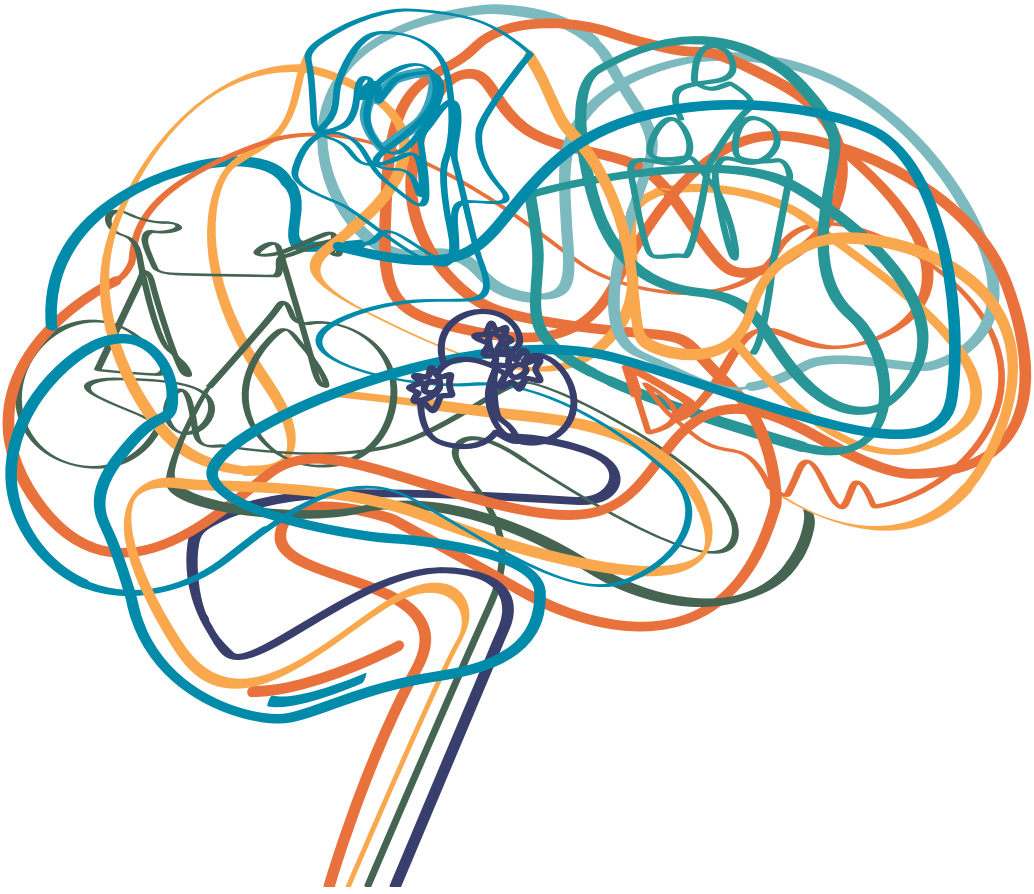
Consent to participate

Participants in this qualitative study provided written informed consent prior to their first interview at T0 (after the baseline visit and randomization, but before the actual start of the intervention). Additionally, before the T1 interviews (conducted at month 12 after start of the intervention), participants were reminded of their right to withdraw from the study at any time without needing to provide a reason.

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CHAPTER 4

Participant typologies in a multidomain dementia prevention trial: an ideal-type analysis (ITA) of longitudinal interviews from FINGER-NL

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Submitted

Abstract

Multidomain lifestyle interventions show promising results for maintaining cognitive functioning. However, individuals differ in how they experience and sustain participation. This study examined participation trajectories of Dutch adults aged 60-80 years enrolled in the 2-year FINGER-NL trial. 103 semi-structured interviews were conducted with 36 participants, 20 high-intensity (HI), 16 low-intensity (LI), at baseline, 12 months, and 24 months. Data were analyzed using ideal-type analysis (ITA) to identify patterns in experienced behavioral change, motivation, and engagement over time. Six distinct trajectories were identified. 'Early peak' participants showed strong initial engagement followed by declining motivation as effort increased. 'Slow adoption' participants progressed gradually, with small changes becoming routine. 'Consistent adherers' established new behaviors early and maintained them steadily. Within the LI-group, 'passive' participants took little action, while 'self-directed' participants initiated lifestyle changes independently of the trial. Across both groups, major life events, such as illness or loss of a loved one, formed barriers to adopting and maintaining healthy lifestyle behaviors and sustaining study engagement, regardless of trajectory. Participants differed both in the lifestyle behaviors they changed, and in how they responded to the support provided. In the HI-group, structured guidance and regular contact supported motivation across domains. In the LI-group, participants often reported that health information alone was insufficient to prompt change. Understanding these trajectories supports a more person-centered approach by showing what type of support participants need and when. Incorporating systematic, theory-based checks on motivation alongside behavioral outcomes may help identify when additional guidance is needed to keep participants on track.

Introduction

The Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER) trial was one of the first to show that a two-year multidomain intervention in older adults at increased risk of dementia can help improve or maintain cognitive functioning. This intervention combined dietary counseling, physical exercise, cognitive training, and vascular risk factor management (1). Subsequently, the U.S. POINTER study adapted the FINGER intervention to American settings and showed that both intervention arms increased in global cognitive composite scores over time. However, participants in the structured, higher-intensity program demonstrated a small, but statistically significantly greater annual improvement than those in the self-guided arm, indicating that a more structured, higher-intensity multidomain lifestyle intervention more effectively supports cognitive improvement in adults at elevated risk of decline (2).

Despite promising results from multidomain lifestyle interventions in dementia prevention, participating in such interventions is often not a straightforward process. Even when the intervention is well-designed and evidence-based, individuals respond in diverse ways (3). In general, differences in response to a multidomain lifestyle intervention are shaped by several factors, including personality traits (4, 5), pre-trial habits (6), social context and support (7), motivation, and how people view their own ageing and health (8, 9). Although dementia prevention research is largely outcome-focused (10), there is growing recognition that effectiveness cannot be assessed by outcomes alone: understanding how and why participants engage, disengage, or drop out (11), and considering subjective experiences such as perceived health and quality of life are equally important (12). Evidence from the FINGER trial further highlights the role of adherence: participants who maintained higher adherence showed greater cognitive benefits, emphasizing that how participants engage with the intervention directly influences its effectiveness (13).

This study specifically focuses on the FINGER-NL trial, the Dutch adaptation of the FINGER trial, with the study design described elsewhere (14). FINGER-NL aims to prevent cognitive decline through behavioral change in multiple lifestyle domains tailored to the Dutch population. The intervention program differed between the two intervention groups. Participants in the high-intensity (HI) group received structured support, including physical and online group sessions, digital cognitive training, and individual consultations with an experienced lifestyle coach based on the I-Change model (15), whereas participants in the low-intensity (LI) group received the same lifestyle themes but in a largely self-guided digital format with minimal contact. By examining how participants engaged with the intervention both during structured sessions and in applying lifestyle advice at home, we can better understand what drives behavioral change, where challenges arise, and what kinds of support participants actually need.

To better understand these differences in engagement and experience, we used ideal-type analysis (ITA), a qualitative method based on Max Weber's idea of the 'ideal type' (16), later adapted into a qualitative research approach by Gerhardt (17). ITA is used to identify recurring patterns across individuals with shared experiences and provides a structured way to build typologies that help explain how people differ in their responses to a, in this case, complex intervention (18). In this study, ITA was used to develop participant typologies grounded in their own perspectives, capturing the diversity in experiences and behavioral trajectories throughout the FINGER-NL intervention. These typologies can help to understand why and how people react differently to the FINGER-NL intervention and guide person-centered future multidomain dementia prevention programs.

Methods

Design

This qualitative study was executed alongside the FINGER-NL trial (Deckers et al., 2024). A longitudinal approach was chosen to explore how participants' perspectives, motivations, and engagement with the lifestyle interventions evolved over time as they participated in the study. This design allowed for an in-depth understanding of the processes underlying participation and provided contextual insight that complements the trial's quantitative outcomes.

Participants

Participants for this qualitative study were recruited from the FINGER-NL intervention. The recruitment procedures for FINGER-NL are described in detail by Waterink, Sikkes (19). In brief, 1,210 participants were enrolled in the Dutch FINGER-NL lifestyle trial. Eligibility was based on having at least three self-reported risk factors for cognitive decline, including a minimum of two modifiable and one non-modifiable risk factor. Non-modifiable risk factors included a first-degree family history of dementia and subjective memory complaints. Modifiable risk factors were assessed through a single-question self-report and included, among others, an unhealthy diet, low mental or cognitive activity, and high blood pressure. Participants were randomly assigned to either a high-intensity group (HI-group), which followed a personalized, supervised, and hybrid intervention targeting seven lifestyle components and one nutritional supplement, or a low-intensity group (LI-group) which received general lifestyle information in self-guided format (see Figure 1 for an overview of the intervention design).

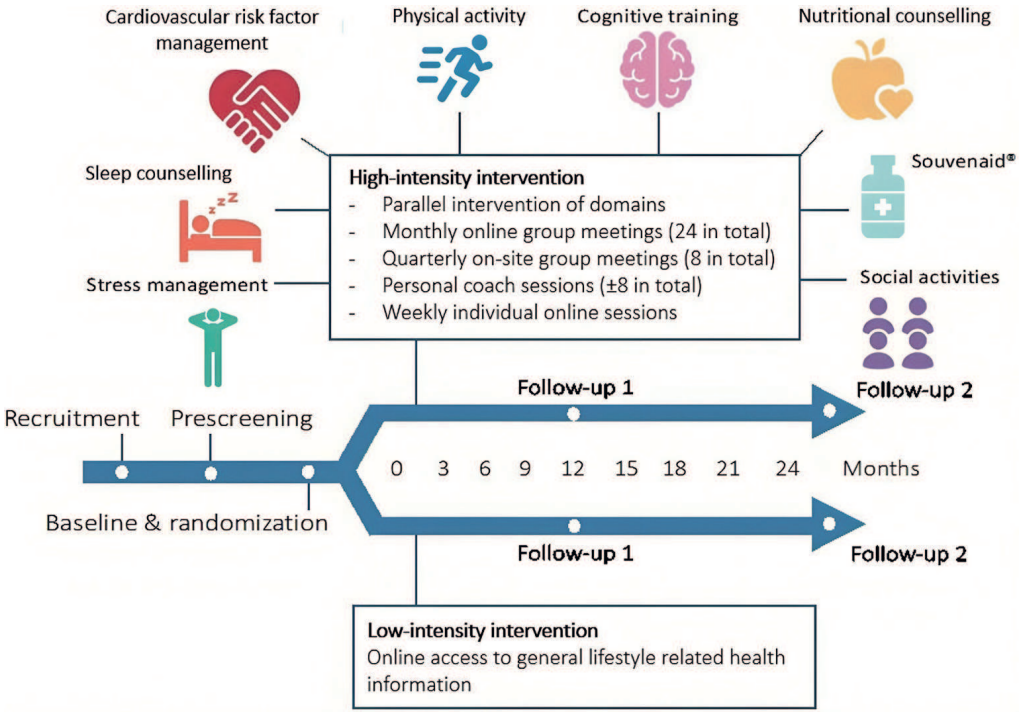


Figure 4. Lifestyle intervention domains covered in the FINGER-NL trial (14).

For this qualitative study, we used purposive maximum variation sampling to capture a wide range of experiences and perspectives *ref to previous paper*. During the baseline visit of the FINGER-NL trial, participants were asked whether they consented to being approached for the qualitative interview study. Participants who provided consent were subsequently contacted by telephone by a member of the research team and informed about the interview procedures. Participants were selected with attention to age, sex, education level, and geographical region. Inclusion criteria were: 1) enrolment in the FINGER-NL trial; 2) ability to participate in interviews in Dutch; and 3) willingness to engage in three interviews over the two-year intervention period. Participants were informed about the purpose of the interview study, and the independence of the qualitative research from the FINGER-NL intervention was explicitly emphasized. Ethical approval for this qualitative study was granted by the *anonymized*.

Data collection

Semi-structured, in-depth interviews were conducted at three time points: at baseline (T0), approximately 12 months after the start of the intervention (T1), and at the end of the two-year intervention period (T2; around 24 months). Each year, participants from both the HI- and LI-groups were invited for an interview. The interview study ran alongside the trial and therefore also included participants who discontinued the trial; however, the present analyses are restricted to participants who remained enrolled in the trial and completed all three interviews. The interview guide explored participants' motivations for joining the trial,

perceived facilitators and barriers to engagement, experiences with each lifestyle component, perceived changes in health and quality of life, and reflections on the support received.

Interviews were held face-to-face or via secure video conferencing, depending on participant preference. All interviews were audio-recorded, transcribed verbatim, and identifying details, such as personal names and the names of specific places, were altered to protect participant anonymity. Most interviews were conducted by the first author (RO), a female PhD candidate with an MSc degree in Nutrition and Health, specialized in research on prevention, behavior change, and the promotion of a healthy lifestyle. RO has extensive training and experience in qualitative research. Several interviews were conducted together with MSc students in Nutrition and Health and fourth-year BSc students in Dietetics, who, after a training period, also conducted interviews independently. They were trained and supervised primarily by the first author (RO), and by the last author (AdK) in cases of absence. The interviewers were not involved in the execution of the FINGER-NL trial, which helped to minimize potential influence on participants' responses.

Data analysis

First, a reflexive thematic analysis was conducted following the six steps described by Braun and Clarke (20, 21) to generate initial patterns and develop themes. This helped us gain an initial understanding of important topics in the data and provided directions for what might be meaningful to explore further.

We then conducted an idiographic, longitudinal interpretative analysis, inspired by the principles of Interpretative Phenomenological Analysis (IPA) (22, 23) to explore how participants made sense of their experiences throughout the intervention. For every participant, the interviews conducted at T0, T1 and T2 were analyzed together to trace changes in behavior, motivation, opinions, and lived experiences over time. To support this process, we used Saldaña's Longitudinal Qualitative Data Summary Matrix to organize and track developments within each narrative (24).

Finally, the insights from both the reflexive thematic analysis and the longitudinal, IPA-inspired case analysis informed the ideal-type analysis (ITA), which formed the core of our analysis. Following the seven iterative steps described by Stapley and O'Keeffe(18) we first familiarized ourselves with the interview material and developed a detailed case reconstruction for each participant to summarize their individual trajectory over time (Steps 1–2). These reconstructions were then systematically compared to identify recurring ways in which participants engaged with the intervention (Step 3). In ITA, ideal types are analytically constructed models representing shared patterns in how participants made sense of the intervention. They are conceptual thinking tools assembled by the researcher to represent a shared trajectory, rather than a direct reflection of any single individual. To illustrate these ideal types, optimal (or exemplary) cases, which are real participants

whose trajectories most closely reflected the defining features of each ideal type, were selected as concrete examples and presented in the results (Step 4). All analyses were conducted in Dutch to stay close to the original language, and translations were only made during the write-up phase (Step 5). In this step, we developed for each ideal type a narrative description based on the key features shared by the cases in that type, using participants' own language where possible. Step 6 is described in more detail below. In Step 7 we compared stronger and weaker fits within each ideal type to illustrate both similarity and variation within the types.

Reflexivity in the analysis

The thematic framework, the case summaries, and the ideal types were reviewed together by members of the research team to check interpretations, discuss differences, and reflect on our analytical choices. Consistent with our constructivist, interpretive approach, we emphasized reflexivity rather than independent agreement (Step 6).

The first author (RO) conducted most of the interviews and was primarily responsible for constructing the case reconstructions. Being closely involved in the intervention helped us to understand participants' experiences in more depth, but it also meant we needed to reflect regularly to avoid missing important perspectives. After the case reconstructions and preliminary type descriptions were written, they were shared with the second author (SvH), who had not taken part in the earlier analysis stages. Her role was not to check whether the first author had 'classified correctly', but to bring a fresh perspective from her perspective as researcher and lifestyle coach in FINGER-NL and to challenge initial assumptions. She independently explored how the participants' trajectories aligned with the emerging types, after which both authors discussed their interpretations. These discussions helped to look more closely at the patterns in the data, clarify the boundaries between the types, and strengthen the descriptions of each ideal type. Through these discussions, we reconsidered our interpretations and became clearer about where the types overlapped or diverged. Revisions to the typology that resulted from these discussions are described in the Findings. We paid particular attention to participants where our classifications differed, discussing which elements of their narratives supported each interpretation, and clarifying which characteristics aligned them more strongly with one type than another. In line with the interpretive nature of the methodology, the aim was not to reach identical classifications, but to improve how clearly and confidently the types were defined.

Findings

Participants

In total, 40, 41, and 38 interviews were included at T0, T1, and T2, respectively. Figure 2 shows the number of interviews at each time point for both the HI- and LI-groups, including participant dropout across the study. For the present analysis, which focused on individual

trajectories over time, we included only those participants who completed interviews at all three time points (n = 36: 20 in the HI-group, 16 in the LI-group). Interviews ranged from 30 to 75 minutes, with LI-group participants typically having shorter interviews than HI-group participants.

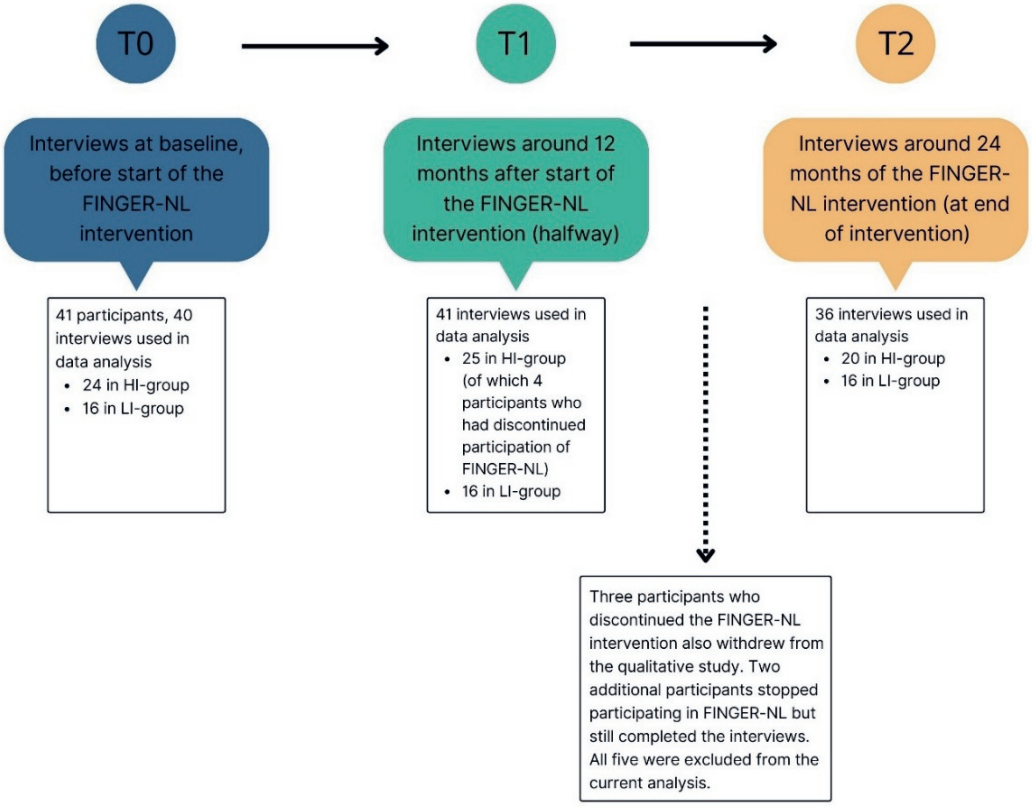


Figure 2. Overview of interview collection across timepoints and the number of interviews included in the data analysis.

Trajectories

The HI-group includes three distinct trajectories: 1) Early peak, 2) Slow adoption 3) Consistent adherence, while the LI-group includes two: 1) Passive participation and 2) Self-directed. One trajectory, interrupted by major life events, was observed in both groups (see Table 1 for an overview).

Table 1. Participant trajectories for the HI and LI groups as defined by ITA, including sex, age (in years) at the start of the 2-year intervention.

High-intensity group			Low-intensity group		
Early peak trajectory	Slow adoption trajectory	Consistent adherence trajectory	Interrupted by major life events trajectory	Passive participation trajectory	Self-directed trajectory
P03, male, 62	P21, male, 66	P04, female, 61	P22, male, 63	P01, male, 68	P06, female, 61
P08, female, 67	P27, female, 63	P05, male, 78	P23, female, 64	P09, male, 63	P07, female, 69
P12, female, 67	P31, female, 65	P13, male, 72	P28, female, 61	P10, female, 64	P11, female, 66
P20, female, 72	P34, female, 70	P25, male, 63	P14, female, 61	P18, female, 61	P15, female, 61
P39, male, 72	P35, male, 65	P26, female 73	P17, female, 63	P29, female, 68	P32, female, 65
	P40, female, 64	P41, female, 78	P36, female, 67	P30, female, 63	P37, female, 78
					P38, male, 73

Typology refinements after typology comparison

After comparing the trajectory assignments by two independent researchers, several refinements were made to the typology. The first trajectory labelled gradual integration was renamed slow adoption, because what really characterized this group was the slow, step-by-step nature of change over a longer period. The term gradual proved too ambiguous, as it could imply either linear improvement or fluctuating progress. The new label reflects more precisely what we saw in the interviews. The description of the interrupted by major life events trajectory was also refined to better capture that it is the life event specifically that disrupts participation. How the trajectory continued afterwards differed per person, and this nuance has now been incorporated. In the LI-group, the earlier label pro-active and self-directed was shortened to self-directed, since taking initiative independently of the study was the key characteristic. Finally, we clarified the description of the passive participation trajectory to avoid suggesting that these participants were passive in general. Many still lived active daily lives, but they did not meaningfully adjust their behavior in response to FINGER-NL.

High-intensity group trajectories

Early peak trajectory

Participants in this trajectory entered the FINGER-NL program with high motivation to prevent cognitive decline and to change their behavior, as clearly expressed in the baseline (T0) interviews. Many had a strong wish to prevent dementia in their own lives, sometimes accompanied by feelings of worry or fear. In the interviews at T1, they frequently reflected on their progress, and the lifestyle changes they had already made. Many of them tried to implement changes across several health areas simultaneously. They indicated that they

were strict with themselves and emphasized the importance of perseverance to sustain these behaviors during the interviews. However, within this trajectory it is distinctive that after the initial motivated start, the motivation of participants tended to decline over time. For some participants this happened within the first year, for others somewhat later. Challenges such as physical limitations and the difficulty of maintaining multiple behaviors at once led to partial drop-off or more selective adherence and commitment. Importantly, this decline was not linear; many participants described later, smaller peaks in motivation when re-engaging with their healthy habits or adopting new changes.

To illustrate how these trajectories unfold in practice, we present an optimal case for each trajectory. This case highlights the defining characteristics of the trajectory, in this instance, the early peak trajectory, without implying that the optimal case represents all participants within the trajectory or reflects an average pattern of engagement.

Optimal case – *Early peak* (P39)

Henry, a male participant aged 72 at the start of the FINGER-NL intervention. At baseline, Henry shared that he felt motivated to start the intervention: *"My mother had dementia and then I thought: yes, lifestyle. I mean, I've been yo-yoing for years and I think, maybe this will be a good stick behind the door.* [(i.e., an external push to finally commit to lifestyle change]*"* He explained that he often begins with good intentions, such as losing weight, but that his motivation usually declines when weight loss stabilizes, and he then falls back into old routines. He hoped that participating in FINGER-NL would give him practical tools for more lasting change and believed that taking part in research alongside others would help him stay motivated, noting that his expectations were *"very high."* His wife is enthusiastic and supportive about his participation in FINGER-NL.

At T1, Henry looked back on the year and reported that he still felt largely the same as at baseline, but with less motivation. He described starting out very strict when the intervention started, *"fanatically even"*, in following the guidelines, and he lost weight (from about 103 kg at baseline to 95 kg at one point). He banned cookies and snacks, *"very much exactly as prescribed, in physical activity, and especially with regard to food."* But after a few months, his motivation declined quite a lot and *"the pleasures of life"*, such as snacking and alcohol, *"crept back in: not excessively, but simply for enjoyment and sociability."* When asked why this happened, he said it began with a few social events, and then it just slipped. Initially Henry felt connected to the group, but that changed and motivation no longer came from the group process: *"I kind of slipped away from the group mentality. Like: guys, you all stay at this level and I'm already sort of down here [points downward]."* He still experienced motivation from the intervention structure itself. Group sessions *"confronted* [him] *with the facts again,"* and he experienced the personal coaching sessions as constructively confrontational as his coach encouraged him to keep up his efforts while he became increasingly honest about his reduced

motivation. He summarized: *"Things just continue the way they were going, with a short period of being really fanatical. That's basically how you could describe it."*

At T2, Henry referred back to his initially highly motivated phase but he reported being back at a more "normal" level. He emphasized that it was not fully back to the pre-FINGER level; small changes in diet and physical activity had remained; *Well let's put it like this (...), we have reached a kind of status quo. Yes. You can call it balance. Yes, that's how we will continue."* He also felt that his health was good, in part because he was sleeping well and continued to monitor his diet for cholesterol. He decided not to participate in the extension program of the FINGER-NL, noting that it seemed less intensive than the original intervention and unlikely to offer additional benefit for him.

Slow adoption trajectory

Participants who are characterized by the slow adoption trajectory usually started out more neutral than participants in the previous 'early peak' trajectory. In the interviews at baseline, they mainly expressed a reserved attitude with caution when it came to the possible positive effects of lifestyle on dementia risk. They generally did not have high expectations but were willing to adapt their lifestyle and follow the recommendations given in the intervention. At the interviews at T1, participants within this trajectory showed a gradual increase in behavior change (and often in motivation as well), but not in a straight upward line. Their trajectory of change is characterized by fluctuations over time: periods of progress followed by dips, pauses, or temporary steps back. At T2, participants again showed more improvements, or had created more new routines, but still described this as a non-linear process rather than a constant steady rise. Participants in this trajectory often indicated that they needed their lifestyle coach or the group interaction and feedback to keep their participation up. At the end of the intervention, participants consistently indicated that, looking to the future, there were still some health areas they would like to continue working on.

Optimal case – *Slow adoption (P34)*

Johanna (72) joined mainly because she needed extra motivation to keep her lifestyle healthy, after a period when mental health issues played a major role: *"My lifestyle is no longer what it used to be (...). So that's why I started this, as a stick behind the door. I think: well, if you're going to join, then you have to really do it."* She emphasized that she is not sporty and dislikes the gym, but hoped the study would give her practical tools to improve her lifestyle. She felt she already paid pretty good attention to her diet: low fat and salt, enough fiber, but still snacks out of habit or for comfort, especially when she's alone. Since her husband passed away, cooking has been more difficult, as he used to do most of it.

At T1, she said that the first year of the intervention was intense, especially the number of trips to the study site and online assignments, which she felt had not been communicated clearly beforehand. The dietary plan remained her biggest challenge, due to costs, portion sizes and complicated recipes. *"Yes, the diet is kind of what I struggle with. But I always discuss that with the lifestyle coach, and they try to guide me through it. That helps."* She focused on manageable changes, such as eating more chicken and turkey. Personal events affected motivation and concentration, especially for the BrainHQ exercises. Still, despite these ups and downs, she stayed committed and was curious to see what the second year would bring.

At T2, Johanna felt, despite all the ups and downs, *"a whole lot better than at the beginning of the program."* She encountered unexpected barriers; *"dietary advice is designed for people with a fairly good income. You also have to think about people who don't have that, because that's where the biggest gains can be made."* She found lifestyle coach indispensable: *"Otherwise I definitely wouldn't have managed it on my own."* Looking back, she says: *"Yes, I always say what really worked for me, what really motivated me, were the in-person meetings. I got the most out of those, learned the most."* In-person meetings motivated her most, and when the sessions increasingly moved online in the final months, she felt relieved when it was finished: "I'm glad it's over." *She aimed to maintain her changes and keep building on them, but she admitted that "the last half year was really... I found it very boring."* She felt the program was presented *"too rosy",* with limited information about what it would involve. Looking back, she described the gains mainly as mental: *"I feel mentally fitter... Physically, I don't think much has changed."*

Consistent adherence trajectory

Participants in the consistent adherence trajectory began the intervention with relatively stable routines and some degree of healthy behavior. What characterizes this group is not a high initial level of motivation, but rather the stability of their engagement; they made changes early-on and then maintained those at a rather steady level. In the interviews, participants often mentioned that it was discipline and the idea of finishing something they had started that kept them motivated to continue their participation at the same level. Although their patterns appeared stable, this does not mean that their change process was entirely linear; these participants merely tended to internalize new habits more quickly, which meant the day-to-day effort received less attention in their interviews compared with the slow adopters. The interview narratives showed little fluctuation across T1 and T2. Participants repeatedly described their changes as 'habits' or 'routine', and emphasized that maintaining these behaviors fit comfortably within their everyday lives. At T2, these participants often indicated that they intended to maintain the changes they had implemented. Many described having reached a personal equilibrium: the time and effort they invested in their health felt 'enough'. Further change was seen as possible but

undesirable, as it would detract from other valued aspects of life, such as time with family or simple daily pleasures like a glass of wine.

Optimal case – *Consistent adherence (P04)*

Evelien (62) had participated in research before, which had already improved het eating habits. Caring for her mother with dementia and concerns about ageing motivated her to take action. She works three days a week and, as someone slightly overweight, wanted to exercise more:*"if you can prevent it in a simple way by living differently now, then I'm definitely going to do that."* She preferred alternatives to the gym, which she dislikes; exercising with a physical therapist felt better but was costly. Evelien believed FINGER-NL would work and hoped it would motivate her: *"If I think it's not going to work, then I can't motivate myself. I have to assume it's going to do something."*

At T1, participation had become routine*: "Participating in the study has become a routine… It's all very doable, and the guidance is just good."* Eating habits were automatic, especially as her husband joined in: *"it is just become the way we do things… you really adjust your life… to stick to those kinds of guidelines."* When asked when it became a habit, she said: *"Well, after about three months"*. Her intervention group was nearly complete, with a pleasant group atmosphere. The combination of group feeling, personal approach, and accessible lifestyle coach helped her keep going despite work and caregiving challenges. She looked forward to exploring new topics: *"Yes, I'm curious what else they have to offer, because you've already had so many subtopics, and some things will be expanded. But like, for example, cardiovascular health, so yeah, what more can you do with that?"*

In the T2 interview, Evelien said that participation has become *"a way of life (…), and I think that's worked out pretty well for me. Because yes, there's the MIND diet, and in the beginning you really have to think about it, but now it's pretty much automatic and my husband just joins in happily. So that makes it easy, I mean, you just eat different things, in a different way too. But yeah, that started two years ago and we don't really know any different anymore."* Her mother passed away, and she is now unemployed, but she stayed in touch with fellow participants, sometimes joining group activities outside the program. Only minor adjustments were needed between T1 and T2. Looking ahead to after FINGER-NL ends, she expected that many of the changes would simply continue, as they had already become part of her routine*; "I don't feel bad about it ending. The only pity is I didn't lose any weight from it. That would've been nice."*

Overlapping trajectory

Interrupted by major life events trajectory

This trajectory occurred in both the high-intensity and low-intensity groups, as external

events can disrupt engagement irrespectively of intervention intensity. Participants initially followed one of the other trajectories, but experienced a major life event during the intervention, like illness, surgery, caregiving duties, or work-related changes, that disrupted their engagement, regardless of prior progress. These events resulted in temporary or longer pauses in their engagement, or in some cases led to (partial) discontinuation, while participants continued with yearly on-site measurements and check-ins. Some of the behaviors that were adopted before were maintained, sometimes temporarily, others were abandoned, modified, or reversed. Overall, the major life event took up so much 'space' that there was little capacity left for participation. What happened after the event differed a lot between people: some participants gradually improved their lifestyle again or took up the activities within FINGER-NL, others did not. This trajectory category represents a broad spectrum of participants who experienced diverse major life events, but is distinct from the other trajectories in that the decline in motivation for the FINGER-NL intervention was clearly linked to such an event.

Optimal case – *Interrupted by major life events (P28)*

Irene (62), allocated to the HI-group, has a public-facing profession with high demands and emotionally charged situations. Personal experiences shaped her motivation: her mother's dementia and her own concerns about memory problems after a period of illness. She hoped that participation will help her sleep better, eat more healthily, be more physically active, and improve her cognitive functioning so that her work becomes easier. She emphasized that she believed lifestyle to be crucial for cognitive health and hoped that participating in a structured study would motivate her to *"do it properly."* She saw the two-year program as sufficient to build lasting changes but was concerned about fitting it around her demanding work schedule, hoping it would be flexible and practical.

At T1, Irene reported a slight improvement in energy, although she was unsure whether this was due to FINGER-NL. Combining the program with working three days a week was challenging, especially group sessions that sometimes required taking time off. She found the social aspects motivating and valued meeting others with similar goals, particularly when older participants inspired her through their physical activity. Sleep remained her biggest barrier; poor sleep reduced her energy and made healthy choices more difficult, especially on busy workdays.

Between T1 and T2, Irene received a completely unexpected diagnosis of colon cancer and underwent major surgery. She described this as *"an event that has had a huge impact and also on my participation."* All assignments were left untouched and now "there is so much *that I feel a bit reluctant to start again."* Although she gradually resumed movement through yoga, aqua-Pilates and walking, fatigue remained a major barrier. She was back to working her usual hours, often without a proper lunch break and too tired in the evenings to cook, which made it difficult to maintain healthy routines.

Reflecting on her recovery, she said: *"after such an operation you really feel like a wreck, you really have the feeling: well, a tram has run over me."* She felt that the program had completely faded into the background, yet she still recognized its importance. She had not kept up with the cognitive training but hoped to start again once she felt better.

Low-intensity group trajectories

Across participants of the LI-intensity group, patterns of lifestyle engagement with the FINGER-NL intervention can be clustered into three trajectories; 1) Passive participation trajectory and 2) Self-directed trajectory and the third trajectory, interrupted by major life events, which appeared in both intensity groups (see section above).

Passive participation trajectory

Participants in the passive participation trajectory were characterized by minimal engagement with the intervention. Take Importantly, this did not mean that they were passive in general; they could have a very healthy and socially active lifestyle. Most of them suspected early on that they had been assigned to the LI-group and remained largely passive, even though they often expressed at baseline that they wanted to make lifestyle changes. Their participation was mostly driven by a sense of duty; some no longer even opened the informational materials, while others read them out of obligation but felt they contained nothing new. Several participants explicitly mentioned that the study mainly confirmed that they were already living quite healthily, and some continued to rely on lifestyle advice they had received elsewhere prior to joining FINGER-NL. Many acknowledged that being part of this 'passive' group was simply part of the study design.

Optimal case – *Passive participation (P09)*

Karel (64) enrolled in FINGER-NL due to family history of dementia, though his interest was more in general and heart health than brain health. He had tried diets before but found them hard to maintain. He did not expect personal benefits and mainly hoped the study would help others. He had work-related stress and heart problems but felt he managed them well. Although he knew he should be more physically active, he struggled with motivation and missed going to the gym, particularly during COVID restrictions, while looking forward to retirement and more leisure time.

During the intervention Karel mentions that he barely notices the study: *"Honestly, I don't notice anything from it, so I think I'm in the quiet part of it (...) yeah, so my motivation is just very low, and that's because I almost don't have to do anything, I just have to read a little bit*." He felt the advice was familiar and saw no need to change his lifestyle. He thought a different set-up might have helped: *"If I actually had to do something actively, like this week do this, next week do that, that would motivate and stimulate me to do more."* He calls it a *"piece of cake*" and said participation *"doesn't amount to much,*

which is fine with him. He was slightly annoyed by notifications and changing login methods but felt that anything more intensive would have been bothersome: changes to his diet or cooking differently, for example. He felt his lifestyle was fine; he could lose some weight, but it had been stable for four or five years and he was okay with that.

T2 – End of the intervention
At T2, after retiring, he reported that the study had little impact on his lifestyle, thinking, or memory. He liked being in a group that *"didn't have much to do,"* and appreciated not having to make changes. The information provided was familiar to him and he concluded: *"I don't think anything changed in my thinking or memory over these two years."* He did not plan to change his lifestyle in the future either. Since retiring, his sleep and stress had improved. He found the input from FINGER-NL minimal and he ended with: *"No, it didn't bring me much."*

Self-directed trajectory

This trajectory describes participants who, between the T0 and the T1 interview, realized that they had been assigned to the low-intensity (LI) group and would not receive any guidance from the FINGER-NL lifestyle intervention. They were often disappointed, and sometimes even frustrated, with their group allocation. However, after this initial reaction, they actively took responsibility for their own health behaviors, driven more by intrinsic motivation than by the intervention itself. They took up activities, both physical and social, and found inspiration, increased awareness, or motivation from the limited information they received from FINGER-NL. In the T2 interview, participants in this trajectory often talked about the changes, small or larger, that they had made. They frequently explained that the reason they had taken these steps without support from the research team was that simply being involved in the study had raised their awareness. This awareness motivated them to make lifestyle changes 'while they still could', with a recurring motivation being the goal to prevent dementia.

Optimal case – *Self-directed trajectory (P15)*

Marion (62) signed up for the FINGER-NL study because she falls into the target group. Her motivation is clear: *"My mother had vascular dementia. It's not a big fear, nah, but I do sometimes think, do I perhaps have a chance myself?"* She wanted to improve her lifestyle but found this difficult, despite being disciplined in other areas. She had a demanding job with night shifts but also relaxing hobbies such as beekeeping. She was already trying to make healthier choices, lose weight, and stay open to learning, and hoped the study would provide accountability: *"If you say yes to something, then you really have to do it."*

After a year, Marion found the program less active than expected and the information largely familiar. She did make a few changes, such as eating more vegetables and biking more. She became more conscious in her lifestyle choices, adjusting some habits like eating less

processed meat, while deliberately keeping others. As she put it: *"I know alcohol isn't good, but I really like a glass of wine… might I die three years earlier because of it? Could be. But does that outweigh not drinking for the next fifteen years? I think: no, this is the choice I'm making now."* She missed motivation and guidance from the FINGER-NL study: *"And I know there are two groups, and one of them has to do more active stuff. I don't think I'm in that group. I mean, I can't imagine I am, in the more active one."* She expected the final year to remain "*a bit less active than I thought,*" but felt that gaining a different perspective on lifestyle was still a meaningful result.

At the end of the intervention, Marion felt the past year had gone well and was "quite proud" of herself for exercising for more than half a year and learning to play a musical instrument, joking that this extra cognitively active behavior might even "mess up" the study. She wondered whether the messages from FINGER-NL had subconsciously encouraged her, but also felt it might simply be her own awareness of ageing; *"Whether it's because of the things I had to read, or whether it's some kind of process inside myself, that I thought: well, you're getting older now, and if you don't start taking care of your body, you can't complain later when it doesn't work properly anymore, you know?"* Although she had hoped to be in the active group and the information from FINGER-NL was not new, she felt participation had helped her: *"So yes, at least it's made me more aware that you can do a lot yourself, you don't have to think: oh well, they'll fix it for me. I'm responsible for this body (…) and at least now I know that change is possible. (…) I've proven that to myself now; you really can change your behavior."*

Discussion

Participant trajectories in FINGER-NL

Applying ITA to longitudinal data from 103 interviews with 36 participants in the two FINGER-NL intervention groups resulted in six distinct participant trajectories: early peak, slow adaptation, consistent adherence, interrupted by major life events, passive participation, and self-directed. The first three trajectories characterized participants in the HI-group, the interrupted by major life events trajectory was observed in both groups, and the last two trajectories were typical of participants in the LI-group. These trajectories capture the differences in how participants integrate lifestyle advice, change their routines, and whether they maintained their motivation during the study period. Rather than representing fixed categories, these trajectories show the dynamics of engagement throughout the study period, which aligns with earlier work emphasizing that behavior change in long-term lifestyle interventions is a fluctuating process rather than a linear pathway (25). We used ITA to identify patterns of change over time rather than isolated themes. This approach allowed us to integrate within-participant developments with between-participant comparisons, making recurring trajectories across the intervention visible.

Across the trajectories in the HI-group, different theoretical mechanisms of behavior change can be observed. Using these models as interpretative lenses helped us understand the patterns, rather than predict individual behavior. For example, participants in the early peak trajectory started with strong intentions and high motivation, but when the effort increased, this became harder to sustain. Sustaining change appeared to require more internalized motivation, as described in Self-Determination Theory (26, 27). In addition, taking up a lot of changes all at once may take too much from one's capability, which, together with opportunity and motivation, is one of the three necessary components for behavior to occur in the COM-B model (28, 29). In the slow adoption trajectory, change built up gradually. Behavior change models such as the Transtheoretical Model describe change as something that happens in stages. Participants here seemed to start with a cautious, low-expectation attitude and slowly moved into action (30). In the consistent adherence trajectory, behavior stabilized early because it quickly became part of everyday life. This fits with habit-formation theory: once a behavior becomes routine, it relies less on motivation and is easier to maintain (31). Moreover, sustained engagement in the HI-group may partly be explained by the presence of a human lifestyle coach, as structured guidance, motivation, and personal feedback are known to improve adherence and long-term behavior change (32). Several participants described forming a personal connection with the coach, which gave them accountability and encouragement.

Across HI-group trajectories, participants attempted to change multiple health behaviors, particularly diet and physical activity, though sustaining motivation across domains proved challenging. Encouragingly, evidence suggests that even a limited number of lifestyle improvements can have substantial cognitive benefits. If limited behavior change is incorporated, the optimal combination of three behaviors for cognitive health was a healthy diet, limited alcohol consumption, and non-smoking (33). The main difference between the trajectories within the LI-group was whether participants actively initiated changes themselves (self-directed trajectory) or remained passive in their response to FINGER-NL (passive participation trajectory). Earlier work already showed that some LI-participants took initiative independently while others did not. This observation is supported by findings from other studies (34) and by the results from the U.S. POINTER study (2), which showed that even the self-guided intervention group demonstrated cognitive improvement over two years, confirming that, even without structured interventions, participants may engage in self-motivated lifestyle changes. It should be noted, however, that the POINTER 'self-guided' group attended six peer group meetings, which may have contributed to motivation, making it not fully comparable to our LI group. The relatively higher number of LI-group participants in the trajectory interrupted by major life events may be linked to the limited program input: when there is less support or guidance to hold on to, everyday life events can more easily take over and push the intervention to the background. Participants in other trajectories also faced impactful situations, but these did not always lead to disrupted participation. Stressful circumstances are known to interfere with lifestyle change and make it harder to maintain new routines (35).

Overall, it is important to realize that there is no single 'perfect' trajectory. People engage with a lifestyle intervention in different ways, depending on their own situation, priorities, and what they find difficult or important at that moment. The goal of this study was not to find out which trajectory is best, but to show that participants follow different paths of change.

Strengths and limitations

The longitudinal approach, with each participant being interviewed three times during their two-year participation in the intervention, enabled us to gain insight into participants' expectations and starting point at the beginning of the intervention, but also to keep track of their (changes in) behavior, motivation, and participation throughout the intervention. This design made it possible to apply a trajectory analysis approach, the ITA, which is a less commonly used method despite the importance of capturing individuals' longitudinal experiences in lifestyle interventions (36). ITA bridges the gap between within-case and cross-case approaches commonly used in qualitative methods, by paying attention to individual cases combined with a cross-case approach to explore similarities and differences between cases (18). The analysis helps to reduce a large variety of individual trajectories, discussed across an even larger number of interviews, into a smaller set of interpretable trajectories, making heterogeneous data more communicable.

Applying ITA also brings some limitations. In categorizing the large amount of interview data into cases and then abstract these cases into trajectories, individual variation and contextual nuances may have gotten lost. Although it is the main goal of this analysis to identify patterns or characteristics of trajectories within this variety of individual experiences, it is good to be aware of this consequence (18). In addition, once the ideal types are formed, the potential of an individual to move between the types or to be 'in' different types simultaneously may be underexplored. Moreover, the construction of the 'ideal types' depends on the researcher's theoretical lens, coding, and interpretative choices, which can raise issues of reliability and replicability. However, involving another researcher with experience as lifestyle coach as a second coder in the analysis helps to reduce potential researcher bias, and adaptations made after the coder discussions strengthen the analysis and trajectory descriptions.

Implications

Overall, our findings highlight that participants follow different lifestyle trajectories, consistent with Roca-Ventura, Solana-Sánchez (37), who showed that people follow different lifestyle trajectories over time and advocated tailoring interventions to different lifestyle profiles. This also appears relevant for FINGER-NL, where participants in different trajectories may benefit from different types of support. These insights may help lifestyle coaches and researchers recognize shifts in engagement and tailor support accordingly, particularly in the HI-group. For example, participants in the early peak trajectory may need anticipatory guidance and timely support to navigate the dip that often follows the initial

steep increase, whereas participants in slower, gradual trajectories may benefit more from continuous encouragement and reinforcement to maintain engagement. Trajectories characterized by fluctuating motivation may require flexible, adaptive support, including reminders, motivational check-ins, or strategies to cope with life events that temporarily take priority. Building on this, our findings point to a clear need for more systematic and proactive monitoring within lifestyle interventions. Although FINGER-NL closely tracked behavioral change through measures such as the MIND score, effective implementation requires tools that capture not only what participants do, but also how engaged and motivated they are over time. Without insight into motivation, adherence, and the impact of major life events, opportunities for timely support may be missed. Incorporating standardized monitoring or regular check-ins would enable lifestyle coaches to detect early signs of declining engagement or competing priorities and to adapt support accordingly, thereby increasing the likelihood of sustained behavior change. An example of such an approach can be found in the LETHE project, where a color-based feedback system was used to monitor participants' adherence trajectories. This system allowed researchers to quickly assess whether participants were adhering as expected (e.g. 'green' pathway) or showing signs of declining engagement, and to act on this information by offering tailored or automated motivational messages when needed (38). Overall, these insights have to be further developed, tested, and quantified in larger datasets using complementary quantitative approaches.

Conclusions

Across the trajectories in the two intervention groups, it became clear that participants did not only differ in what they changed, but especially in how they responded to the support they received. In the HI-group, structured guidance, regular contact moments, and a clear program helped participants maintain motivation across multiple lifestyle domains. In contrast, LI participants often indicated that they already knew the information that was provided, and because they received little support or follow-up, they did not always feel a sense of urgency to actually change their behavior. These findings suggest that providing information alone is not enough; participants benefit from action-oriented guidance and accountability. At the same time, it is important to keep in mind that ITA has its limitations; trajectories simplify reality and should not be treated as fixed categories or as 'the truth', but rather as a helpful tool to make sense of a wide range of individual experiences, and as a starting point for further refinement in future research and additional analyses. The trajectories help to visualize where and how motivation can shift over time, and they highlight the need to anticipate these changes. Embedding behavior change theory more explicitly in lifestyle interventions could support this, by helping to recognize early signals of declining motivation and to put strategies in place that maintain engagement. In this way, the insights from these trajectories can inform the design of more responsive and adaptive interventions in the future.

Statements and declarations

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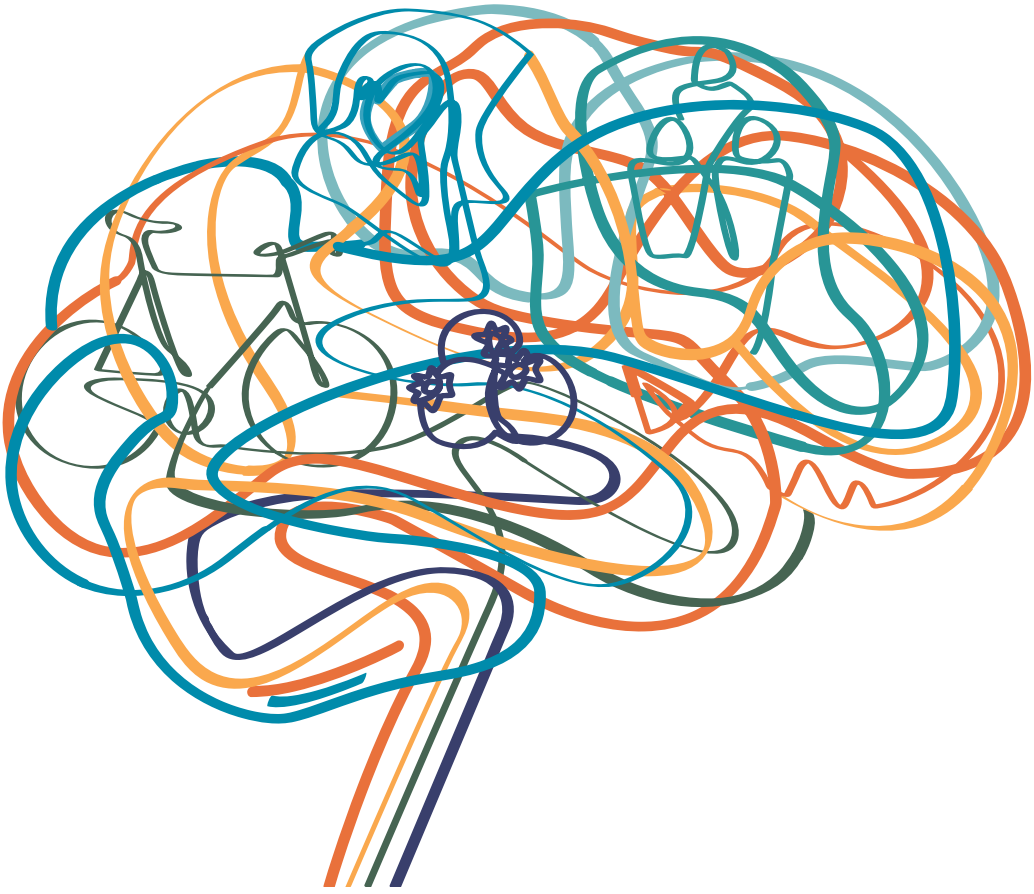
Ethical statement
Ethical approval for this qualitative study was granted by the Ethical Research Committee (ECO) of the HAN University of Applied Sciences, Nijmegen, the Netherlands (ECO 310.12/21). The study was deemed exempt from the Medical Research Involving Human Subjects Act (WMO) and was reviewed to ensure compliance with scientific and ethical standards. The FINGER-NL trial was reviewed and approved by the Medical Ethical Committee VU Medical Center (NL77242.029.21; Amsterdam, The Netherlands) and is registered at ClinicalTrials.gov (ID: NCT05256199) and the Netherlands Trial Register (NL9634).

Consent to participate
Participants in this qualitative study provided written informed consent prior to their first interview at T0 (after the baseline visit and randomization, but before the actual start of the intervention). Additionally, before the T1 interviews (conducted at month 12 after start of the intervention) and the T2 interviews, conducted at the end of the intervention, participants were reminded of their right to withdraw from the study at any time without needing to provide a reason.

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CHAPTER 5

Associations between the Motivation to Change Lifestyle and Health Behaviors for Dementia Risk Reduction (MCLHB-DRR) and dementia risk factors in older adults

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Abstract

Introduction Although a healthy lifestyle is associated with lower levels of dementia-related risk factors, modifying lifestyle-related behaviors remains complex. Using the Motivation to Change Lifestyle and Health Behaviors for Dementia Risk Reduction (MCLHB-DRR) scale, this study examined whether motivational factors related to dementia risk reduction are associated with self-reported modifiable dementia risk factors, and whether these associations differ according to subjective memory complaints or a family history of dementia.

Methods Cross-sectional baseline data from the Dutch multicenter randomized controlled FINGER-NL trial were used, including 1,210 adults aged 60–79 years. The MCLHB-DRR comprises seven psychological subscales based on the Health Belief Model, assessing key attitudinal and motivational constructs related to dementia risk reduction. The following self-reported modifiable dementia risk factors were assessed and dichotomized as favorable or unfavorable: smoking, diet, alcohol consumption, sleep, social engagement, cognitive activity, and physical activity. Associations between motivational factors and dementia risk factors were examined using univariable and multivariable logistic regression analyses, adjusting for relevant sociodemographic and health-related covariates. Interaction effects with subjective memory complaints and family history of dementia were tested, followed by subgroup analyses when interaction terms met a predefined criterion ($p < 0.10$).

Results Higher perceived severity was associated with more favorable sleep (OR = 1.11). Higher perceived barriers to changing lifestyle behaviors for dementia risk reduction were associated with a healthier diet (OR = 1.17), higher cognitive activity (OR = 1.13), and higher social engagement (OR = 1.28), but with lower odds of favorable alcohol use (OR = 0.78); this association differed according to family history of dementia. Cues to action were associated only with cognitive activity (OR = 1.14). Higher general health motivation was associated with lower odds of favorable smoking behavior (OR = 0.49), with differences by family history of dementia. No associations were observed for perceived susceptibility or perceived benefits.

Conclusions In this study, only a limited number of motivational factors were associated with lifestyle-related dementia risk factors, and these associations varied across specific risk domains. Higher motivation did not consistently coincide with more favorable dementia risk profiles, and differences related to subjective memory complaints or family history of dementia were limited and inconsistent. Dementia risk factors seemed more strongly associated with sociodemographic characteristics, such as education, income, sex, and study site, than with motivational factors alone. These findings suggest that addressing dementia-related lifestyle risk factors in older adults may require approaches that extend beyond increasing motivation, and that more explicitly account for individuals' daily routines, habits, and broader social context.

Introduction

There is growing recognition that a healthy lifestyle plays a key role in maintaining cognitive health and reducing the risk of dementia (1, 2). A healthy lifestyle that includes regular physical activity, a balanced diet, social engagement, mental stimulation, avoidance of smoking, and management of cardiometabolic conditions is associated with a lower risk of dementia and cognitive decline at the population level (3). Importantly, much of this evidence concerns associations between these lifestyle-related risk factors and cognitive health, with limited insight into how these factors evolve over time at the individual level. It is well established that health behaviors and lifestyle patterns associated with dementia risk are shaped by a complex interplay of environmental and individual factors, including individual attitudes, perceptions and motivation. Different health behavior theories and models have been used to explain the complex interplay between these factors (4, 5). This complexity is further illustrated in dementia research, which shows that so-called modifiable risk factors vary substantially in their actual modifiability across individuals and contexts (6).

The Motivation to Change Lifestyle and Health Behaviors for Dementia Risk Reduction (MCLHB-DRR) scale was designed to assess individuals' motivation to adopt lifestyle changes in the context of dementia prevention (7). Previous research with the MCLHB-DRR in different populations indicates that motivation levels may vary according to different socio-demographic and individual factors; younger individuals and those with higher education levels tend to express greater motivation towards lifestyle change (8, 9). Moreover, having a family history of dementia makes individuals more aware of their risks and motivates them to change their lifestyle to reduce their dementia risk (10). The Dutch DEMIN study, a randomized controlled trial investigating the uptake and effectiveness of a tailor-made online lifestyle program targeting modifiable risk factors for dementia among middle-aged descendants of people with recently diagnosed dementia and a qualitative study, indicated that having a parent or close relative with dementia can function as a significant life event that influences peoples' risk perception and perceived personal vulnerability, thereby increasing their motivation to engage in dementia risk-reducing behaviors (11, 12). Similarly, subjective memory complaints have been linked to greater concern about one's cognitive health, which may translate into higher motivation. Recent research among community-dwelling older adults found a moderate positive correlation between perceived cognitive decline and motivation to engage in dementia risk-reduction behaviors (13). Importantly, while many studies focus on behavior change, the relationship between motivation and the presence of modifiable dementia risk factors is less well understood. Motivation may influence engagement in risk-reducing behaviors, but existing risk profiles may also shape individuals' motivation and risk perception.

Therefore, this study aims to explore the associations between attitudes, perceptions, and motivation towards dementia risk reduction (measured by the MCLHB-DRR) and

modifiable dementia risk factors among older adults with one or more lifestyle risk factors for dementia, participating in the FINGER-NL trial. In this study, the term dementia risk factors refers to modifiable, lifestyle-related risk factors for dementia. Throughout this study, the term dementia risk factors refers to modifiable, lifestyle-related factors that are relevant for dementia risk reduction and assessed through self-reported behavior at baseline. Given the cross-sectional design and the selected nature of the study population, this study is explicitly exploratory in nature. In this context, higher motivation may reflect awareness of unfavorable lifestyle risk factors rather than a healthier dementia risk profile. Rather than assuming a single or predefined direction of association, we examine how motivational factors are related to current modifiable dementia risk factors. Additionally, we explore whether these associations differ for individuals with or without subjective memory complaints or a family history of dementia.

Methods

Sample and setting

For this study, baseline data from FINGER-NL participants were used, collected between February 2022 and May 2023. This multi-center randomized controlled trial, conducted at five research centers in the Netherlands (Maastricht, Amsterdam, Nijmegen, Groningen, Wageningen), evaluates the effectiveness of a two-year multidomain lifestyle intervention on cognitive performance among older adults with one or more lifestyle-related risk factors for dementia. The FINGER-NL trial is registered under ClinicalTrials.gov (ID: NCT05256199) and was approved by the Medical Ethical Committee of VU Medical Center (NL77242.029.21).

The trial includes 1,210 older adults aged 60 - 79 years (14). Individuals were eligible to participate if they met at least one non-modifiable dementia risk factor (subjective memory complaints or a first-degree family history of dementia) and at least two modifiable risk factors. Modifiable risk factors consisted of an unhealthy diet, physical inactivity, mental/cognitive inactivity, a high body mass index (BMI), high blood pressure, and elevated cholesterol levels. Participants were randomized 1:1 into a high-intensity and low-intensity treatment group, stratified by center, and received either a high-intensity multidomain lifestyle intervention or general lifestyle advice for optimizing brain health. Baseline characteristics of the study sample have been described in detail elsewhere (14).

Measures

Independent variable

The Motivation to Change Lifestyle and Health Behaviors for Dementia Risk Reduction (MCLHB-DRR)

The Dutch version of the Motivation to Change Lifestyle and Health Behaviors for Dementia

Risk Reduction (MCLHB-DRR) scale, demonstrating good psychometric properties, including reliability, internal consistency, and construct validity (15), was used to assess participants' attitudes and beliefs toward addressing dementia-related lifestyle risk factors. The scale consists of 23 items, across seven subscales. Perceived susceptibility (3 items) refers to an individual's perceived likelihood of developing dementia. Perceived severity (5 items) reflects beliefs about the seriousness of dementia and its potential consequences for one's life. Perceived benefits (2 items) capture beliefs about the effectiveness of lifestyle changes for reducing dementia risk. Perceived barriers (4 items) represent perceived obstacles or difficulties related to engaging in lifestyle behaviors aimed at dementia risk reduction. Cues to action (4 items) reflect the extent to which individuals experience internal or external prompts that encourage lifestyle change (e.g., information, symptoms, or advice from others). Self-efficacy (2 items) refers to an individual's confidence in their ability to initiate and maintain lifestyle changes to reduce dementia risk. General health motivation (3 items) refers to an individual's overall motivation to maintain or improve health through lifestyle-related behaviors. Items were rated on a 5-point scale, ranging from "strongly disagree" [1] to "strongly agree" [5]. Subscale scores were summed and transformed to a 0–100 scale to allow comparability across subscales. Higher scores reflect stronger motivation and more positive attitudes toward addressing dementia-related lifestyle risk factors.

Dependent variables

Dementia risk factors were dichotomized into low-risk ('favorable') and high-risk ('unfavorable') categories, based on established cut-off values. Dichotomization was applied to align with established clinical cut-offs and to facilitate interpretability across heterogeneous lifestyle domains relevant to dementia risk reduction.

Dementia risk factors

Seven lifestyle factors relevant to dementia risk reduction were included for this study: smoking, diet, alcohol consumption, sleep, social engagement, cognitive activity, and physical activity. All risk factors were assessed at baseline, prior to randomization, and were dichotomized into favorable (low-risk = 1) versus unfavorable (high-risk = 0) categories for use in logistic regression analyses. Although stress management constitutes one of the intervention domains within the FINGER-NL trial, this domain was not included as a lifestyle risk factor in the present analyses because baseline measures did not allow classification into a dichotomous lifestyle risk status comparable to the other domains. For clarity, factor-specific descriptive labels (e.g., sufficient vs. insufficient, high vs. low engagement) are used in tables and figures to reflect conceptual differences between dementia risk factors.

Smokers

Participants were classified as non-smokers (low-risk = 1), including both former and never smokers, and current smokers (high-risk = 0).

Diet

Adherence to a healthy diet was evaluated using the MIND-NL-Eetscore Food Frequency Questionnaire (FFQ) adapted for the Dutch context. This instrument assesses the quality of the diet according to consumption of various food groups associated with cognitive health (16). Participants scoring ≥9.5 were classified as having a healthy diet (low-risk = 1), indicating adherence to the MIND dietary pattern, while those scoring <9.5 were classified as having an unfavorable diet-related risk profile (high-risk = 0).

Alcohol consumption

Alcohol consumption was categorized based on the Dutch Dietary Guidelines, using the DHD2015 (17). Participants were classified as having low-risk alcohol consumption (1) if they consumed ≤10 grams of ethanol per day (corresponding to approximately one standard alcoholic consumption per day), and as having high-risk alcohol consumption (0) if they exceeded this threshold.

Sleep

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), a validated instrument measuring sleep disturbances over a one-month period (18). In line with established cut-offs, a global PSQI score ≤5 was classified as adequate sleep quality (low-risk = 1), whereas a score <5 indicated unfavorable sleep-related risk status (high-risk = 0).

Social engagement

Social engagement was measured using the Lubben Social Network scale including 6 items (LSNS-6) (19). A clinical cut-off score of less than 12 on LSNS-6 is commonly used to identify individuals at risk of social isolation. Participants scoring ≥12 were classified as having high social engagement (low-risk = 1), whereas those scoring <12 were classified as having low social engagement (high-risk = 0).

Cognitive activity

To assess an individual's engagement in behaviors and activities that contribute to cognitive reserve, the Cognitive Reserve Index Questionnaire (CRIq) was used (20). In line with the original interpretation of the CRIq, a total score ≥130, indicating high cognitive reserve, was classified as high cognitive activity (low-risk = 1). Scores <130 were classified as not high cognitive activity (high-risk = 0) for analytical purposes.

Physical activity

Physical activity was assessed using the self-reported Short Questionnaire to Assess Health-enhancing Physical Activity (SQUASH) (21). The World Health Organization (WHO) recommends in their guidelines for physical activity and sedentary behavior that older adults should engage regular physical activity to enhance functional capacity and prevent falls, and that aerobic physical activity volumes of at least 300 minutes of moderate-intensity activity per week (or 150 minutes of vigorous-intensity activity per week) are

associated with additional health benefits (22). Participants meeting the WHO recommendations for physical activity were classified as having sufficient physical activity (low-risk = 1); those not meeting these recommendations were classified as having unfavorable physical activity-related risk status (high-risk = 0).

Covariates

Sociodemographic variables included age (in years), sex (male/female), marital status (married or in a long-term relationship vs. other), employment status (working at least one hour per week yes / no) and study site (Maastricht, Amsterdam, Nijmegen, Wageningen, Groningen. Educational level was assessed using nine categories, ranging from early childhood education to a doctoral or equivalent degree, and was subsequently categorized into three levels following the International Standard Classification of Education (23): low (0–6 years, e.g., primary or lower vocational education), medium (7–12 years, including intermediate secondary or vocational education), and high (more than 12 years, such as higher vocational education or university). Self-reported equivalized household income was calculated using the Organisation for Economic Co-operation and Development (OECD) square root scale (24). Net monthly household income was self-reported in predefined categories, after which the midpoint of the selected income category was divided by the square root of the number of household members dependent on this income. The resulting equivalized household income was subsequently categorized into low, middle, and high income groups based on tertiles. Comorbid conditions, including depression, diabetes, and chronic heart disease, were assessed using self-reported questionnaire items at baseline.

Moderators included self-reported presence of a first-degree family history of dementia (yes/no; reference = no) and self-reported subjective memory complaints (yes/no; reference = no).

Statistical analysis

Participant characteristics, including MCLHB-DRR subscale scores, dementia risk factors, and covariates, were summarized using descriptive statistics. Analyses were conducted on a complete-case basis; participants with missing data on the MCLHB-DRR or any of the variables included in the regression models were excluded from the respective analyses (see Figure 1). We conducted univariable and multivariable logistic regression models to investigate the associations between the MCLHB-DRR subscale scores and the dementia risk factors, adjusting for the following covariates: Model 0 included only MCLHB-DRR subscales and dementia risk factors. Model 1 additionally adjusted for age, sex, and study site. Model 2 further included level of education, household income, marital status, and employment status. Model 3 included all covariates from Model 2 and, additionally adjusted for subjective memory complaints and family history of dementia, which were included given their potential role as effect modifiers rather than primary confounders. The

following self-reported, outcome-specific covariates were added to Model 3: depression for sleep and social engagement outcomes; diet for the diabetes outcome; physical activity for the chronic heart disease outcome; smoking for the alcohol-use outcome; and alcohol use for the smoking outcome. In this analysis, we also tested interaction terms between each MCLHB-DRR subscale and (1) self-reported subjective memory complaints and (2) self-reported family history of dementia. When interaction effects showed a $p < 0.10$, subgroup analyses were conducted. Model 4 represents the final model and includes all covariates from Model 3, with the addition of interaction terms that met the predefined threshold ($p < 0.10$). To elucidate significant interaction effects, all MCLHB-DRR subscale scores were analyzed per 10-point increase. Dementia risk factors were dichotomized such that the unfavorable (high-risk) category served as the reference (0) and the favorable (low-risk) category as the outcome (1); therefore, odds ratios > 1 indicate higher odds of a favorable status for the respective dementia-related lifestyle factor. To assess potential multicollinearity among independent variables, we examined variance inflation factors (VIFs); all VIF values were below the commonly used threshold, indicating no concerns for multicollinearity. A two-sided p-value < 0.05 was considered statistically significant for main effects, while the threshold $p < 0.10$ was used to identify potential interaction effects.

Results

Of the 1,210 participants enrolled in the FINGER-NL baseline sample, 1,192 (98.5%) had complete MCLHB-DRR data and were included in the analyses (Figure 1). The final sample size differed across the multivariable models due to missing data on the dementia risk factors and on the covariates included in the models. Baseline characteristics of the study sample are presented in Table 1.

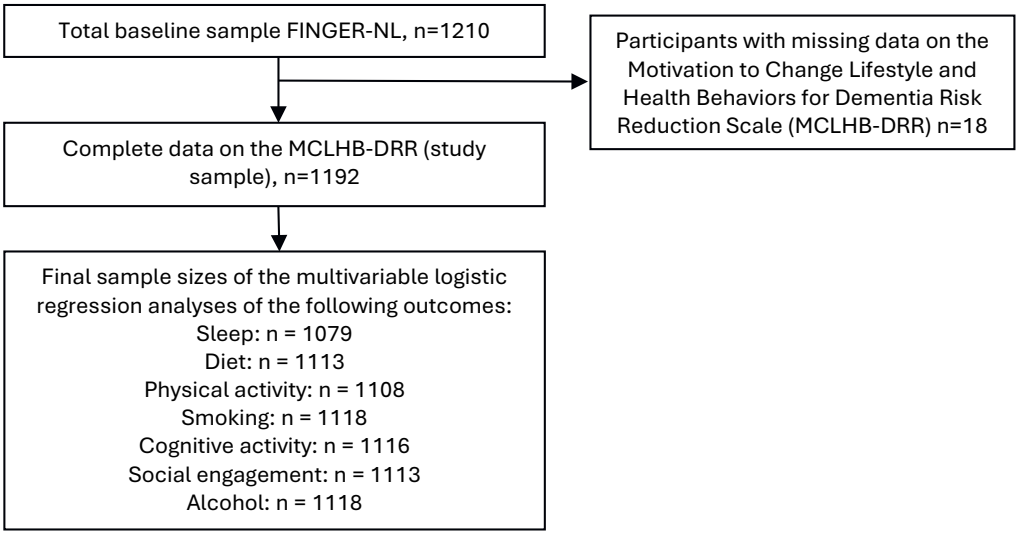


Figure 5. Flowchart of participant inclusion in the multivariable analyses.

Table 2. Baseline characteristics of the total study sample

	Study sample (n =1192) [a]
Age; mean (SD)	67. 6 (4.6)
Male; n (%)	433 (36.3%)
Educational level; n (%) (n=1191)	
Low	166 (13.9%)
Medium	301 (25.3%)
High	724 (60.8%)
Married or long-term relationship; n (%)	835 (70.1%)
Household income; n (%) (n=1118)	
Low	433 (36.3%)
Middle	314 (26.3%)
High	371 (31.1%)
Paid work (n=1192)	372 (31.2%)
Subjective memory complaints (SMC) (n=1191)	876 (73.5%)
Family history of dementia (FH) (n=1191)	784 (65.8%)
MCLHB-DRR scores subscales, median (IQRs)	
Perceived susceptibility	50.0 (33.5-50.0)
Perceived severity	45.0 (35.0-60.0)
Perceived benefits	25.0 (25.0-37.5)
Perceived barriers	75.0 (68.8-87.5)
Cues to action	37.5 (31.2-50.0)
General health motivation	25.0 (16.7-33.3)
Self-efficacy	37.5 (25.0-50.0)
Modifiable dementia risk factors, n (%)	

Non-smokers	1143 (96%)
Healthy diet (n=1187)	373 (31.4%)
Low and moderate alcohol consumption	737 (61.8%)
Enough physical activity (SQUASH) (n=1181)	768 (64.4%)
Good sleep quality (PSQI) (n=1150)	581 (50.5%)
No risk of social isolation (n=1187)	1030 (86.4%)
Sufficient cognitive activity (n=1190)	600 (50.3%)
Presence of co-morbidities (self-reported)	
Coronary heart disease (CHD)	156 (13.1%)
Depression	146 (12.2%)
Diabetes	122 (10.2%)

[a] Participants with available data on the MCLHB-DRR scale

Associations between subscale scores of the MCLHB-DRR and dementia risk factors

The final model (Model 4) showed that several MCLHB-DRR subscales were associated with dementia risk factors (Table 2). Higher perceived severity scores were associated with adequate sleep quality, with a modest effect size (OR = 1.1). Perceived barriers to changing lifestyle behaviors for dementia risk reduction showed the broadest pattern of associations, including higher odds of a healthy diet (OR = 1.2), high cognitive activity (OR= 1.1), and high social engagement (OR = 1.3), but were more likely to be excessive alcohol consumers (OR = 0.8). Higher cues to action scores were positively associated with high cognitive activity (OR = 1.1), whereas participants with a higher general health motivation scores were more likely to smoke (OR = 0.5). No statistically significant associations were observed for perceived susceptibility or perceived benefits. The pattern of associations was comparable across Models 1–3, with effect estimates becoming smaller after adjustment for sociodemographic and health-related covariates. Table 2 presents the results of Model 4; results for all other models are available in *Appendix 1*. A small number of interaction effects met the predefined criterion of $p < 0.10$ (full estimates in Appendix 1. Specifically, significant interaction effects were observed for the associations with diet (cues to action × family history of dementia), smoking (general health motivation × family history of dementia), and alcohol use (perceived barriers × family history of dementia; self-efficacy × subjective memory complaints). These interaction terms were included in the respective final models and are reported in Table 2. For the outcomes physical activity and cognitive activity, none of the interaction effects met the predefined criterion of $p < 0.10$.

Table 3. Associations between MCLHB-DRR subscales and dementia risk factors in the fully adjusted model (Model 4), including all covariates from Model 3 and, where applicable, interaction terms with subjective memory complaints and family history of dementia. Odds ratios are presented per 10-point increase in subscale scores. Descriptive labels (e.g., adequate, healthy, sufficient, high, or low-risk) indicate favorable (low-risk) categories.

Subscales of the MCLHB-DRR	Adequate sleep quality (n = 1079)	Healthy diet (n=1113)	Sufficient physical activity (n=1108)	Non-smoking (n=1118)	High cognitive activity (n=1116)	High social engagement (n=1113)	Low risk alcohol consumption (n=1118)
Perceived Susceptibility	1.01 (0.93–1.09), p = 0.886	1.04 (0.97–1.13), p = 0.287	0.98 (0.91–1.06), p = 0.671	1.04 (0.87–1.23), p = 0.671	0.93 (0.85–1.00), p = 0.064	1.03 (0.92–1.15), p = 0.581	0.97 (0.90–1.05), p = 0.461
Perceived Severity	**1.11 (1.02–1.21), p = 0.012**	1.03 (0.95–1.11), p = 0.526	1.01 (0.94–1.10), p = 0.720	0.99 (0.82–1.21), p = 0.946	1.00 (0.92–1.09), p = 0.972	1.08 (0.96–1.22), p = 0.185	1.08 (1.00–1.17), p = 0.063
Perceived Benefits	1.02 (0.92–1.14), p = 0.669	0.97 (0.87–1.07), p = 0.522	1.08 (0.98–1.20), p = 0.122	1.10 (0.86–1.40), p = 0.461	0.90 (0.80–1.00), p = 0.056	1.07 (0.92–1.25), p = 0.350	0.96 (0.86–1.06), p = 0.404
Perceived Barriers	1.09 (0.97–1.22), p = 0.151	**1.17 (1.04–1.31), p = 0.007**	1.02 (0.91–1.13), p = 0.785	1.10 (0.85–1.41), p = 0.483	**1.13 (1.00–1.27), p = 0.04**	**1.28 (1.10–1.49), p = 0.001**	**0.78 (0.66–0.92), p = 0.004**
Cues to Action	0.98 (0.89–1.08), p = 0.708	0.99 (0.89–1.09), p = 0.791	1.06 (0.96–1.17), p = 0.221	1.06 (0.83–1.36), p = 0.617	**1.14 (1.03–1.27), p = 0.012**	0.98 (0.85–1.13), p = 0.748	1.00 (0.91–1.10), p = 0.991
General Health Motivation	1.06 (0.95–1.18), p = 0.297	0.94 (0.84–1.04), p = 0.230	0.97 (0.88–1.08), p = 0.629	**0.49 (0.31–0.76), p = 0.002**	0.94 (0.84–1.05), p = 0.302	0.98 (0.84–1.14), p = 0.775	0.95 (0.86–1.06), p = 0.362
Self-efficacy	1.00 (0.91–1.11), p = 0.939	0.94 (0.85–1.04), p = 0.241	1.05 (0.95–1.16), p = 0.356	0.80 (0.63–1.02), p = 0.074	0.97 (0.87–1.08), p = 0.560	1.11 (0.96–1.28), p = 0.156	1.18 (0.99–1.39), p = 0.058
Age (in years)	1.02 (0.99–1.05), p = 0.237	0.99 (0.96–1.03), p = 0.671	1.01 (0.98–1.04), p = 0.659	**1.10 (1.02–1.19), p = 0.019**	0.98 (0.95–1.01), p = 0.264	1.03 (0.99–1.08), p = 0.134	0.99 (0.96–1.02), p = 0.627
Sex (ref. female)	**2.26 (1.69–3.03), p = <0.001**	**0.60 (0.44–0.81), p = <0.001**	1.13 (0.85–1.50), p = 0.415	0.59 (0.29–1.18), p = 0.137	0.90 (0.67–1.21), p = 0.482	**0.55 (0.37–0.83), p = 0.004**	**0.52 (0.40–0.69), p = <0.001**

Site (ref. Maastricht)							
Amsterdam	0.87 (0.57–1.33), p = 0.522	0.85 (0.55–1.30), p = 0.451	0.81 (0.55–1.21), p = 0.311	0.98 (0.37–2.57), p = 0.959	1.16 (0.75–1.80), p = 0.501	0.78 (0.44–1.37), p = 0.386	1.00 (0.67–1.50), p = 0.998
Wageningen	1.10 (0.73–1.67), p = 0.642	1.00 (0.66–1.52), p = 0.992	**1.65 (1.09–2.49), p = 0.018**	0.90 (0.34–2.36), p = 0.830	1.51 (0.98–2.32), p = 0.064	0.86 (0.49–1.53), p = 0.615	1.08 (0.72–1.61), p = 0.710
Nijmegen	1.50 (0.99–2.28), p = 0.059	1.01 (0.66–1.54), p = 0.964	1.06 (0.71–1.58), p = 0.764	1.23 (0.45–3.38), p = 0.688	**1.55 (1.00–2.40), p = 0.048**	**1.96 (1.02–3.78), p = 0.044**	1.17 (0.78–1.76), p = 0.435
Groningen	0.93 (0.61–1.41), p = 0.725	0.90 (0.58–1.38), p = 0.617	1.31 (0.87–1.97), p = 0.198	1.04 (0.39–2.79), p = 0.934	1.24 (0.80–1.92), p = 0.337	0.88 (0.50–1.56), p = 0.664	1.28 (0.85–1.92), p = 0.243
Education (Ref. high)							
Low	0.71 (0.47–1.06), p = 0.092	**0.50 (0.32–0.77), p = 0.002**	0.91 (0.62–1.34), p = 0.643	0.43 (0.18–1.01), p = 0.054	**0.10 (0.06–0.17), p = <0.001**	0.73 (0.43–1.25), p = 0.249	1.07 (0.72–1.60), p = 0.726
Medium	0.97 (0.71–1.34), p = 0.876	**0.67 (0.48–0.93), p = 0.016**	0.52 (0.25–1.07), p = 0.075	0.50 (0.24–1.04), p = 0.063	**0.25 (0.18–0.34), p = <0.001**	0.75 (0.48–1.17), p = 0.202	0.94 (0.69–1.28), p = 0.694
Household income (Ref. high)							
Low	0.81 (0.58–1.13), p = 0.207	0.76 (0.55–1.07), p = 0.119	0.78 (0.56–1.08), p = 0.130	0.45 (0.19–1.06), p = 0.068	**0.48 (0.34–0.67), p = <0.001**	0.69 (0.43–1.11), p = 0.126	**2.08 (1.50–2.89), p = <0.001**
Medium	0.91 (0.65–1.28), p = 0.592	0.84 (0.60–1.17), p = 0.295	0.92 (0.66–1.28), p = 0.604	0.77 (0.30–1.99), p = 0.593	0.84 (0.60–1.19), p = 0.322	1.18 (0.69–2.00), p = 0.547	**1.59 (1.16–2.19), p = 0.004**
Marital status (ref. married or long-term relationship)	0.96 (0.71–1.29), p = 0.770	1.11 (0.82–1.50), p = 0.493	0.98 (0.73–1.31), p = 0.869	**0.33 (0.17–0.65), p = 0.001**	0.88 (0.64–1.20), p = 0.420	**0.56 (0.37–0.84), p = 0.005**	**1.35 (1.00–1.82), p = 0.050**
Paid work (ref. no paid work)	0.96 (0.69–1.33), p = 0.788	0.97 (0.70–1.34), p = 0.834	0.92 (0.67–1.25), p = 0.584	1.25 (0.59–2.65), p = 0.556	**1.40 (1.01–1.96), p = 0.047**	1.49 (0.93–2.39), p = 0.099	0.93 (0.68–1.27), p = 0.657

Subjective memory complaints (ref. no)	**0.53 (0.38–0.73), p = <0.001**	1.08 (0.78–1.49), p = 0.659	0.79 (0.57–1.09), p = 0.150"	1.04 (0.50–2.19), p = 0.912	0.73 (0.52–1.02), p = 0.065	0.92 (0.55–1.53), p = 0.749	**2.22 (1.11–4.44), p = 0.025**
Family history (ref. no)	1.07 (0.78–1.48), p = 0.663	1.05 (0.76–1.46), p = 0.751	0.79 (0.58–1.08), p = 0.135	**0.10 (0.02–0.63), p = 0.014**	0.89 (0.64–1.23), p = 0.477	**1.71 (1.11–2.63), p = 0.015**	0.25 (0.05–1.28), p = 0.095
Smoking (ref. no)							0.63 (0.33–1.18), p = 0.146
CHD (ref. no)			1.20 (0.81–1.79), p = 0.360				
Depression (ref. no)	**0.22 (0.14–0.36), p = <0.001**					0.67 (0.40–1.10), p = 0.116	
Alcohol (ref. low)				0.57 (0.30–1.07), p = 0.081			
Diabetes (ref. no)		0.91 (0.58–1.44), p = 0.695					
Cues to Action X family history		0.99 (0.97–1.01), p = 0.179					
Perceived Barriers X family history							**1.02 (1.00–1.04), p = 0.051**
General Health Motivation X family history				**1.06 (1.01–1.12), p = 0.025**			
Self-efficacy X subjective memory complaints							**0.98 (0.96–1.00), p = 0.015**
Nagelkerke R^2	0.192	0.074	0.045	0.149	0.294	0.124	0.107

Note: Values represent odds ratios (OR) with 95% confidence intervals (CI) and p-values. Model 4 is adjusted for age, sex, study site, education, household income, marital status, and employment status, as well as outcome-specific covariates: for sleep, additionally adjusted for depression; for diet, diabetes; for physical activity, chronic heart disease (CHD); for non-smoking, alcohol use; for social engagement, depression; and for alcohol use, smoking. Nagelkerke R^2 is reported as a measure of model fit (explained variance).

Subscales of the MCLHB-DRR

Perceived severity

Participants with higher perceived severity scores (e.g., stronger agreement with statements such as 'The idea of dementia frightens me', 'When I think about dementia, my heart starts beating faster', and 'consider getting dementia worse than getting other diseases') were more likely to have adequate sleep quality (OR = 1.11, 95% CI 1.02-1.21).

Perceived barriers

Participants who reported higher perceived barriers by scoring higher on questionnaire items such as 'I am too busy to change my lifestyle and/or health behavior', 'My financial circumstances prevent me from changing my lifestyle and health behavior', or 'Family responsibilities make it difficult to change my lifestyle and health behavior' were more likely to have a healthy diet (OR = 1.17, 95% CI 1.04-1.31), a higher cognitive activity (OR = 1.13, 95% CI 1.00-1.27), and a higher social engagement (OR = 1.28, 95% CI 1.10-1.49). In contrast, participants with higher perceived barriers were associated with lower odds of favorable alcohol use (OR = 0.78, 95% CI 0.66–0.92). However, participants with a family history of dementia showed that they are less likely to be excessive alcohol consumers if their perceived barriers were higher (OR = 1.02, 95% CI 1.00–1.04).

Cues to action

The subscale cues to action was only associated with the outcome high cognitive activity. Participants who scored higher on cues to action, for example agreeing with items such as 'Being forgetful makes me think that I should change my lifestyle and health behavior' and 'Because my family member has dementia, I think that I should change my lifestyle and live healthier' were more likely to have a higher cognitive activity (OR = 1.14, 95% CI 1.03–1.27).

General health motivation

Participants with higher scores on the general health motivation subscale (e.g. items such as 'good health is very important to me' and 'I feel I should pay attention to my health') were more likely to smoke (OR = 0.49, 95% CI 0.31–0.76). On the other hand, participants with a higher general health motivation and a family history of dementia were more likely to be a non-smoker (OR = 1.06, 95% CI 1.01–1.12).

Perceived susceptibility, perceived benefits and self-efficacy

For the outcome alcohol consumption, the main effect of self-efficacy was not statistically significant (OR = 1.18, 95% CI 0.99–1.39). However, a significant interaction between self-efficacy and subjective memory complaints was observed (interaction OR = 0.98, 95% CI 0.96–1.00), indicating that higher self-efficacy is less strongly associated with excessive alcohol consumption among participants with subjective memory complaints.

Discussion

Summary of main findings

This study examined the association between attitudes, perceptions and motivations toward dementia risk reduction, measured by the MCLHB-DRR, and modifiable lifestyle behaviors that are commonly used as proxies for dementia risk factors in participants of the FINGER-NL trial. We also explored whether these associations differed depending on the presence of subjective memory complaints or a family history of dementia. Overall, only a small subset of the MCLHB-DRR subscales showed relevant associations with these baseline lifestyle-related dementia risk factors, and the specific patterns differed across risk domains. Additionally, a limited number of interaction effects met the predefined criterion for subgroup differences. Below, we summarize the key findings.

Perceived barriers showed associations with several dementia risk factors, but the direction of these associations varied. In our study, individuals reporting higher perceived barriers were more likely to be having a healthy diet, high cognitive activity, and high social engagement. This pattern contrasts with previous findings suggesting that greater perceived barriers are generally associated with a lower likelihood of health behavior change (26). One possible explanation is that individuals who are highly motivated or more aware of dementia risk and the importance of a healthy lifestyle may also be more attuned to the challenges involved in maintaining such behaviors. As a result, higher perceived barriers may reflect greater awareness of lifestyle-related challenges rather than lower engagement in favorable behaviors. This interpretation aligns with earlier work suggesting that increased awareness of dementia risk can coincide with heightened recognition of lifestyle-related challenges (27). In addition, the content of the perceived barriers subscale may contribute to these findings, as several items capture aspects of a busy or active lifestyle, which may naturally co-occur with higher social and cognitive engagement, rather than directly reflecting barriers to behavior change.

For alcohol use, the pattern was more as expected. People who reported more barriers were more likely to be drinking alcohol at higher-risk levels. We also found that this association attenuated among people with a family history of dementia, possibly because they are more aware of their risk and may try harder to regulate their alcohol use. The different patterns observed for alcohol consumption may also relate to the social and behavioral context of drinking alcohol in older adults. Alcohol consumption is highly normalized in this age group, particularly among men: in our study, men had substantially higher odds of high-risk alcohol consumption compared with women. In addition, people with a higher household income were also more likely to drink at higher levels of alcohol consumption, as alcohol often plays a role in social activities, is a way to relax, and is embedded in daily routines (28). In these groups, drinking is generally viewed as harmless

or even as part of a healthy lifestyle (29), which may make it harder to change behavior even when people recognize barriers or want to reduce their intake.

Participants with higher scores on general health motivation were more likely to be a current smoker, a finding that contrasts with conventional expectations that health-motivated individuals would avoid smoking. In the cross-sectional baseline context of the FINGER-NL trial, this association may reflect awareness of an unfavorable smoking-related risk profile rather than successful behavior change. Individuals who smoke may report high general health motivation because they recognize that smoking conflicts with their health goals. This interpretation is supported by previous research showing that addiction-related behaviors do not necessarily change in response to general motivation alone (30). The observed interaction with family history suggests that a familial risk of dementia may be associated with greater motivation for adopting a healthy lifestyle, including being a non-smoker.

People who scored higher on perceived severity and saw dementia as a very serious condition tended to report better sleep. Several factors may help explain this association. Many people are not even aware that sleep supports brain health (31, 32), and sleep is also something people cannot fully control; next to sleep hygiene, stress, health problems and daily routines all play a role (33). In our study, women were less likely than men to report adequate sleep quality, suggesting potential sex differences in sleep-related processes. Specifically participants with subjective memory complaints were less likely to have a good sleep quality, which is consistent with evidence that cognitive worries and related emotional distress are associated with poorer sleep quality (34). Future research should further explore sex differences in sleep quality and examine whether factors such as worry, or rumination may help explain these patterns.

Cues to action were linked only to cognitive activity. People who reported more triggers, for example noticing their own forgetfulness, were more likely to engage in mentally stimulating activities. Several background factors also played a role: participants with lower or medium education were less likely to engage in cognitive activities, and those with paid work tended to engage more in these activities. Cues to action were not related to any of the other dementia risk factors. It is important to note that cognitive activity in this study was assessed using the Cognitive Reserve Index Questionnaire (CRIq), which reflects cognitive engagement across the life course, including education and occupational history, rather than intentional cognitive activities aimed at dementia prevention in later life. The observed association may therefore reflect greater awareness of cognitive functioning or long-term cognitive engagement, rather than conscious efforts to reduce dementia risk. This interpretation partly aligns with findings by Heger et al., who showed that the majority of participants were initially unaware of a relationship between lifestyle and dementia risk, although many did identify low cognitive activity, physical inactivity, and unhealthy diet as dementia-related risk factors once prompted. However, this does not explain why physical

activity and diet did not show similar associations with motivational factors in the present study, confirming that recognizing a lifestyle factor as relevant does not necessarily translate into differences in lifestyle risk profiles at baseline (35)

Although Lam & Cheng (2013) showed that self-efficacy is often a strong driver of behavior change (36), we did not observe significant associations between self-efficacy and lifestyle risk factors. This differs from findings described by Simone, Kaplan (37) who identified self-efficacy as a key motivational factor for adopting a healthy lifestyle among middle aged adults. This difference may reflect characteristics of the FINGER-NL sample, in which participants were already motivated and willing to engage in lifestyle change, resulting in limited variability in self-efficacy. Simone, Kaplan (37) studied midlife adults, whereas dementia risk profiles in older adults may be more strongly shaped by long-established habits and routines. Moreover, self-efficacy may have shown limited variability in this sample, given that participants were already participating in a lifestyle-focused intervention trial. In older adults, lifestyle habits are often long established and may not depend as much on how capable someone feels. In addition, the FINGER NL participants were already a highly motivated group, which likely meant that most felt confident about making lifestyle changes. This left little variation in self-efficacy, making it harder to detect meaningful associations.

Perceived susceptibility to dementia and perceived benefits of lifestyle change were not associated with any of the dementia risk factors. This suggests that higher perceived risk or stronger beliefs about potential benefits do not necessarily coincide with more favorable dementia risk profiles, particularly in a cross-sectional baseline context.

Across dementia risk factors, several covariates showed strong and consistent associations that were independent of the MCLHB-DRR subscales. Education showed the strongest and most consistent associations: individuals with low or medium education had substantially lower odds of engaging in cognitive activity, and lower-educated participants were also less likely to follow a healthy diet. Income was also relevant, particularly for alcohol use: people with low incomes were less likely being excessive alcohol consumers, while those with medium income were more likely to be drinking alcohol at higher levels. Men were more likely to report good sleep, but less likely to have a healthy diet, less socially engaged, and more likely to drink at higher-risk levels. These findings suggest that lifestyle-related dementia risk indicators are strongly shaped by sociodemographic and contextual factors beyond individual motivation.

Subgroup differences: family history and subjective memory decline

Only a few interaction effects reached our threshold, suggesting that having subjective memory complaints or a family history of dementia did not strongly or consistently modify the associations between motivational factors and dementia risk factors. This fits with the idea that these determinants can influence motivation, but do not always lead to clear or

consistent differences in the presence of dementia risk factors. In our sample, individuals with a family history of dementia had substantially lower odds of having a favorable smoking status (OR = 0.10), but higher odds of high social engagement (OR = 1.71). Individuals with subjective memory complaints had lower odds of adequate sleep quality (OR = 0.53), but higher odds of favorable alcohol use (low or moderate consumption; OR = 2.22). Because these associations point in different directions across lifestyle domains, they do not suggest a coherent or uniform risk pattern and should therefore be interpreted cautiously.

Implications

The findings of this study have several implications for the field of dementia prevention. They show that, although some motivational factors are linked to specific dementia risk factors, higher motivation does not consistently coincide with more favorable dementia risk profiles at baseline. In the context of these cross-sectional findings, this underscores that the relationship between motivation and lifestyle-related dementia risk factors is not straightforward. Lifestyle behaviors are embedded in daily routines and shaped by broader social and environmental contexts, extending beyond individual motivation alone. This is consistent with earlier work suggesting that dementia risk reduction may feel abstract or less personally relevant, particularly when dementia is seen as a condition that occurs later in life or as something determined by fate. When the risk feels distant or uncontrollable, it becomes harder to translate awareness or good intentions into concrete changes in daily routines (4). As a result, motivation and awareness may coexist with ongoing lifestyle-related risk at baseline. At the same time, our results show that different psychological factors may be relevant for different dementia risk domains. For instance, cues to action were only related to cognitive activity, while perceived severity was mainly linked to sleep. Although our data is not strong enough to make clear recommendations for risk-specific intervention strategies, this pattern does support the idea that tailored information or support, aligned with the psychological factors most relevant to specific dementia risk domains, may have even greater potential to encourage meaningful change than a general one-size-fits-all approach.

Within the FINGER-NL study, qualitative interviews were also conducted at different time points, offering more in-depth insights into how participants understand dementia risk and lifestyle change. These qualitative findings are reported elsewhere and indicated that participants are motivated to change one or more aspects of their lifestyle by personal gain, aiming to improve their cognitive and physical health, driven by concerns about aging, the risk of developing dementia, cognitive decline, and the desire to change their behavior (25). Future research that combines quantitative measures such as the MCLHB-DRR with qualitative approaches may therefore be particularly valuable. Such mixed-methods designs could provide a more comprehensive understanding of how motivational factors are experienced and how they translate into everyday behavior, and help explain why strong intentions do not always result in observable lifestyle changes (38).

Strengths and limitations

This study has several strengths. We were able to use a large and well-described sample of older adults at risk of cognitive decline, and we applied the adapted and validated Dutch version of the MCLHB-DRR scale (15) to assess motivation, attitudes and perceptions related to dementia risk reduction. Another strength is that we examined multiple dementia risk factors within the same analytic framework, allowing us to explore how different motivational factors relate to a broad range of day-to-day health behaviors that are known to be relevant for dementia risk reduction. However, several limitations should be considered. The cross-sectional design prevents conclusions about causality or how motivation and behavior may change over time. All dementia risk factors were self-reported and dichotomized, which may reduce precision and not leave room for gradations in behavior. Although participants were selected based on the presence of one or more modifiable risk factors for dementia, the FINGER-NL sample represents a relatively motivated and health-conscious group who voluntarily enrolled in a lifestyle trial. Compared with population-based samples of similar age, participants were on average healthier and had fewer modifiable dementia risk factors. This high level of baseline health and motivation may limit generalizability and reduce variability in both dementia risk factors and motivational constructs measured by the MCLHB-DRR. Finally, the overall explanatory value of the models (see Table 2, and Appendix Table 5) was modest, suggesting that many other factors beyond motivation are likely to influence the presence of dementia risk factors in this population. Overall, given the limited number of interaction effects and their inconsistent direction, the findings should be interpreted cautiously.

An additional consideration concerns the measurement of motivation and intentions using a structured, quantitative instrument. The MCLHB-DRR is a validated and widely used scale (39-41), and a clear strength of this instrument is that it was specifically developed to assess motivation and beliefs related to dementia risk reduction. At the same time, it is important to recognize that such scales are designed to translate complex psychological constructs into simplified, quantifiable measures. Some participants may have experienced the MCLHB-DRR items as relatively abstract or difficult to answer, which is not uncommon for self-reported questionnaires used in this study. As a result, minor variation in how items were understood cannot be ruled out, which may have influenced response patterns. The MCLHB-DR therefore provides an important starting point for assessing motivation, but may not fully capture the complexity and contextual nature of behavior change.

Conclusion

This study examined how attitudes, perceptions and motivation toward dementia risk reduction relate to baseline lifestyle behaviors that serve as proxies for modifiable dementia risk factors in older adults with one or more lifestyle-related risk factors for cognitive decline. Overall, only a limited number of motivational factors as assessed with

the MCLHB-DRR were associated with modifiable dementia risk factors, operationalized through favorable versus unfavorable baseline risk profiles, and these associations differed across domains. Higher motivation did not consistently coincide with more favorable (low-risk) dementia risk profiles, suggesting that awareness and intention may coexist with less favorable lifestyle patterns, particularly at baseline. Differences between individuals with subjective memory complaints or a family history of dementia were small and inconsistent, suggesting that these factors play a limited role in how motivation relates to the presence of dementia risk factors. Our findings also show that the presence of dementia risk factors was strongly influenced by background characteristics such as education, income, sex, and study site (place of residence), independent of motivation. Together, these results suggest that encouraging behavior aimed at reducing dementia risk may require more than increasing awareness or motivation alone. More tailored approaches that consider people's daily lives, habits, and social context, and that focus on specific lifestyle-related dementia risk domains, may be more effective.

Appendix 1

Tabel 1 – Model 0, unadjusted

Subscales of MCLHB-DRR	Good sleep quality (n=1150)	Healthy diet quality	Sufficient physical activity	Non-smoking	Sufficient cognitive activity	Sufficient social engagement	Low/moderate alcohol use
Perceived Susceptibility	0.99 (0.93–1.06), p = 0.831	1.04 (0.97–1.12), p = 0.271	1 (0.93–1.07), p = 0.981	0.93 (0.79–1.1), p = 0.415	**0.93 (0.87–1.00), p = 0.0365**	0.98 (0.89–1.08), p = 0.686	0.96 (0.90–1.03), p = 0.27
Perceived Severity	**1.13 (1.05–1.22), p < 0.001**	1.00 (0.93–1.08), p = 0.947	1.02 (0.95–1.1), p = 0.608	0.97 (0.81–1.16), p = 0.725	1.05 (0.98–1.13), p = 0.15	1.08 (0.97–1.2), p = 0.152	1.03 (0.96–1.11), p = 0.41
Perceived Benefits	1.04 (0.94–1.14), p = 0.430	0.98 (0.89–1.08), p = 0.708	1.07 (0.97–1.18), p = 0.162	1.05 (0.83–1.34), p = 0.676	0.94 (0.86–1.03), p = 0.19	1.06 (0.92–1.21), p = 0.436	0.97 (0.88–1.07), p = 0.546
Perceived Barriers	1.09 (0.99–1.21), p = 0.067	**1.22 (1.1–1.35), p < 0.001**	1.03 (0.93–1.14), p = 0.533	1.13 (0.89–1.43), p = 0.316	**1.21 (1.10–1.33), p < 0.001**	**1.32 (1.15–1.51), p < 0.001**	**0.89 (0.81–0.99), p = 0.0253**
Cues to Action	1.04 (0.95–1.14), p = 0.365	0.96 (0.87–1.05), p = 0.337	1.09 (1–1.2), p = 0.0618	0.93 (0.74–1.16), p = 0.523	1.06 (0.97–1.15), p = 0.197	0.94 (0.83–1.07), p = 0.377	0.99 (0.9–1.08), p = 0.761
General Health Motivation	**1.10 (1.00–1.21), p = 0.043**	0.95 (0.86–1.05), p = 0.293	0.98 (0.89–1.08), p = 0.677	**0.76 (0.61–0.95), p = 0.0176**	1.01 (0.92–1.1), p = 0.901	1.01 (0.88–1.16), p = 0.913	0.92 (0.84–1.01), p = 0.08
Self-efficacy	0.95 (0.87–1.04), p = 0.285	0.96 (0.88–1.06), p = 0.43	1.04 (0.95–1.15), p = 0.37	0.89 (0.71–1.12), p = 0.314	0.96 (0.88–1.05), p = 0.394	1.08 (0.95–1.24), p = 0.242	1.02 (0.93–1.11), p = 0.716

Note. The predictor variables from the MCLHB-DRR subscales were measured on a 0 to 100 scale. To improve interpretability, results are presented per 10-point increase in each subscale. All other covariates and confounders are reported per 1-unit increase or per category.

Tabel 2 – Model 1, adjusted for age, sex and study site

Subscales of MCLHB-DRR	Good sleep quality (n=1150)	Healthy diet quality	Sufficient physical activity	Non-smoking	Sufficient cognitive activity	Sufficient social engagement	Low/moderate alcohol use
Perceived Susceptibility	0.98 (0.91–1.05), p = 0.559	1.05 (0.98–1.12), p = 0.200	1 (0.93–1.07), p = 0.994	1.06 (0.89–1.25), p = 0.521	**0.94 (0.88–1), p = 0.0597**	0.97 (0.88–1.08), p = 0.609	0.97 (0.9–1.03), p = 0.322
Perceived Severity	1.11 (1.03–1.2), p = 0.00718	1.02 (0.95–1.1), p = 0.577	1.01 (0.94–1.09), p = 0.752	0.97 (0.81–1.17), p = 0.763	1.05 (0.97–1.13), p = 0.217	1.1 (0.99–1.23), p = 0.088	1.07 (0.99–1.15), p = 0.0855
Perceived Benefits	1.04 (0.94–1.14), p = 0.461	0.98 (0.89–1.09), p = 0.742	1.07 (0.97–1.18), p = 0.172	1.04 (0.82–1.33), p = 0.721	0.94 (0.86–1.03), p = 0.208	1.05 (0.92–1.21), p = 0.465	0.97 (0.88–1.07), p = 0.548
Perceived Barriers	**1.14 (1.03–1.25), p = 0.0129**	**1.21 (1.09–1.35), p < 0.001**	1.04 (0.94–1.15), p = 0.459	0.89 (0.7–1.13), p = 0.342	**1.2 (1.09–1.33), p < 0.001**	**1.31 (1.15–1.5), p = <0.001**	**0.87 (0.78–0.96), p = 0.00552**
Cues to Action	1.02 (0.94–1.12), p = 0.601	0.96 (0.87–1.05), p = 0.379	1.09 (0.99–1.19), p = 0.078	1.07 (0.85–1.34), p = 0.558	1.07 (0.98–1.16), p = 0.156	0.95 (0.83–1.08), p = 0.407	1 (0.91–1.09), p = 0.966
General Health motivation	1.1 (1–1.21), p = 0.0619	0.95 (0.86–1.05), p = 0.357	0.98 (0.89–1.08), p = 0.702	**0.77 (0.61–0.97), p = 0.0237**	1 (0.91–1.09), p = 0.933	1.02 (0.89–1.17), p = 0.772	0.93 (0.85–1.03), p = 0.147
Self-efficacy	0.98 (0.89–1.08), p = 0.664	0.95 (0.87–1.05), p = 0.345	1.04 (0.95–1.15), p = 0.374	0.88 (0.7–1.11), p = 0.289	0.97 (0.88–1.06), p = 0.44	1.09 (0.95–1.24), p = 0.217	1 (0.91–1.09), p = 0.933

Age	1.01 (0.98–1.04), p = 0.435	0.99 (0.96–1.02), p = 0.546	1.01 (0.98–1.04), p = 0.508	**1.07 (1–1.15), p = 0.05**	0.96 (0.94–0.98), p = 0.00162	1.01 (0.97–1.05), p = 0.550	1.01 (0.98–1.03), p = 0.615
Sex (ref. female)	**2.43 (1.87–3.15), p < 0.001**	**0.63 (0.48–0.82), p < 0.001**	1.21 (0.93–1.57), p = 0.153	0.96 (0.52–1.77), p = 0.895	1.17 (0.91–1.49), p = 0.228	0.77 (0.54–1.1), p = 0.149	**0.42 (0.33–0.55), p <0.001**
Site (ref. Maastricht)							
Amsterdam	0.9 (0.62–1.33), p = 0.607	0.87 (0.58–1.3), p = 0.493	0.79 (0.54–1.14), p = 0.209	0.91 (0.37–2.23), p = 0.842	1.18 (0.81–1.7), p = 0.384	0.91 (0.54–1.51), p = 0.705	1.03 (0.71–1.5), p = 0.878
Wageningen	1.14 (0.78–1.67), p = 0.507	1.03 (0.69–1.53), p = 0.889	**1.54 (1.04–2.29), p = 0.033**	0.99 (0.4–2.45), p = 0.982	**1.76 (1.21–2.55), p = 0.00294**	1.05 (0.62–1.77), p = 0.856	1.1 (0.75–1.6), p = 0.63
Nijmegen	1.45 (0.99–2.13), p = 0.0583	0.93 (0.63–1.39), p = 0.729	1 (0.68–1.46), p = 0.999	1.01 (0.4–2.56), p = 0.987	1.37 (0.94–1.98), p = 0.0976	**2.02 (1.11–3.66), p = 0.021**	1.2 (0.82–1.76), p = 0.343
Groningen	0.81 (0.55–1.19), p = 0.287	0.9 (0.6–1.34), p = 0.601	1.24 (0.84–1.84), p = 0.275	1.13 (0.44–2.89), p = 0.792	1.23 (0.85–1.78), p = 0.274	0.98 (0.58–1.65), p = 0.936	1.28 (0.87–1.88), p = 0.205

Tabel 3 – Model 2 additionally adjusted for educational level, household income, marital status, and employment status

Subscales of MCLHB-DRR	**Good sleep quality (n=1079)**	**Healthy diet quality**	**Sufficient physical activity**	**Non-smoking**	**Sufficient cognitive activity**	**Sufficient social engagement**	**Low/moderate alcohol use**
Perceived Susceptibility	0.98 (0.91–1.05), p = 0.563	1.04 (0.97–1.12), p = 0.300	1.00 (0.93–1.07), p = 0.899	1.09 (0.92–1.29), p = 0.301	0.93 (0.86–1.01), p = 0.067	0.98 (0.88–1.08), p = 0.674	0.96 (0.9–1.04), p = 0.310

Perceived Severity	**1.12 (1.03–1.21), p = 0.005**	1.03 (0.95–1.11), p = 0.521	1.01 (0.94–1.1), p = 0.726	0.98 (0.81–1.18), p = 0.804	1.00 (0.92–1.09), p = 0.989	1.11 (0.99–1.25), p = 0.072	1.08 (1–1.17), p = 0.053
Perceived Benefits	1.03 (0.93–1.14), p = 0.614	0.96 (0.87–1.07), p = 0.500	1.07 (0.97–1.18), p = 0.198	1.06 (0.83–1.36), p = 0.630	0.89 (0.8–1.00), p = 0.046	1.08 (0.93–1.25), p = 0.310	0.97 (0.88–1.08), p = 0.573
Perceived Barriers	**1.12 (1.01–1.25), p = 0.034**	**1.17 (1.04–1.31), p = 0.007**	1.01 (0.91–1.12), p = 0.846	1.08 (0.84–1.37), p = 0.561	**1.14 (1.01–1.28), p = 0.030**	**1.3 (1.12–1.51), p = <0.001**	**0.89 (0.8–0.99), p = 0.032**
Cues to Action	1.02 (0.93–1.12), p = 0.642	0.98 (0.89–1.08), p = 0.729	1.08 (0.98–1.19), p = 0.112	0.91 (0.72–1.15), p = 0.440	**1.16 (1.05–1.29), p = 0.005**	0.96 (0.83–1.1), p = 0.521	0.98 (0.89–1.08), p = 0.712
General Health Motivation	1.08 (0.97–1.2), p = 0.149	0.94 (0.84–1.04), p = 0.237	0.97 (0.88–1.08), p = 0.570	**0.73 (0.58–0.93), p = 0.011**	0.95 (0.85–1.06), p = 0.315	0 (0.87–1.16), 1 p = 0.967	0.96 (0.87–1.06), p = 0.406
Self-efficacy	0.99 (0.9–1.1), p = 0.903	0.94 (0.85–1.04), p = 0.252	1.05 (0.95–1.16), p = 0.362	0.83 (0.66–1.05), p = 0.115	0.96 (0.87–1.07), p = 0.491	1.1 (0.96–1.27), p = 0.173	0.99 (0.89–1.09), p = 0.784
Age	1.02 (0.99–1.05), p = 0.272	0.99 (0.96–1.03), p = 0.693	1.01 (0.97–1.04), p = 0.728	**1.09 (1.01–1.18), p = 0.029**	0.98 (0.95–1.01), p = 0.212	1.04 (0.99–1.08), p = 0.122	1 (0.97–1.03), p = 0.785
Sex (ref. female)	**2.19 (1.66–2.9), p = <0.001**	**0.6 (0.44–0.8), p = <0.001**	1.17 (0.88–1.54), p = 0.286	1.74 (0.88–3.44), p = 0.112	0.9 (0.67–1.21), p = 0.492	**0.54 (0.36–0.8), p = 0.003**	**0.51 (0.39–0.67), p = <0.001**
Site (ref. Maastricht) Amsterdam	0.87 (0.58–1.31), p = 0.515	0.85 (0.56–1.31), p = 0.473	0.82 (0.55–1.22), p = 0.320	0.91 (0.35–2.36), p = 0.843	1.18 (0.76–1.83), p = 0.458	0.77 (0.44–1.35), p = 0.369	1.01 (0.68–1.51), p = 0.957

Wageningen	1.11 (0.74–1.65), p = 0.621	1 (0.66–1.52), p = 0.995	**1.65 (1.09–2.48), p = 0.017**	0.88 (0.34–2.27), p = 0.798	**1.55 (1.01–2.38), p = 0.045**	0.89 (0.51–1.56), p = 0.677	1.11 (0.75–1.65), p = 0.605
Nijmegen	**1.51 (1.01–2.25), p = 0.046**	1 (0.66–1.52), p = 0.987	1.06 (0.71–1.57), p = 0.783	1.15 (0.42–3.11), p = 0.788	**1.6 (1.04–2.46), p = 0.032**	1.86 (0.99–3.52), p = 0.054	1.19 (0.8–1.76), p = 0.398
Groningen	0.84 (0.56–1.27), p = 0.410	0.91 (0.59–1.39), p = 0.649	1.28 (0.85–1.93), p = 0.229	1.05 (0.4–2.77), p = 0.922	1.23 (0.79–1.9), p = 0.361	0.83 (0.47–1.46), p = 0.515	1.28 (0.85–1.92), p = 0.236
Education (Ref. high)							
Low	**0.68 (0.46–1), p = 0.050**	**0.49 (0.32–0.76), p = 0.001**	0.91 (0.62–1.34), p = 0.640	0.46 (0.2–1.07), p = 0.071	**0.1 (0.06–0.17), p = <0.001**	0.68 (0.4–1.15), p = 0.146	1.08 (0.73–1.6), p = 0.702
Medium	0.88 (0.64–1.22), p = 0.450	**0.66 (0.48–0.93), p = 0.015**	0.85 (0.63–1.16), p = 0.311	0.53 (0.26–1.08), p = 0.081	**0.25 (0.18–0.34), p = <0.001**	0.74 (0.48–1.14), p = 0.175	0.92 (0.67–1.25), p = 0.595
Household income (Ref. high)							
Low	0.75 (0.54–1.03), p = 0.077	0.77 (0.55–1.08), p = 0.133	1.29 (0.93–1.79), p = 0.130	0.54 (0.24–1.25), p = 0.150	0.47 (0.34–0.66), p = <0.001	0.67 (0.42–1.08), p = 0.103	**2.02 (1.46–2.79), p = <0.001**
Medium	0.88 (0.64–1.22), p = 0.450	0.84 (0.6–1.17), p = 0.300	1.1 (0.79–1.53), p = 0.575	0.88 (0.35–2.21), p = 0.779	**0.84 (0.59–1.18), p = 0.311**	1.14 (0.68–1.92), p = 0.624	**1.58 (1.15–2.18), p = 0.005**
Marital status (ref. married or long-term relationship)	0.83 (0.63–1.11), p = 0.219	1.12 (0.83–1.5), p = 0.471	0.94 (0.71–1.26), p = 0.691	**0.35 (0.18–0.67), p = 0.002**	0.86 (0.63–1.17), p = 0.334	**0.54 (0.36–0.8), p = 0.002**	1.3 (0.97–1.74), p = 0.083
Paid work (ref. no)	0.99 (0.72–1.36), p = 0.942	0.97 (0.7–1.35), p = 0.866	1.1 (0.81–1.51), p = 0.541	1.29 (0.62–2.72), p = 0.497	**1.39 (1.00–1.95), p = 0.050**	1.5 (0.94–2.39), p = 0.092	0.94 (0.69–1.28), p = 0.698

Tabel 4 – Model 3: adjusted for subjective memory complaints, family history of dementia, outcome-specific covariates, and interaction terms (p < 0.10)

Subscales of MCLHB-DRR	**Sufficient sleep quality (n=1077)**	**Healthy diet quality**	**Sufficient physical activity**	**Non-smoking**	**Sufficient cognitive activity**	**Sufficient social engagement**	**Low/moderate alcohol use**
Perceived susceptibility	1.09 (0.86–1.36), p = 0.485	0.94 (0.76–1.18), p = 0.617	1.10 (0.88–1.37), p = 0.416	1.03 (0.60–1.79), p = 0.903	0.97 (0.77–1.23), p = 0.810	1.01 (0.73–1.38), p = 0.963	1.09 (0.87–1.35), p = 0.464
Perceived severity	1.00 (0.79–1.26), p = 0.973	0.99 (0.79–1.25), p = 0.934	1.00 (0.79–1.25), p = 0.976	1.29 (0.70–2.39), p = 0.413	0.83 (0.65–1.06), p = 0.138	1.00 (0.71–1.42), p = 0.998	1.13 (0.90–1.41), p = 0.295
Perceived benefits	0.94 (0.69–1.28), p = 0.680	0.89 (0.65–1.22), p = 0.481	0.88 (0.65–1.20), p = 0.418	1.09 (0.50–2.36), p = 0.825	0.89 (0.65–1.24), p = 0.496	1.24 (0.77–1.98), p = 0.374	0.87 (0.64–1.17), p = 0.348
Perceived barriers	1.15 (0.84–1.58), p = 0.369	1.04 (0.75–1.44), p = 0.823	1.10 (0.81–1.50), p = 0.532	0.96 (0.45–2.06), p = 0.913	0.90 (0.65–1.25), p = 0.532	1.33 (0.85–2.06), p = 0.210	**0.68 (0.50–0.93), p = 0.017**
Cues to action	1.06 (0.82–1.38), p = 0.643	**1.33 (1.02–1.74), p = 0.035**	1.00 (0.77–1.30), p = 0.994	0.90 (0.42–1.93), p = 0.790	**1.32 (1.00–1.75), p = 0.048**	0.83 (0.57–1.23), p = 0.355	1.03 (0.79–1.33), p = 0.829
General health motivation	1.16 (0.85–1.58), p = 0.350	0.98 (0.72–1.34), p = 0.903	1.06 (0.79–1.44), p = 0.685	**0.31 (0.14–0.65), p = 0.002**	0.91 (0.66–1.25), p = 0.548	0.74 (0.47–1.16), p = 0.189	1.04 (0.77–1.39), p = 0.812
Self efficacy	1.03 (0.77–1.38), p = 0.860	0.98 (0.73–1.31), p = 0.883	1.09 (0.82–1.45), p = 0.553	1.10 (0.51–2.40), p = 0.807	0.86 (0.63–1.17), p = 0.336	1.17 (0.76–1.80), p = 0.468	1.32 (0.99–1.76), p = 0.058
Subjective memory	1.42 (0.11–18.45), p = 0.787	0.42 (0.03–5.62), p = 0.514	0.47 (0.04–5.61), p = 0.548	1.77 (0.01–575.26), p = 0.847	0.12 (0.01–1.69), p = 0.117	0.13 (0.00–5.15), p = 0.279	1.03 (0.08–12.80), p = 0.983

complaints (ref. no)							
Family history dementia (ref. no)	0.83 (0.10–7.17), p = 0.868	1.59 (0.16–15.50), p = 0.688	3.91 (0.50–30.64), p = 0.194	0.03 (0.00–7.79), p = 0.215	0.17 (0.02–1.63), p = 0.125	4.60 (0.31–67.58), p = 0.266	0.85 (0.10–7.14), p = 0.877
Age (years)	1.02 (0.99–1.05), p = 0.279	0.99 (0.96–1.02), p = 0.591	1.01 (0.97–1.04), p = 0.710	**1.10 (1.02–1.20), p = 0.018**	0.98 (0.95–1.02), p = 0.273	1.04 (1.00–1.09), p = 0.071	0.99 (0.96–1.02), p = 0.555
Gender (ref. female)	**2.32 (1.73–3.11), p < 0.001**	**0.62 (0.46–0.84), p = 0.002**	1.11 (0.83–1.48), p = 0.498	0.58 (0.28–1.19), p = 0.138	0.91 (0.67–1.24), p = 0.561	**0.53 (0.35–0.80), p = 0.003**	**0.52 (0.40–0.69), p = <0.001**
Site (ref. Maastricht)							
Amsterdam	0.87 (0.57–1.33), p = 0.520	0.84 (0.54–1.29), p = 0.422	0.83 (0.55–1.24), p = 0.358	0.97 (0.36–2.59), p = 0.955	1.13 (0.72–1.76), p = 0.593	0.76 (0.43–1.36), p = 0.361	1.03 (0.68–1.55), p = 0.890
Wageningen	1.14 (0.75–1.73), p = 0.541	0.98 (0.64–1.50), p = 0.922	**1.73 (1.14–2.63), p = 0.010**	0.86 (0.32–2.30), p = 0.769	1.49 (0.96–2.30), p = 0.076	0.84 (0.47–1.50), p = 0.550	1.10 (0.73–1.65), p = 0.641
Nijmegen	1.51 (0.99–2.30), p = 0.054	1.02 (0.67–1.56), p = 0.936	1.05 (0.70–1.57), p = 0.805	1.29 (0.46–3.65), p = 0.629	1.53 (0.99–2.37), p = 0.057	**1.98 (1.02–3.84), p = 0.044**	1.19 (0.79–1.78), p = 0.411
Maastricht	0.91 (0.60–1.39), p = 0.671	0.89 (0.58–1.38), p = 0.602	1.35 (0.89–2.04), p = 0.154	1.06 (0.39–2.93), p = 0.906	1.24 (0.80–1.92), p = 0.345	0.89 (0.50–1.60), p = 0.694	1.27 (0.84–1.92), p = 0.251
Education (Ref. high)							
Low	0.71 (0.47–1.07), p = 0.099	**0.49 (0.31–0.76), p = 0.002**	0.92 (0.62–1.36), p = 0.688	0.42 (0.17–1.01), p = 0.051	**0.10 (0.06–0.17), p = <0.001** **0.25 (0.18–**	0.74 (0.43–1.28), p = 0.283 0.75 (0.48–1.18), p = 0.215	1.06 (0.71–1.59), p = 0.765

Medium	0.97 (0.70–1.34), p = 0.843	**0.67 (0.48–0.94), p = 0.019**	0.84 (0.61–1.15), p = 0.272	0.52 (0.25–1.09), p = 0.085	**0.34), p = <0.001**		0.95 (0.69–1.30), p = 0.743
Household income (Ref. high)	0.81 (0.57–1.13), p = 0.218	0.84 (0.60–1.18), p = 0.315	0.77 (0.55–1.07), p = 0.124	0.45 (0.19–1.07), p = 0.072	0.48 (0.34–0.67), p = <0.001	0.66 (0.41–1.08), p = 0.101	2.10 (1.51–2.92), p = <0.001
Low	0.93 (0.67–1.31), p = 0.689	0.79 (0.56–1.11), p = 0.168	0.91 (0.65–1.28), p = 0.604	0.80 (0.31–2.08), p = 0.645	0.86 (0.61–1.22), p = 0.409	1.18 (0.69–2.02), p = 0.547	1.59 (1.15–2.19), p = 0.005
Medium							
Marital status (ref. married or long-term relationship)	0.96 (0.71–1.30), p = 0.800	1.12 (0.83–1.52), p = 0.456	0.95 (0.71–1.28), p = 0.736	0.34 (0.17–0.67), p = 0.002	0.90 (0.65–1.23), p = 0.502	**0.55 (0.36–0.84), p = 0.005**	1.33 (0.98–1.80), p = 0.064
Paid work (ref. no)	0.94 (0.67–1.30), p = 0.696	0.96 (0.69–1.34), p = 0.827	0.92 (0.67–1.27), p = 0.621	1.33 (0.62–2.88), p = 0.462	1.39 (0.99–1.95), p = 0.054	1.59 (0.98–2.57), p = 0.062	0.94 (0.68–1.28), p = 0.676
Depression (ref. no)	**0.22 (0.13–0.36), p < 0.001**					0.67 (0.40–1.12), p = 0.126	
Diabetes (ref. no)		0.92 (0.58–1.46), p = 0.729					
CHD (ref. no)			1.23 (0.82–1.84), p = 0.314				
Alcohol (ref. no)				0.54 (0.28–1.03), p = 0.062			
Smoking (ref. no)							0.62 (0.33–1.17), p = 0.139
Perceived susceptibility x SMC (ref. no)	1.03 (0.85–1.24), p = 0.777	1.01 (0.99–1.02), p = 0.506	0.99 (0.97–1.01), p = 0.324	1.00 (0.96–1.04), p = 0.967	0.99 (0.97–1.01), p = 0.461	0.99 (0.97–1.02), p = 0.637	1.00 (0.98–1.02), p = 0.872

Perceived susceptibility x Family history dementia (ref. no)	0.88 (0.73–1.05), p = 0.155	1.01 (0.99–1.03), p = 0.471	0.99 (0.98–1.01), p = 0.538	1.00 (0.96–1.05), p = 0.841	1.00 (0.98–1.02), p = 0.973	1.01 (0.99–1.04), p = 0.415	0.99 (0.97–1.00), p = 0.122
Perceived severity x SMC (ref. no)	1.08 (0.88–1.33), p = 0.445	1.00 (0.98–1.02), p = 0.864	1.01 (0.99–1.03), p = 0.560	0.98 (0.93–1.02), p = 0.322	1.02 (1.00–1.04), p = 0.134	1.01 (0.98–1.05), p = 0.433	1.00 (0.98–1.02), p = 0.669
Perceived severity x Family history dementia (ref. no)	1.08 (0.90–1.29), p = 0.406	1.01 (0.99–1.03), p = 0.416	1.00 (0.98–1.01), p = 0.713	0.99 (0.94–1.04), p = 0.631	1.01 (0.99–1.03), p = 0.257	1.00 (0.97–1.02), p = 0.822	1.00 (0.98–1.02), p = 0.775
Perceived benefits x SMC (ref. no)	1.06 (0.82–1.38), p = 0.643	1.00 (0.98–1.03), p = 0.814	1.02 (1.00–1.05), p = 0.116	0.98 (0.92–1.04), p = 0.434	0.99 (0.97–1.02), p = 0.695	0.98 (0.94–1.02), p = 0.376	1.01 (0.98–1.03), p = 0.509
Perceived benefits x Family history dementia (ref. no)	1.08 (0.84–1.38), p = 0.553	1.01 (0.98–1.04), p = 0.450	1.01 (0.98–1.03), p = 0.485	1.02 (0.96–1.09), p = 0.498	1.01 (0.98–1.03), p = 0.607	1.00 (0.97–1.03), p = 0.974	1.01 (0.98–1.03), p = 0.668
Perceived barriers x SMC (ref. no)	0.87 (0.66–1.16), p = 0.344	1.02 (0.99–1.05), p = 0.137	1.00 (0.97–1.03), p = 0.911	0.99 (0.93–1.06), p = 0.844	1.02 (0.99–1.05), p = 0.182	1.01 (0.97–1.05), p = 0.778	1.01 (0.99–1.04), p = 0.351
Perceived barriers x Family	1.08 (0.85–1.37), p = 0.529	0.99 (0.97–1.02), p = 0.683	1.00 (0.97–1.02), p = 0.161	1.02 (0.96–1.09), p = 0.435	1.01 (0.99–1.04), p = 0.313	0.99 (0.96–1.02), p = 0.359	**1.03 (1.00–1.05), p = 0.038**

history dementia (ref. no)							
Cues to action x SMC (ref. no)	0.87 (0.69–1.10), p = 0.249	0.98 (0.96–1.01), p = 0.142	1.00 (0.98–1.02), p = 0.918	1.02 (0.96–1.08), p = 0.544	1.00 (0.97–1.02), p = 0.684	1.02 (0.99–1.06), p = 0.186	1.00 (0.98–1.02), p = 0.985
Cues to action x Family history dementia (ref. no)	1.02 (0.82–1.27), p = 0.872	0.97 (0.95–1.00), p = 0.017	1.01 (0.99–1.03), p = 0.410	1.00 (0.94–1.07), p = 0.907	0.98 (0.96–1.01), p = 0.139	1.00 (0.97–1.03), p = 0.930	1.00 (0.97–1.02), p = 0.656
General health motivation x SMC (ref. no)	1.03 (0.80–1.34), p = 0.801	1.00 (0.98–1.03), p = 0.943	1.00 (0.97–1.02), p = 0.844	1.04 (0.98–1.10), p = 0.183	1.00 (0.98–1.03), p = 0.861	1.01 (0.97–1.06), p = 0.502	1.00 (0.98–1.03), p = 0.992
General health motivation x Family history dementia (ref. no)	0.85 (0.66–1.08), p = 0.175	0.99 (0.97–1.02), p = 0.479	0.99 (0.97–1.01), p = 0.399	**1.09 (1.02–1.15), p = 0.008**	1.00 (0.98–1.03), p = 0.868	1.03 (0.99–1.06), p = 0.100	0.99 (0.96–1.01), p = 0.286
Self efficacy x SMC (ref. no)	0.96 (0.75–1.23), p = 0.752	0.99 (0.96–1.01), p = 0.306	1.00 (0.98–1.03), p = 0.846	1.00 (0.95–1.06), p = 0.906	1.00 (0.98–1.03), p = 0.864	1.01 (0.97–1.05), p = 0.543	**0.97 (0.95–0.99), p = 0.017**
Self efficacy x Family history	1.02 (0.81–1.29), p = 0.849	1.01 (0.99–1.03), p = 0.459	0.99 (0.97–1.01), p = 0.425	0.96 (0.90–1.02), p = 0.194	1.02 (0.99–1.04), p = 0.168	0.97 (0.94–1.01), p = 0.110	0.99 (0.97–1.01), p = 0.419

dementia (ref. no)	

Table 5 - Nagelkerke R^2 values for logistic regression models predicting health behaviors.

	Good sleep quality	Healthy diet quality	Sufficient physical activity	Non-smoking	Sufficient cognitive activity	Sufficient social engagement	Low/moderate alcohol use
Model 0	0.037	0.032	0.02	0.033	0.032	0.034	0.011
Model 1	0.104	0.047	0.039	0.045	0.054	0.051	0.064
Model 2	0.118	0.073	0.044	0.121	0.293	0.104	0.092
Model 3	0.202	0.095	0.062	0.168	0.305	0.143	0.117
Model 4	0.192	0.074	0.045	0.149	0.294	0.124	0.107

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Intermezzo 2

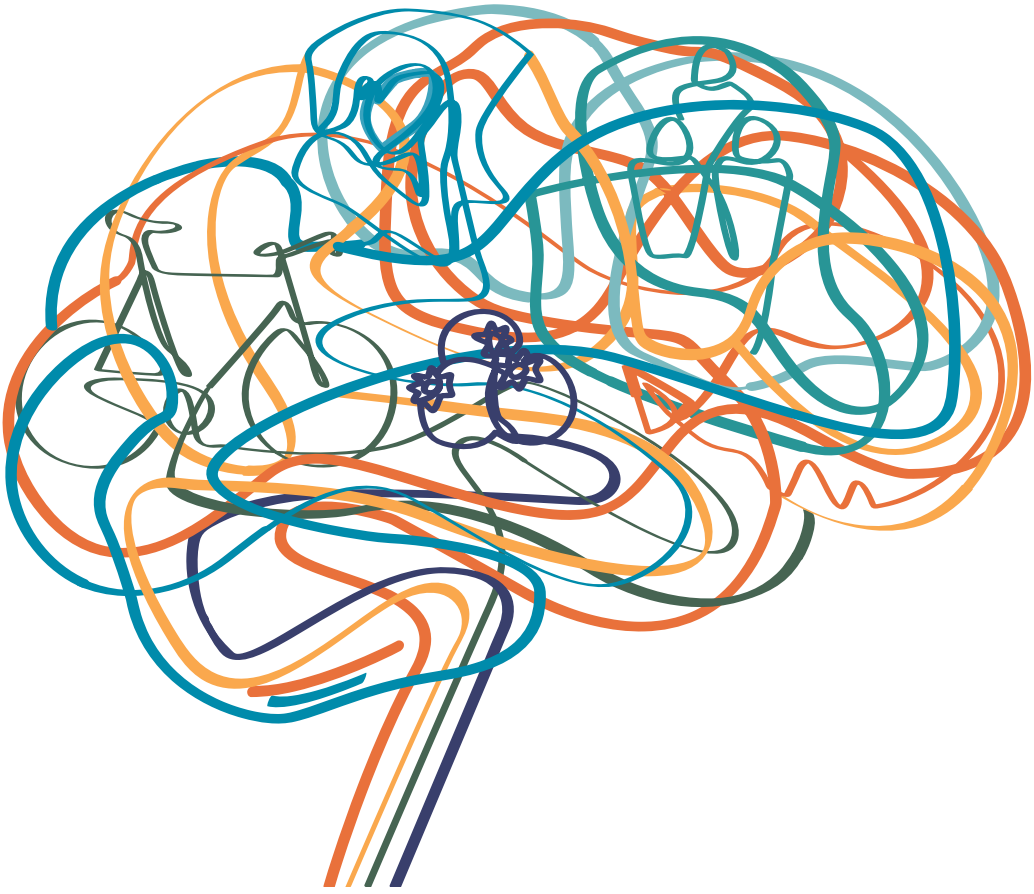
De ‘Nun study’

In 1986 begon epidemiologist David Snowdon een onderzoek: de Nun Study. Hij volgde 678 Amerikaanse nonnen die aan waren gesloten bij de zusters van de school van Notre dame. Doordat al deze zusters een vergelijkbaar leven leidde, kon het team onderzoeken wat zien wat voor aspecten invloed hebben op gezondheid, geheugen en dementie. Bij de start van het onderzoek waren alle deelneemsters tussen de 75 en 102 jaar oud. De opleiding van de deelneemsters aan de Nun Study varieerde van basisschoolniveau tot promotieniveau, maar 85% behaalde minstens een bachelordiploma en 89% werkte op enig moment in hun carrière als docent (n = 678).

Een van de interessantste ontdekkingen uit dit onderzoek was dat het taalgebruik van de nonnen in hun autobiografieën een belangrijke voorspeller was voor hun latere denkvermogen. Deze autobiografieën schreven zij toen ze het klooster binnentraden. Nonnen die rijker en complexer taalgebruik gebruikten, met meer variatie en levendigheid, hadden later in hun leven een kleinere kans op cognitieve achteruitgang en de ziekte van Alzheimer.

Deze vroege bevindingen uit de Nun Study over het verband tussen taalvaardigheid op jonge leeftijd en cognitief functioneren op latere leeftijd wezen op ‘cognitieve reserve’ als een mogelijke verklaring voor veerkracht. De National Institutes of Health omschrijft cognitieve reserve als het vermogen van de hersenen om beter te functioneren dan je zou verwachten, ondanks veranderingen door veroudering, hersenletsel of ziekte. David Snowdon en zijn collega’s vermoedden dat deelnemers met een sterkere taalvaardigheid op jonge leeftijd ook een grotere cognitieve reserve hadden. Deze reserve zou hen beter beschermen tegen cognitieve achteruitgang en aandoeningen zoals Alzheimer op latere leeftijd.

Verder vonden Snowdon en zijn collega’s nog een aantal opvallende verbanden in de autobiografieën van de nonnen. Ze ontdekten drie indicatoren die samenhingen met een langere levensduur: het aantal positieve zinnen, het gebruik van positieve woorden en de variatie aan positieve emoties in het schrijven. Nonnen die meer positieve emoties gebruikten in hun vroege levensverhalen hadden een grotere kans om een hoge leeftijd te bereiken. Tegelijkertijd waren er veel persoonlijke eigenschappen die de onderzoekers niet uit de autobiografieën konden afleiden, zoals langdurige hoop of somberheid, optimisme, pessimisme, ambitie en andere karaktertrekken. Daarnaast speelde ook opleidingsniveau een belangrijke rol. Nonnen met een hogere opleiding ontwikkelden later minder vaak Alzheimer en leefden gemiddeld langer dan nonnen zonder hogere opleiding. Ook fysieke activiteit bleek belangrijk: nonnen die regelmatig bewogen, behielden hun cognitieve vaardigheden beter, zelfs als ze pas op latere leeftijd met sporten begonnen.



CHAPTER 6

Using Qualitative Comparative Analysis to identify components for successful weight loss interventions

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Abstract

Objectives: Obesity treatment requires a multifaceted approach addressing various lifestyle factors. Current research often overlooks interactions between different intervention components. We used a crisp-set Qualitative Comparative Analysis (QCA) to explore how intervention components ('conditions') interact in weight loss interventions in adults with obesity.

Methods: Data from 26 published weight loss intervention studies with 58 arms from a systematic review served as QCA 'cases'. Data were extracted and calibrated based on five conditions: (1) energy restriction, (2) physical activity, (3) behavioral change strategy, (4) group setting, and (5) intervention duration of ≥6 months. Cases with ≥5% population-level weight loss were considered successful. Necessity and sufficiency analyses were conducted to identify conditions for a successful outcome.

Results: The necessity analysis indicated that no single condition alone could fully explain successful weight loss. The sufficiency analysis identified one configuration (combination of conditions) leading to successful weight loss including the conditions: dietary energy restriction, physical activity, and a behavioral change strategy (consistency: 0.78; coverage: 0.64).

Conclusions: This QCA showed that a combination of dietary energy restriction, physical activity, and a behavioral change strategy is linked to successful weight loss, demonstrating that no single factor alone ensures success, highlighting the complexity of weight loss interventions.

Introduction

Obesity is a complex chronic disease (1), contributing to an increased risk of a variety of comorbidities, including cardiovascular diseases, diabetes, musculoskeletal disorders, various types of cancer, and impaired mental health (2-4). It is caused by a complex interplay of biological, genetic, epigenetic, environmental, and psychosocial factors (5). Furthermore, the social and physical environment influence lifestyle behaviors, such as diet and physical activity (6, 7), which are highly related to the development of obesity (8). Weight loss of 5-10% is associated with a wide range of health benefits including reduction of fasting blood glucose, HbA1c values, systolic and diastolic blood pressure, and improvement in plasma lipid profile (9).

Weight loss interventions are complex and require a multifaceted comprehensive approach targeting multiple lifestyle factors (10). They vary greatly in how they are designed and structured. Apart from the dietary component, they may also include various other elements, such as physical activity and/or behavior change (11). Moreover, various strategies and methods of delivery are used in these interventions. Factors such as the duration, number of contact moments and counseling time of interventions might also impact their outcome (12). Also, the intervention context encompasses a range of factors that influence the intervention, such as including social relationships and living environment (13). Consequently, interventions with similar components may yield different outcomes depending on the contextual setting (14). Overall, interventions aimed at weight loss vary significantly in their outcomes due to the diverse configurations of components within the interventions.

Previous studies have provided valuable insights into the effectiveness of individual interventions (15). However, these only explain a small part of the variance of the outcome (16) and often lack information on how the different components of an intervention interact with each other, partly due to insufficient data (17). Standard statistical methods and meta-analyses generally assume that the effect of an independent variable remains constant. Yet, this is not applicable to complex interventions such as weight loss interventions. These interventions are characterized by the nonlinearity of effects, where outcomes depend on the combination and context of the components (18). In contrast to a linear effect, nonlinearity of effects occurs when the combined effect of multiple components within an intervention produces outcomes that differ from the sum of their individual effects. This complexity is especially evident in weight loss interventions, which tend to exhibit more complex and non-linear effects when different components are combined (19).

Designing effective interventions aimed at weight loss requires a thorough understanding of how various intervention components interact with each other. Qualitative Comparative Analysis (QCA) offers the possibility to examine these complex causal pathways that characterize interventions such as multifactorial weight loss interventions (‘causal

complexity'). QCA was originally developed by Ragin for use in political, historical and social sciences (20). While the methodology is still mainly used in these fields, its increasing application in public health research shows its ability to address causal complexity (21).

The primary strength of the QCA method lies in its ability to address causal complexity. This includes situations where multiple components jointly lead to an outcome or where different configurations of components lead to the same outcome. Rather than isolating independent components that explain the most variance in the outcome, QCA aims to identify various configurations of components, including contextual factors that are related to the outcome (17).

In this study, we aimed to investigate the complex causality between different intervention components and their effects in adult individuals with overweight or obesity, focusing on interventions aiming at weight loss.

Methods and Results

In this QCA, we analyzed the complex relationship between different intervention components and effective weight loss in adults with overweight and obesity enrolled in a weight loss intervention study. We explored the relation between various intervention components (hereafter called 'conditions') and ≥5% weight loss on group level (outcome). In common QCA terminology, the selected lifestyle interventions are referred to as 'cases'. For this study, a crisp set QCA (csQCA) was used. CsQCA deals with binary or 'crisp' sets, where conditions and outcomes are either present '1' or absent '0' in a set of cases.

In the set-theoretic QCA approach, individual cases (in this study, the cases are the intervention studies) are classified according to whether they belong to a 'set'. Each case can either be a 'member' of a set, indicating that a certain condition or outcome is present, or not, indicating its absence. This determines set-membership. A set includes cases that share a particular condition, or combination of conditions. The concept of subsets plays an important role in QCA. A subset occurs when cases with a particular condition or combination of conditions consistently also demonstrate the outcome. The condition or combination are then considered to cause (or be "sufficient" for) the outcome. Thus, by assessing how sets of cases relate to the outcome, necessity and sufficiency of the conditions for the outcome can be determined. Necessity means that the outcome cannot occur unless this condition is present. In other words, the condition must exist for the outcome to be possible, but it alone may not be enough to produce the outcome. Sufficiency refers to a condition or a configuration of conditions being sufficient for the outcome. Whenever the condition or configuration occurs, the outcome will also occur,

although the outcome can also occur in other ways. If a configuration is sufficient, it means that it is a subset of the set of all configurations that lead to the outcome.
QCA is an iterative method, meaning part of the methodology is to revisit earlier research steps and the research design itself based on emerging insights, involving a continuous 'dialogue between ideas and evidence' (20). For this reason, we chose to present the methods and results together, as outcomes often guide the next methodological step. Figure 1 summarizes the design, analysis stages, and key results. The process began with defining the QCA model, followed by three steps, based on the data analysis stages outlined by Ragin (20).

Defining the QCA model

Defining the outcome

Cases were members of the set of cases with the successful outcome, if they resulted in weight loss of ≥5% compared to baseline. This cut-off is based on evidence for significant positive metabolic health effects in patients with overweight and obesity after a weight reduction of 5-10% (9). Since data on individual level was not available, the outcome was assessed on study population level in each case.

Selecting and defining conditions

According to Ragin (20), a QCA model should include four to eight 'conditions', which in our study can be described as the components of an intervention. After an in-depth review of the literature and two expert opinion sessions with co-authors BvdM and MdvdS, five conditions were selected and pre-defined for the QCA model: (1) dietary energy restriction, (2) physical activity, (3) behavioral change strategies, (4) intervention setting (group versus individual), and (5) duration of the intervention. The definition and hypothesized associations of each condition to the weight loss outcome, as examined from literature, are provided in Appendix 1.

Selecting and defining cases

For the selection of cases, we followed a strategy similar to that of Thomas, O'Mara-Eves (17), which involved including studies from a recently published systematic review. We purposefully selected the systematic review by de Menezes, Duarte (10), on weight loss interventions aimed at managing obesity in primary and secondary health care. This review was considered to be appropriate, because it focuses on weight loss interventions in adults with obesity and includes a sufficient number of recent studies with relevant and sufficient data on various intervention components. In QCA, cases must be selected based on their comparability, ensuring that they are similar enough to be comparable while also achieving a maximum of heterogeneity (22). Given that all intervention studies we included as cases focused on weight loss in adults with obesity, we considered them similar enough to compare. On the other hand, because of the different setups of intervention components across the studies, they form a heterogeneous set of cases, allowing for proper comparison

between different combinations of components. Table 1 shows the inclusion and exclusion criteria applied by de Menezes, Duarte (10) along with the additional criterion to exclude studies in a population not generalizable to the general population.

Figure 1. Overview of the QCA process in this study

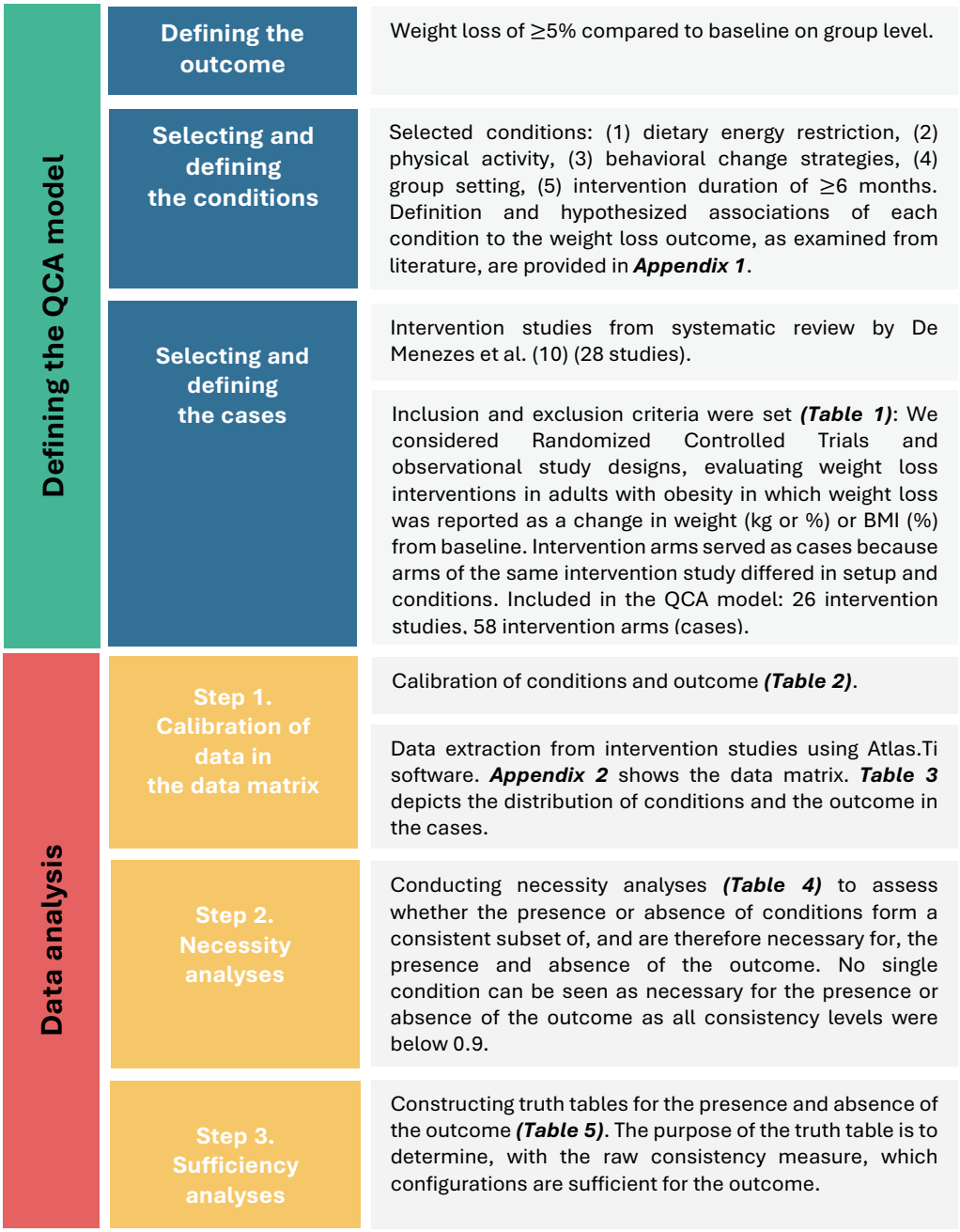


Figure 1. Overview of the QCA process in this study (continued)

Step 3. Sufficiency analyses	The complex solution for the presence of the outcome ***(Table 6.1)*** consists of one configuration in which the conditions 'caloric restriction', physical activity, and behavioral change strategy are present, with a coverage of 0.64 and consistency of 0.78. The complex solution for the absence of the outcome ***(Table 6.2)*** consists of three solutions with an overall coverage of 0.57 and consistency of 1.

Table 1. Inclusion and exclusion criteria

Criteria used in De Menezes et al. (2020) systematic review	
Inclusion criteria	Exclusion criteria
• Adults and elderly (≥20 years of age); • Randomized Controlled Trials evaluating nutritional intervention for weight loss in primary or secondary • Intervention duration of ≥12 weeks; • Comparison with control or another intervention; • Adults with a BMI of (rounded numbers) >30 kg/m^2 at baseline on group level; • Report of data on weight loss in kg or %.	• Experimental or observational studies; systematic reviews and meta-analyses; letters; and editorials; • Any duplicate or redundant publications; • Studies with a nutritional supplement or surgical intervention; • Studies performed on pregnant or immunosuppressed individuals.
Additional exclusion criterion in this QCA	
• Studies with a study population not generalizable to the general population (i.e., eating disorder, cancer, chronic kidney disease, severe mental disorder, cognitive impairment, only including one sex, etc.).	

The inclusion and exclusion criteria were met by 26 of the 28 studies from the systematic review by de Menezes, Duarte (10) and these were selected for the QCA. Two studies were excluded after applying the additional exclusion criterion; one study involved only men (23) and the other focused on cancer survivors (24). Each study included multiple arms, including the intervention arm, variations of the intervention and thus multiple intervention arms, or (active) control arms. We analyzed each arm individually as a stand-alone intervention. As a result, a total of 58 interventions from the 26 studies were selected as the sample population of cases (data matrix) for the QCA. Information on the studies included can be found in the review by De Menezes, Duarte (10).

Data analysis

Step 1. Calibration of data in the data matrix

The 'data matrix' is a structured representation that includes all necessary information about the outcome and conditions in the QCA model. The key step in building the data matrix involves the 'calibration' of raw data from the cases. Calibration is the process of assigning 'set-membership scores' to cases for the outcome and each condition. Each outcome or condition is coded as '1' (membership in the set) or '0' (non-membership in the set). The criteria for assigning scores to the outcome and conditions in our matrix are presented in Table 2 below.

Table 2: Calibration of the QCA outcome and conditions

Outcome	**(0)**	**(1)**
Weight loss >5% from baseline	Not present (thus <5%)	Present
Condition	(0)	(1)
Dietary energy restriction	Not present	Present
Physical activity	Not present	Present
Behavioral change strategy	Not present	Present
Group setting	Not present (thus individual setting)	Present
Intervention duration of ≥6 months[1]	Not present (thus <6 months)	Present

[1]After resolving contradictory configurations (step 3), the condition 'intervention duration' was recalibrated. The analysis was carried out with the final calibration of intervention duration with the cut-off at 6 months.

Based on the criteria described in Table 3, we extracted information from the intervention studies on the outcome and conditions, using the software program ATLAS.ti. version 23.21. The codes in ATLAS.ti on the outcome and conditions of each intervention arm were used to build the data matrix (Appendix 2). Table 3 shows how often the outcome and conditions were present in the cases. The proportions fulfill the skewness norm of Oana et al. (25).

The result of the calibration process is presented in the data matrix (Appendix 2.) This data matrix was uploaded into the software program QCA version 4.1 (26), which was used to

analyze the data following the steps described below.

Table 3. Distribution of conditions in the cases

	Distribution in cases (n)	***Percentage (%)***
Outcome		
≥5% weight loss	28 out of 58	***48%***
Conditions		
Dietary energy restriction	34 out of 58	***59%***
Physical activity	43 out of 58	***74%***
Behavioral change strategy	34 out of 58	***59%***
Group setting	29 out of 58	***50%***
Intervention duration of ≥6 months[1]	44 out of 58	***76%***
[1]After resolving contradictory configurations (step 3) the condition 'intervention duration' was recalibrated. The analysis was carried out with the final calibration of intervention duration with the cut-off at 6 months.		

Step 2. Necessity analyses

Necessity analyses were conducted to assess whether individual conditions form a consistent subset of and are therefore 'necessary' for the presence or absence of the outcome. A condition should have a consistency level of at least 0.9 before it can be considered necessary. Since the conditions did not exceed that threshold (Table 4), none of them were considered necessary.

Table 4. Necessity analyses

	Presence of the outcome (weight loss ≥5%)		Absence of the outcome (<5% weight loss)	
Individual condition present	Consistency[1]	Coverage[2]	Consistency	Coverage
Dietary energy restriction	0.86	0.67	0.40	0.33
Physical activity	0.89	0.56	0.67	0.44
Behavioral change strategy	0.75	0.62	0.43	0.38
Group setting	0.68	0.66	0.33	0.34
Intervention duration of ≥6 months	0.68	0.43	0.83	0.57
Absence of individual condition	Consistency	Coverage	Consistency	Coverage

No dietary energy restriction	0.14	0.18	0.60	0.82
No physical activity	0.11	0.23	0.33	0.77
No behavioral change strategy	0.25	0.29	0.57	0.71
No group setting *(thus individual setting)*	0.32	0.31	0.67	0.69
No intervention duration of ≥6 months *(thus <6 months)*	0.32	0.64	0.17	0.36

[1] The consistency rate indicates the extent to which a condition is necessary for the outcome.

[2] The coverage rate indicates how much of the outcome is explained by a necessary condition or combination of conditions. The more the coverage rate nears 1, the more relevant the condition is, although there is no strict lower limit for this parameter.

Step 3. Sufficiency analyses

To perform the sufficiency analyses, we constructed a truth table from the data matrix, which lists all logically possible configurations of conditions and how cases are distributed across these configurations (14) (Table 5), for both presence (Table 5.1) and absence (Table 5.2) of the outcome. Following the csQCA procedure, we assessed the quality of the truth table by reviewing it for contradictory configurations, where cases share the same causal conditions, but have different outcomes. Resolving these contradictory configurations is a standard step in QCA. This typically involves checking if the raw consistency of the truth table rows can be improved by deleting cases, adding conditions, or adjusting the calibration of the data Ragin (20). We re-examined how the various conditions in the model were operationalized and recalibrated the condition 'Intervention duration'. Initially, we set the threshold at 12 months, coding interventions under 12 months as '0' (out of the set) and those lasting 12 months or more as '1' (in the set), based on literature supporting successful weight loss over this period (27). Upon re-evaluation, we revised the threshold to 6 months, aligning with European guidelines for obesity management in adults (28) and applied this cut-off in the final calibration (Table 2). This recalibration resolved some of the contradictory configurations.

Once the truth table was generated, the minimum consistency for each configuration of conditions was established. In csQCA, it is recommended to achieve a consistency of 75% (or 0.75). This means that 75% of cases with a particular configuration should lead to the presence of the outcome (i.e., ≥5% weight loss) for that configuration to be considered sufficient for a successful outcome.

Table 5. Truth tables for presence (5.1) and absence (5.2) of the outcome

***5.1** Truth table for **presence** of the outcome (i.e. ≥5% weight loss)* [1]							
Dietary energy restriction	**Physical activity**	**Behavioral change strategy**	**Group setting**	**Intervention duration of ≥6 months**	**# cases** [2]	**Outcome ≥5% weight loss**	***Raw consistency*** [3]
1	1	1	0	0	1	1	*1*
1	1	1	1	1	14	1	*0.79*
1	1	1	1	0	4	1	*0.75*
1	1	1	0	1	4	1	*0.75*
1	1	0	0	0	3	0	*0.67*
1	1	0	1	0	3	0	*0.67*
1	0	0	0	1	3	0	*0.67*
0	0	0	0	0	2	0	*0.50*
0	1	1	1	1	7	0	*0.43*
0	0	0	0	1	6	0	*0*
1	1	0	0	1	4	0	*0*
0	1	1	0	1	3	0	*0*
0	1	0	0	1	2	0	*0*
0	0	0	1	0	1	0	0
0	0	1	0	1	1	0	0
***5.2** Truth table for **Absence** of the outcome (i.e. <5% weight loss)* [1]							
Dietary energy restriction	**Physical activity**	**Behavioral change strategy**	**Group setting**	**Intervention duration of ≥6 months**	**# cases** [2]	**Outcome <5% weight loss**	**Raw consistency** [3]
0	0	0	0	1	6	1	1
1	1	0	0	1	4	1	1
0	1	1	0	1	3	1	1
0	1	0	0	1	2	1	1
0	0	0	1	0	1	1	1
0	0	1	0	1	1	1	1
0	1	1	1	1	7	0	0.57
0	0	0	0	0	2	0	0.50
1	1	0	0	0	3	0	0.33
1	1	0	1	0	3	0	0.33
1	0	0	0	1	3	0	0.33
1	1	1	1	0	4	0	0.25
1	1	1	0	1	4	0	0.25
1	1	1	1	1	14	0	0.21
1	1	1	0	0	1	0	0

[1]The truth table for presence of the outcome displays all observed configurations of conditions in the data matrix, the number of cases per configuration, the presence of the outcome ≥5% weight loss and the absence of the outcome (<5% weight loss) in Table 5.2, and the raw consistency. Each row represents a unique combination of conditions and its association with the outcome.

[2] The number of cases indicates how many cases share the specific configuration of conditions in the truth table.

[3] The raw consistency shows the proportion of cases in a configuration aligning with the observed outcome, with '1' indicating perfect alignment. The configurations with a raw consistency of ≥0.75 (highlighted) included in the sufficiency analyses.

Sufficiency analyses were conducted based on the truth table for presence and absence of the outcome. By logically minimizing the 'sufficient' truth table rows (i.e., consistency level of ≥0.75), the complex solution is obtained (Table 6).

The complex solution for the presence of the outcome (Table 6.1) presents one configuration for achieving the outcome of ≥5% weight loss in which three conditions are present; energy restriction, physical activity and behavioral change strategy. The group setting as well as duration of ≥6 months are not included in the solution. This is because the analysis indicates that both presence and absence of these conditions resulted in the same outcome within our dataset. Thus, they are irrelevant as they effectively offset each other and do not provide meaningful differentiation in terms of effectiveness, a concept referred to as 'redundant' in QCA terminology. This solution configuration is present in 23 out of the 58 cases in the data matrix. The consistency rate of 0.78 means that in 78% (18 out of 23) of the cases with this configuration there is a ≥5% weight loss (a 'successful' outcome), and in 5 cases there was <5% weight loss (an 'unsuccessful' outcome). The coverage of 0.64 indicates that 18 of the interventions with successful weight loss outcomes out of the 28 cases in total (64%) is explained by this combination of conditions. The complex solution for the absence of the outcome, i.e. <5% weight loss (Table 6.2) presents three configurations. Configuration 1 shows that the combined absence of dietary energy restriction and physical activity is a subset of, and therefore sufficient for the absence of the outcome. Thus, when both energy restriction and physical activity are missing, the outcome is absent. In this solution, behavioral change strategies show to be redundant, there is no group setting (thus individual setting), and the duration is longer than 6 months. The configuration has a raw coverage of 0.40, indicating that 40% of all cases with unsuccessful outcomes are explained by this combination of factors, with a consistency of 1, showing that in 100% of the cases in which this configuration was present, the outcome was absent (i.e. weight loss of <5%). In configurations 2 and 3, dietary energy restriction is either absent or redundant, and no behavioral change strategy is implemented. Configuration 2 reflects 6 cases (with a coverage of 0.20) and includes physical activity, a group setting, and a duration of six months or more. In contrast, configuration 3 covers only a single case in which energy restriction, physical activity and behavioral change are absent, the intervention is delivered in a group setting, and the duration is less than six months.

Table 6. Sufficiency analyses: Conditions consistent with the presence (6.1) and absence (6.2) of the outcome

	Dietary energy restriction	Physical activity	Behavioral change strategy	Group setting	Intervention duration of ≥6 months	Number of cases	Raw coverage[1]	Unique coverage[2]	Consistency[3]
*6.1 Complex solution: Conditions consistent with **presence** of the outcome (i.e. ≥5% weight loss)*									
Configuration	Present	Present	Present	Redundant[4]	Redundant	23	0.64	0.64	0.78
*6.2 Complex solution: Conditions consistent with **absence** of the outcome (i.e. <5% weight loss)*									
	Dietary energy restriction	**Physical activity**	**Behavioral change strategy**	**Group setting**	**Intervention duration of ≥6 months**	**Number of cases**	**Raw coverage[1]**	**Unique coverage[2]**	**Consistency[3]**
Configuration 1	Absent	Absent	Redundant	Absent *(thus individual setting)*	Present	12	0.40	0.33	1
Configuration 2	Redundant	Present	Absent	Absent *(thus individual setting)*	Present	6	0.20	0.13	1
Configuration 3	Absent	Absent	Absent	Present	Absent *(thus <6 months)*	1	0.03	0.03	1
Total solution						17[5]	0.57		1

[1] Raw coverage indicates the proportion of the outcome that can be explained by a solution, ranging from 0-1, without considering whether other configurations might also cover the same cases.
[2] Raw coverage indicates the proportion of the outcome that can be explained by a solution, ranging from 0-1, cases that also contribute to other solutions are excluded.
[3] Consistency measures the extent to which a combination leads to an outcome, ranging from 0-1.
[4] Redundant in QCA means that there are both configurations with these conditions present, as well as absent and therefore are offset against each other.
[5] There are two cases that are present in two solutions, which is the reason that the total number of cases in the total solution is 17 and not 19.

Discussion

In this study, we investigated the complex relationship between different intervention components (conditions) and their effects on individuals with overweight or obesity in weight loss interventions. The results of this QCA indicate that no single condition alone can explain the presence of the successful outcome. Instead, a combination of various conditions contributes to successful weight loss. Our findings confirm the complexity and multifaceted nature of weight loss interventions.

The results in our analysis show that the combination of energy restriction, physical activity, and a behavioral change strategy together are important for achieving ≥5% population level weight loss. This combination of conditions was present in 64% of the interventions ('cases') that successfully achieved a ≥5% weight loss. Although these three conditions had considerable necessity rates, they were neither necessary nor sufficient for the outcome to occur. In other words, they were not enough on their own, as individual conditions, to guarantee success and they were not absolutely required to achieve a successful outcome. Nevertheless, the presence of these conditions in the solution suggests that they are relevant elements to include in interventions. This is supported by the analysis of the absence of the outcome, showing that two configurations associated with less than 5% weight loss lack both energy restriction and physical activity. In two of the three solutions for absence, a behavioral change strategy is absent, while in the third solution it is redundant. Essentially, the first configuration for the absence of the outcome is the reverse of the solution for the desired outcome. However, also in this case, not having an energy restriction, physical activity and behavioral change strategy does not necessarily lead to the absence of the outcome. In interventions with a successful outcome, the conditions 'group setting' and 'duration of intervention ≥ 6 months' were redundant. Although redundant in our dataset, other studies investigating these conditions have drawn other conclusions. A review by Abbott et al. (29) into group versus one-to-one multi-component weight loss interventions concluded that participants of group interventions were more likely to attain ≥5% weight loss compared to those in one-to-one interventions. Factors such as peer support or time efficiency, the latter allowing for more contact time per participant, might play a promotive role in group interventions. Results from a meta-analysis investigating intensity and duration of lifestyle interventions for long-term weight loss suggest that more interventions were associated with greater weight loss at 12 months compared to those with a shorter duration (30). Another review indicated that interventions with a longer duration (e.g., one year), combined with multiple components (diet, physical activity, and behavioral strategies) and/or intensive contacts, resulted in clinically meaningful weight loss (31). However, no studies directly compared different durations or intensities in the same intervention set-up. Overall, similar to the findings from this QCA analysis, the effectiveness of these interventions may be due to the combination of factors, rather than only the inclusion of a group element or the duration alone as single condition.

In order to understand the underlying dynamics in the solution, we looked into the variety within the conditions among the 23 interventions that included the solution configuration for presence of the outcome. While some applied energy restriction via low-fat diets (30, 32), others offered flexibility between low-carbohydrate or low-fat diets (33). Physical activity was included as a structured program in some (34), and as self-reported or technology-assisted activity in others (35). Behavioral change strategies also varied, including group-based sessions for peer support (30, 36) telephone counseling (34, 36) and cognitive-behavioral therapy (38). We also compared configurations leading to the presence of the outcome (n=17) with those leading to the absence of the outcome (n=5). These varied in group size (36), diet type (32), frequency of contact and engagement (35, 37) and population characteristics, such as a prediabetic population (34). This suggests that differences within the configuration conditions or unexamined study characteristics may influence the outcome. For example, the successful group in Dutton and Nackers (36) had 12 participants, while the unsuccessful group consisted of 30. Though both coded as a group setting, the size might have influenced social dynamics. Additionally, the intervention context including personal context, food environment and country may play a role. Most interventions were conducted in high-income countries, highlighting global research disparities (39). It is important to highlight that our results are based on the studies included and cannot be generalized.

Although QCA is not yet widely used in analysis of public health interventions, its application is growing. A review by Hanckel and Petticrew (21) demonstrates the method's diverse applications across various topics, with eight of the 26 public health studies focusing on nutrition and/or obesity. In addition, Parrott and Henry (13) used QCA to explore how context characteristics affect pediatric weight management outcomes. Their approach was comparable to ours, apart from using an outcome specifically defined for the pediatric context. They identified multiple configurations leading to success, while also reinforcing that no single configuration fits all situations. The same was true in a QCA investigating factors that influence overweight and obesity in adolescents, where nine configurations were found for the outcome of overweight and obesity (40). This QCA provides another example of how to use an alternative method to linear regression and meta-analysis for assessing causal pathways in complex health settings. Moreover, this study highlights again the importance of focusing on a combination of multiple (lifestyle) components in the treatment of patients with obesity.

Strengths and limitations

Our study demonstrated the potential of QCA to explore complex relationships between intervention components in weight loss interventions for individuals with obesity. Unlike meta-analyses (41) and systematic reviews (10, 11), QCA identifies and analyzes the combined effects and intrinsic relationships among multiple components. This approach enables a better understanding of the interplay of components, which is a critical factor for the success of lifestyle interventions (42).

However, this study also had several limitations. First, a configuration's success may be influenced by conditions not considered in this QCA. For example, the professional backgrounds or number of healthcare providers involved in delivering the intervention may vary, along with the use of technology for delivering and monitoring intervention components through digital tools. Second, crisp set QCA was chosen because the conditions in this study were either binary in nature, or the available data from the intervention studies provided insufficient information about the conditions to distinguish degrees of set-membership, as is common in fuzzy set QCA (43). While using dichotomized conditions in csQCA improved interpretability, it reduced the nuanced insights provided by approaches like fuzzy set QCA (40). Third, using secondary data from published studies limited the depth of our analysis and interpretation, as also noted by Hanckel, Petticrew (21).

Last, when interpreting our QCA results, it is important to consider that ≥5% weight loss improves individual health, while our analysis focused on study population averages. Population level success may not reflect individual variations, as interventions effective for some participants may appear unsuccessful overall.

Practical implications

The results of this study offer practical guidance for designing weight loss interventions, especially regarding the decision on which (lifestyle and contextual) conditions to include. Practitioners and researchers can use these insights to better tailor interventions to meet the needs of patients and their settings. In this, understanding how individual conditions and the interaction between these conditions affect the intervention's success is key. Nevertheless, more detailed data on various intervention components in weight loss is needed to study the contribution of the multitude of intervention characteristics and interplay between these. As several published studies did not provide complete information about outcomes and conditions our study also revealed a lack of guidelines on describing weight loss intervention methodologies in the literature. There are currently no established guidelines outlining the necessary components of a weight loss intervention designed for a general population. This emphasizes the need for clear criteria for designing, reporting, and assessing such interventions.

Conclusions

This study showed that successful weight loss is linked to the combination of three conditions within weight loss interventions: dietary energy restriction, physical activity, and a behavioral change strategy. Our results, generated by QCA analysis, demonstrate that no single factor alone can guarantee success. Moreover, these findings underscore the complexity of weight loss interventions and the need for further research into how different components interact to support successful interventions.

Statements and declarations

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Appendix 1

QCA model conditions: definitions and rationale

Condition	Definition	Rationale
Dietary energy restriction	Dietary energy restriction is defined as eating plan designed to help treat/manage overweight and obesity with the application of caloric restriction. The condition was coded as present based on study information, ranging from an explicit calorie restriction to a percentage reduction from normal intake. We did not define a minimum or maximum dietary energy restriction.	Clinically significant weight loss may be achieved by obese individuals following an energy-restricted diet (Johnston et al., 2014).
Physical activity	Physical activity is defined as any bodily movement produced by skeletal muscles that require energy expenditure (WHO). E.g., walking, cycling, sports, active recreation, and play. In this study, physical activity includes exercise: exercise is a planned, structured, and repetitive activity to improve or maintain physical fitness and body weight. E.g., aerobic exercise, resistance training.	Regular physical activity enhances the efficiency of diet and is important for maintaining diet-induced weight loss (WHO, 2024).
Behavioral change strategy	A behavioral change strategy is defined as a plan of action that helps an individual modify their behavior to promote better health, with or without the use of theories of change. E.g., Motivational interviewing, goal setting, self-	Behavioral change strategies, especially with the association of a psychologist, increase the adherence to dietetic interventions, leading not only to greater weight loss but maintenance (LeBlanc et al., 2018, Madigan et al., 2022).

	monitoring, problem-solving barriers.	
Intervention setting	The intervention setting refers to whether the intervention is delivered on group level or individual level.	The effectiveness of group lifestyle interventions for weight loss in adults is higher than that of individual lifestyle interventions (Abbott et al., 2021).
Duration of intervention	The duration of intervention, refers to how long the intervention lasted as reported by the author(s) in the intervention studies included in this QCA. E.g., 12 weeks, 24 weeks, 52 weeks.	A longer intervention period, particularly a 12-month intervention, results in greater weight loss and other clinical benefits (Lv et al., 2017).

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Appendix 2. QCA data matrix

Ref no.	Article[1] – arm no[2]	Sufficiency analysis for presence of the outcome	Sufficiency analysis absence of the outcome	Description arm	Dietary energy restriction	Physical activity	Behavioral change strategy	Group setting	Intervention duration of ≥6 months	Weight loss outcome ≥5%
1	**Alghamdi (2017) – arm 1**	Solution		*Intensive lifestyle intervention (ILI)*	1	1	1	0	0	1
	Alghamdi (2017) – arm 2			*Education-only active comparator (AC)*	1	1	0	0	0	0
2	**Appel et al. (2011) – arm 1**	Solution		*In-person support group*	1	1	1	1	1	1
	Appel et al. (2011) – arm 2	Solution		*Remotely group*	1	1	1	0	1	1
	Appel et al. (2011) – arm 3		Solution 1	*Control group*	0	0	0	0	1	0
3	**Ard et al. (2016) – arm 1**	Solution		*Intensive low calorie diet (ILCD)*	1	1	1	1	0	1
	Ard et al. (2016) – arm 2	Solution		*Balanced deficit diet (BDD)*	1	1	1	1	0	1
4	**Beeken et al. (2017) – arm 1**		Solution 1	*Ten top tips (10TT)*	0	0	1	0	1	0
	Beekenet al. (2017) – arm 2		Solution 1	*Usual care*	0	0	0	0	1	0
5	**Bennettet al. (2012) – arm 1**			*Behavioral intervention*	0	1	1	1	1	0
	Bennett et al. (2012) – arm 2		Solution 1	*Usual care*	0	0	0	0	1	0
6	**Bertéus Forslund et al. (2008) – arm 1**		Solution 2	*Three meals per day (3M)*	1	1	0	0	1	0
	Bertéus Forslund et al. (2008) – arm 2		Solution 2	*Threemeals&threesnacksperday (3+3M)*	1	1	0	0	1	0
7	**Dalle Grave et al. (2013) – arm 1**			*High protein diet(HPD)*	0	1	1	1	1	1
	Dalle Grave et al. (2013) – arm 2			*High carbohydrate diet (HCD)*	0	1	1	1	1	1

8	***Dutton et al. (2014) – arm 1***	*Solution*		*Large group(LG)*	*1*	*1*	*1*	*1*	*1*	*0*
	Dutton et al. (2014) – arm 2	*Solution*		*Small group(SG)*	*1*	*1*	*1*	*1*	*1*	*1*
9	***Fabricatore et al. (2011) – arm 1***	*Solution*		*Low fat diet*	*1*	*1*	*1*	*1*	*1*	*0*
	Fabricatore et al. (2011) – arm 2	*Solution*		*Low glycemic load diet*	*1*	*1*	*1*	*1*	*1*	*1*
10	***Guirado et al. (2015) – arm 1***			*Intensive program of change in lifestyle (PICEV)*	*1*	*1*	*0*	*1*	*0*	*1*
	Guirado et al. (2015) – arm 2			*Traditional treatment(TT)*	*1*	*1*	*0*	*1*	*0*	*0*
11	***Jeffery et al. (2003) – arm 1***		*Solution 1*	*Mail intervention*	*0*	*1*	*1*	*0*	*1*	*0*
	Jeffery et al. (2003) – arm 2		*Solution 1*	*Phone intervention*	*0*	*1*	*1*	*0*	*1*	*0*
	Jeffery et al. (2003) – arm 3		*Solution 1&2*	*Usual care*	*0*	*1*	*0*	*0*	*1*	*0*
12	***Lombardo et al. (2014) – arm 1***			*Group1 (G1)*	*1*	*1*	*0*	*0*	*0*	*1*
	Lombardo et al.(2014) – arm 2			*Group2 (G2)*	*1*	*1*	*0*	*0*	*0*	*1*
13	***Mason et al. (2016) – arm 1***	*Solution*		*Mindfulness training*	*1*	*1*	*1*	*1*	*0*	*1*
	Mason et al. (2016) – arm 2			*Without mindfulness training*	*1*	*1*	*0*	*1*	*0*	*1*
14	***Mueller et al. (2010) – arm 1***			*Carbohydrate-controlled diet*	*1*	*0*	*0*	*0*	*1*	*1*
	Mueller et al. (2010) – arm 2			*Fat-controlled diet*	*1*	*0*	*0*	*0*	*1*	*1*
15	***Nackers et al. (2013) – arm 1***	*Solution*		*A 1000 kcal diet*	*1*	*1*	*1*	*1*	*1*	*1*
	Nackers et al. (2013) – arm 2	*Solution*		*A 1500 kcal diet*	*1*	*1*	*1*	*1*	*1*	*1*
16	***Racine et al. (2012) – arm 1***			*DASH diet meals + Medical nutrition therapy*	*1*	*0*	*0*	*0*	*1*	*0*
	Racine et al. (2012) – arm 2		*Solution 1*	*Medical nutrition therapy only*	*0*	*0*	*0*	*0*	*1*	*0*
17	***Rodriguez-Hernandez (2009) – arm 1***	*Solution*		*Cognitive behaviour theory-low carbohydrate diet (CBT-LC)*	*1*	*1*	*1*	*0*	*1*	*1*
	Rodriguez-Hernandez (2009) – arm 2	*Solution*		*Cognitive behavior theory-low fat diet (CBT-LF)*	*1*	*1*	*1*	*0*	*1*	*1*

	Rodriguez-Hernandez (2009) – arm 3		*Solution 2*	*Control group with low carbohydrate diet (C-LC)*	*1*	*1*	*0*	*0*	*1*	*0*
	Rodriguez-Hernandez (2009) – arm 4		*Solution 3*	*Control group with low fat diet (C-LF)*	*1*	*1*	*0*	*0*	*1*	*0*
18	***Rogers et al. (2016) – arm 1***	*Solution*		*Standard behavioral weight loss (SBWL)*	*1*	*1*	*1*	*1*	*1*	*1*
	Rogers et al. (2016) – arm 2	*Solution*		*Technology-based system + monthly intervention telephone call (TECH)*	*1*	*1*	*1*	*1*	*1*	*0*
	Rogers et al. (2016) – arm 3	*Solution*		*Enhanced technology-based system + monthly intervention telephone call(EN-TECH)*	*1*	*1*	*1*	*1*	*1*	*1*
19	***Rosas et al. (2015) – arm 1***			*Case-management intervention (CM)*	*0*	*1*	*1*	*1*	*1*	*0*
	Rosas et al. (2015) – arm 2			*Case-management intervention with community health workers (CM+CHWs)*	*0*	*1*	*1*	*1*	*1*	*0*
	Rosas et al. (2015) – arm 3		*Solution 1*	*Usual care*	*0*	*0*	*0*	*0*	*1*	*0*
20	***Sellman et al. (2017) – arm 1***			*Green prescription plusKia_kina (KA/GRx)*	*0*	*1*	*1*	*1*	*1*	*0*
	Sellman et al.(2017) – arm 2		*Solution 1&2*	*Green prescription alone (GRx)*	*0*	*1*	*0*	*0*	*1*	*0*
21	***Ter Bogt et al. (2009) – arm 1***		*Solution 1*	*Nurse practitioner group(NP)*	*0*	*1*	*1*	*0*	*1*	*0*
	Ter Bogt et al. (2009) – arm 2		*Solution 1*	*General practitioner usual care(GPUC)*	*0*	*0*	*0*	*0*	*1*	*0*
22	***Tonstad et al. (2014) – arm 1***			*High fibre diet*	*0*	*0*	*0*	*0*	*0*	*0*
	Tonstad et al. (2014) – arm 2			*Low carbohydrate diet*	*0*	*0*	*0*	*0*	*0*	*1*
23	***Weinstock et al. (2013) – arm 1***	*Solution*		*Individual calls (IC)*	*1*	*1*	*1*	*0*	*1*	*0*
	Weinstock et al. (2013) – arm 2	*Solution*		*Conference calls (CC)*	*1*	*1*	*1*	*1*	*1*	*1*

24	***West et al. (2011) – arm 1***	*Solution*		*Diabetes prevention program (DPP) lifestyle intervention*	*1*	*1*	*1*	*1*	*0*	*0*
	West et al. (2011) – arm 2		*Solution 3*	*Cognitive training*	*0*	*0*	*0*	*1*	*0*	*0*
25	***Yancyet.al. (2015) – arm 1***			*Choice low carbohydrate diet (Choice LCD)*	*0*	*1*	*1*	*1*	*1*	*1*
	Yancyet.al. (2015) – arm 2	*Solution*		*Comparator low fat diet (Comparator LFD)*	*1*	*1*	*1*	*1*	*1*	*1*
26	***Zwickert et al. (2016) – arm 1***	*Solution*		*Cognitive behavior therapy +intensive technological support (CBT+ITS)*	*1*	*1*	*1*	*1*	*1*	*1*
	Zwickert et al. (2016) – arm 2	*Solution*		*Cognitive behavior therapy + minimal technological support (CBT+MTS)*	*1*	*1*	*1*	*1*	*1*	*1*

[1] Articles are selected from the review of De Menezes et al. (2020) (see Methods & Results), more information on the intervention characteristics can be found in this review or in the articles themselves.

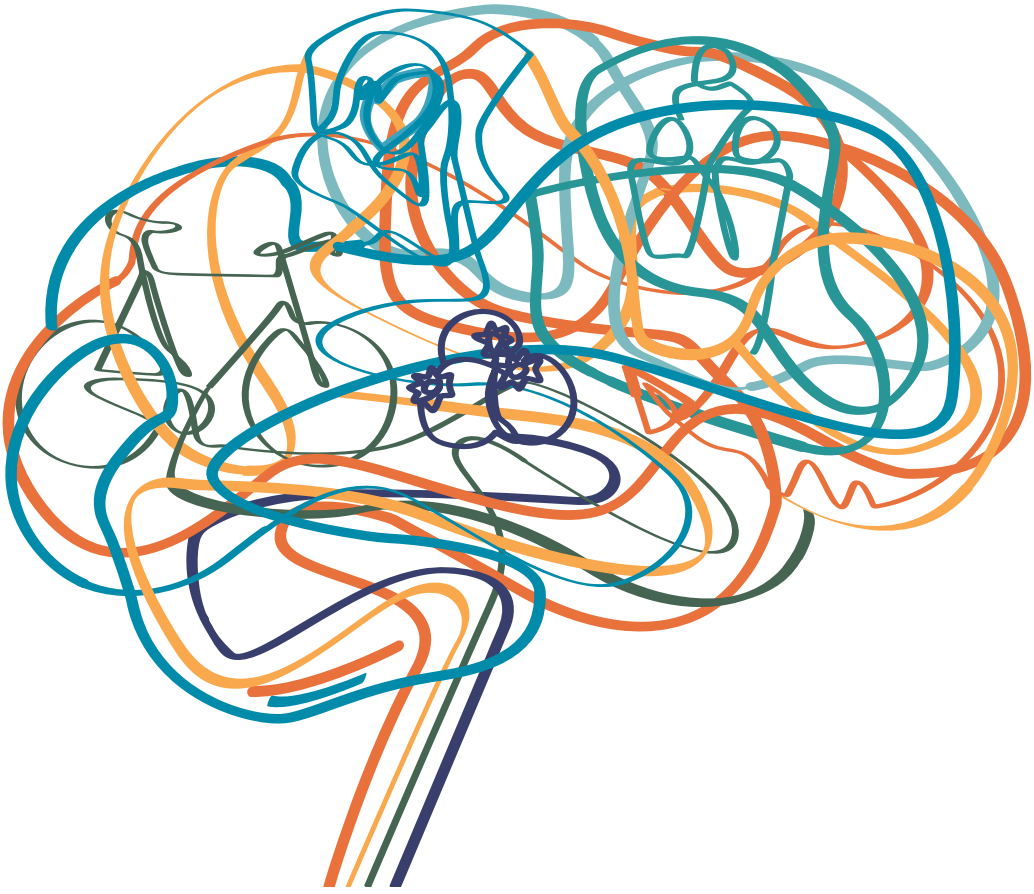
[2] As explained in the Methods & Results section, we took different intervention groups (arms) as separate cases as different arms have a different set-up of conditions.

2 This column indicates whether the case was present in the configuration of the solution.

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CHAPTER 7

Dietitians' perspectives on key components relevant for successful dietetic treatment of adults with obesity in primary health care: a qualitative study in the Netherlands

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Abstract

Background: Dietetic treatment of adults with obesity can result in effective weight loss with health improvements. However, it remains unclear which components of dietetic consultation are key for successful treatment of individual patients. Therefore, the aim of this study is to explore dietitians' peceptions of key components relevant for successful dietetic treatment of adults with obesity in primary health care in the Netherlands.
Methods: In this phenomenological study, semistructured interviews were con-ducted with 18 dietitians who have experience in treating adults with obesity in primary care. Validation of interview data was performed through two focus group discussions with 14 dietitians. Thematic analysis was used to analyse the data.
Results: Four main themes were identified: (i) building a good relationship; (ii) identifying patient needs; (iii) supporting behaviour change and (iv) providing advice. Dietitians highlighted the relevance of building a good relationship with their patients and emphasised adopting a counselling role alongside their role of educator. They also recommended the use of educational materials, counselling techniques and behaviour change strategies (e.g. goal setting, self-monitoring, addressing barriers) to address specific patient needs, such as health literacy, self-efficacy and motivation.
Conclusions: This study demonstrates that dietitians perceive the ability to
build a trusted relationship, in which patient needs are properly explored and addressed, as the key to successful dietetic treatment of adults with obesity. Our findings emphasise the importance of the dietitian's approach in this process and show that patient factors influence the choice of appropriate treatment approaches.

Introduction

Globally, the prevalence of obesity has doubled since 1990, with 16% of all adults being obese in 2022 (1). The same trend is observed in the Netherlands, where 14% of the adult population was obese in 2021 (2). Obesity contributes to a variety of chronic diseases and is associated with negative effects on mental health (3–5). A weight reduction of 5%–10% in people living with overweight or obesity has been associated with positive health outcomes on comorbidities, such as a reduction in fasting glycaemia, hemoglobin A1c, systolic and diastolic blood pressure and plasma lipid profile (6). Therefore, healthcare interventions for people with obesity are usually aimed at weight loss. A systematic review demonstrated that weight loss interventions provided by dietitians during controlled trials are effective in reducing body mass index, waist circumference and blood pressure and have a positive effect on quality of life compared to a control group usual care (7). However, in dietetic practice in the Netherlands, only a quarter of patients with overweight and obesity achieved weight loss of 5% or more and many patients drop out before the recommended treatment time of 6–12 months (8). Thus, dietetic treatment is not effective for a large group of patients, and yet, the underlying causes of this remain inadequately understood (9).

Because the treatment of obesity is complex and requires a multimodal approach (10), dietetic treatment guidelines include a wide range of components that dietitians focus on in consultations with patients with obesity. These guidelines are mainly focused on diet characteristics and weight loss and include general guidance on counselling techniques and multidisciplinary cooperation (11). A review of dietetic guidelines from several European countries on the treatment of patients with obesity showed that it remains unclear which components of dietetic consultation are relevant for the successful treatment of individual patients (12). Dietitians combine the various recommended treatment components in individual treatment based on their experience, but it is unclear how different treatment components interact with each other (13). In contrast to the high number of studies focused on diet characteristics for maximising health benefits, the methods used by dietitians to facilitate these dietary shifts and lifestyle improvement in patients with obesity have been understudied. In addition, most research focuses on the outcomes of an intervention, rather than delving into the experiences of patients and dietitians or the dynamics of the patient–dietitian relationship (14). Previous studies report that treatment should focus on a positive patient–dietitian relationship, individualised care and patient involvement in their care process. However, guidance on how to tailor dietetic treatment based on different patient needs is lacking.

Insights into the experiences of practising dietitians are crucial for obtaining a more comprehensive understanding of the factors that contribute to treatment effectiveness and adherence. Therefore, the aim of this phenomenological qualitative study is to identify key

components relevant for the successful dietetic treatment of patients with obesity from the perspective of primary healthcare dietitians in the Netherlands.

Methods

This study is part of the four-year research project entitled 'Dietetics building the future' (Box 1). Data were collected through a multimethod qualitative study design, consisting of semi-structured interviews, followed by two focus group sessions with primary care dietitians treating adults with obesity and comorbidities in the Netherlands. We reported the findings according to the Standards for Reporting Qualitative Research (15) checklist (see Supporting Information).

Box 1. Description of research project Dietetics building the future

> The research project 'Dietetics building the future' is a research collaboration of (applied) universities, practising dietitians and other relevant stakeholders in the Netherlands to develop an evidence-based toolbox for personalised dietetic care for patients with obesity and comorbidities. The project addresses research questions regarding the optimisation of treatment, improving effectiveness and patients' self-efficacy. Furthermore, the research pays special attention to patients with low health literacy, stimulating behavioural change and application of innovative technologies. The project consists of quantitative analyses and statistical modelling to identify key components of dietetic care. Concurrently, qualitative studies are conducted, such as the current study from the perspectives of dietitians, along with semistructured interviews with patients, to capture their experiences, needs and opinions. The results of the earlier research phases will be used for the development (co-design) and testing of a toolbox, offering personalised interventions based on various individual patient factors. A summary of the project can be found on the website of ZonMw, the organisation that funded this research (16).

Participants and data collection

Individual interviews

In the Netherlands, dietitians operate within a two-tier system comprising primary and secondary care. Primary care dietitians work in the community setting, providing nutritional counselling and interventions for chronic conditions such as obesity. Patients can visit primary care dietitians on their own initiative or can be referred by the general practitioner for either weight loss or dietary advice for comorbidities. Secondary care dietitians, on the other hand, are based in hospitals, where they manage more complex clinical cases, including malnutrition, metabolic disorders and pre- and postsurgical nutritional support. One-on-one interviews were conducted with primary care dietitians treating patients with obesity and comorbidities in the Netherlands. Semi-structured interviews were used because they offer the opportunity to obtain rich data and contextual insights instead of aiming for generalisability (17). By using semi-structured one-on-one interviews, we

provided dietitians with an open space to share their thoughts and experiences. The interviews took place between November 2022 and September 2023.

We recruited dietitians through diverse channels, including the distribution of informational flyers in the newsletter of the Dutch Association of Dietitians and the LinkedIn page of Dietetic Building the Future Research Project (Box 1). To ensure that we captured a wide range of perspectives, we aimed to interview at least 16 dietitians. The sample size is comparable to similar qualitative studies conducted in this field (17). Purposeful sampling was applied to achieve a heterogeneous study sample. To include dietitians treating patients with diverse characteristics, a preregistration questionnaire was used to gather information about the dietitians and their patient populations. In the prescreening questionnaire, questions regarding dietitians' characteristics covered their age, years of professional experience, type of practice, including self-employed and those employed in a dietitians practice, and geographical location. To ensure that participating dietitians worked with a diverse range of patients, we also used the prescreening questionnaire to select dietitians who represented various patient categories. These categories included patients with varying comorbidities, socioeconomic positions, migrant backgrounds, health literacy levels and places of residence (rural or urban). Special attention was given to dietitians treating patients with low (health) literacy levels.

A topic guide was created based on the literature on dietetic treatment of patients with obesity. This guide helped to provide consistency across the different interviews, ensuring that all relevant areas were covered. Additionally, it allowed participants to discuss topics important to them, even if these were not initially included in the guide, thus offering flexibility for in-depth exploration of participant responses (18). The topic guide included the following topics: duration and frequency of consultations, experiences with successful or non-successful treatment, treatment characteristics (e.g., conversation styles used, goal setting, providing feedback, tracking motivation, self-monitoring), patient characteristics (e.g., comorbidities, health literacy), patient–dietitian relationships, behaviour change, information provision, new technologies, early drop-out of patients, treatment outcomes and needs for tools to use in dietetic treatment. For each topic, several probing questions were predefined, but researchers could decide themselves whether to use these. One pilot interview was conducted with both first authors present to test the topic list and probing questions, after which some minor changes were implemented.

The interviews were conducted in Dutch by the primary authors of this research, RO and AvdR, who both have a background and expertise in the fields of human nutrition, health sciences and/or dietetics. The face-to-face interviews took place at the participants' dietetic practices, except for one, which was conducted at the participant's home upon their request. Conducting the interviews in the practice/home setting made it easier to build rapport, create a comfortable environment for the participants and observe social and nonverbal cues (19). Participants were informed about the aim and procedure of the

interview and provided consent before the start of the interview. We aimed to build rapport between the interviewer and the participant by ensuring sufficient time for an introduction of the study and the interviewer and by highlighting that the interview is an open conversation in which there are no right or wrong answers. Interviews lasted approximately one to one-and-a-half hours. The first two interviews were conducted with both first authors (RO and AvdR) present, aiming to ensure a consistent approach throughout and to enable real-time feedback. Dietitians received a 50-euro voucher as reimbursement for their participation in the interviews. After completing the interviews and transcripts, member checks were conducted by providing three participants with summaries of their individual interviews. With these member checks, participants had the opportunity to review the summaries, provide feedback on the interpretations or findings and confirm their agreement with the representations of their perspectives and experiences (20). The participants agreed with the summaries and only minor additions were shared by participants via email.

Focus groups

Subsequently, focus groups were organised to enable dietitians to freely discuss topics raised in interviews with their peers. The use of focus groups alongside individual interviews provides a dual-method approach that offers several advantages. First, it allows for a more comprehensive understanding of the subject through data triangulation, where insights from interviews are validated by the findings of the focus group discussion. Second, topics that may not have been extensively covered or remained unclear in interviews can be further explored and clarified in focus groups. Finally, the group setting of focus groups promotes interaction among the participating dietitians, which results in rich discussions and thereby deeper, and sometimes even new, insights into the topics (21). In addition to data triangulation, practical insights were gathered in the focus group discussions on how to translate important treatment components to practical tools to use in dietetic practice. This will be further explored in the next phase of the research in which a toolbox for dietitians will be developed (Box 1). Recruitment of dietitians for the focus groups was conducted in the same manner as for the interviews. For the focus groups, only dietitians who did not participate in the interviews were selected to obtain different perspectives. The focus group discussions took place in a conference room in two different cities, both located centrally within the Netherlands (Amersfoort and Almere), allowing dietitians from different regions to attend. We aimed to include six to eight participants in each focus group discussion. This number is large enough to allow diversity in the group and to facilitate a discussion. It also ensures that all participants have the opportunity to share, preventing the formation of sub-groups (22). The sessions were scheduled during the evening, each lasting 2 h, with a 15-min refreshment break. Moderation of the focus groups was carried out by the primary authors, RO and AvdR, with assistance from researchers from the Division of Human Nutrition and Health of the Wageningen University and Research. Participants were seated around a table and were encouraged to actively contribute to the discussions. All focus group participants provided informed consent before the start of the discussion. The conversations followed a predefined topic guide, serving as a guide for the

discussion and allowing for a participant-driven exploration. The participants had room to shape the discussion in their own direction, whereas the moderator ensured that all topics were covered. Topics for the focus groups were derived from the data analysis of the interviews to enable data triangulation and validate the findings from the interviews. To design the focus group topics, the two first authors (RO and AvdR) discussed the themes derived from the interviews, composed a list of topics and defined the main priorities. Together with two other authors (EN and HJ), the topic guide and protocol were finalised. The main topics were client characteristics, barriers and facilitators in treatment and motivation and behaviour change.

Recording and transcription

All interviews and focus groups were recorded using audiorecording equipment and transcribed verbatim using Amberscript software. After the interviews and focus groups, the transcribed content was cross-checked against the audio recordings and refined by fourth-year BSc students in Dietetics engaged in the study to ensure the accuracy of the transcription.

Data analysis

Data analysis of the interviews was conducted first, followed by the analysis of the focus groups. For both the analysis of the interview and focus group data, we used a thematic analysis approach as outlined by Braun and Clarke (23, 24). We used a stepwise approach for conducting thematic analysis by following their six-step framework.

Familiarising with the data

Transcripts were read by the researchers to become familiar with the content of the interviews and to make intermediate adjustments in the topic list.

Generating initial codes

In the second phase, initial codes were applied to the interview data in the program ATLAS.ti Web (version 5.20.0). To ensure consistency in the coding process, both first authors (RO and AvdR) independently coded the first three interviews. Thereafter, the codes were discussed in a consensus meeting by RO, AvdR, EN and HJ. Subsequent interviews were coded separately by the two first authors and structural meetings were held between them to discuss the coding process and unclear codes. Coding was performed using both deductive and inductive methods. Due to the semistructured interview set-up, codes deductively emerged from the preset topics.

Additionally, because of the open nature of the interviews, new topics emerged, leading to inductive coding as well. The same principles used for the analysis of the interview data applied to coding the focus group discussions. The topic guide for the focus group discussions included the main topics from the interviews, leading to deductive coding, whereas the new topics that arose during the discussions were coded inductively.

Searching for themes

After coding all interviews, initial codes were grouped into preliminary themes. The collation of codes took place during a work session in which the two first authors (RO and AvdR) and a research assistant discussed the relationships between all codes and emerging themes, and grouped and regrouped these into initial themes. The focus group discussions followed the same themes as the interviews.

Reviewing themes

In the next phase, the initial themes and subthemes from the interviews were discussed and assessed by RO, AvdR, EN and HJ, to determine whether the data that belonged to these themes cohered meaningfully and whether themes were adequately distinct from each other. This involved reviewing whether the coded extracts from the interviews fitted well within the themes, as well as assessing whether the themes reflected the content and meaning of the data set as a whole.

Refining and defining themes

After mapping of themes within the interview data, we further refined and defined the themes. This process included identifying subthemes and providing structure to the complex data set. In addition, we assigned appropriate titles to the themes to accurately reflect their content. During the theme refinement process, multiple discussion meetings were arranged between members of the research team.

Presenting the findings

The final step was to present the thematic analysis in a concise and comprehensive way, while providing sufficient evidence and examples of the different themes. In the presentation of the results, we aimed to represent the views of all participants, supported by individual statements. We reviewed data extracts within each theme to determine which fragments captured the overall message within each theme best. The Dutch quotes were translated into English and checked by a native speaker. Furthermore, the quotes were checked for personal details to ensure the anonymity of individual statements.

Results

Participant characteristics

From the 35 dietitians who applied for the interviews, 18 dietitians (one male and 17 females) were selected to participate in one-on-one semi-structured interviews, and in total, 14 dietitians participated in two focus group discussions from the 21 who applied. The selection was made based on the answers in the preregistration questionnaire and the targeted number of participants (at least 16 for interviews and six to eight for each focus group discussion). We conducted 18 interviews including the pilot interview. All participants were employed in primary care at the time of the study and treated patients with obesity, with or without comorbidities. They either worked as independent dietitians

or within a larger dietetic organisation (salaried). The participants represented 10 out of the 12 provinces in the Netherlands and worked in both rural and urban areas. The youngest participant had worked less than five years as a dietitian, whereas the oldest had worked as a dietitian for more than 40 years.

Themes

The interviews and focus group discussions covered a wide range of topics related to what treatment components are important for successful treatment. Successful treatment was defined and perceived by dietitians as achieving individually determined patient treatment goals and patient satisfaction. We identified four themes (Figure 1): (1) building a good relationship, (2) identifying patients' needs, (3) supporting behaviour change and (4) providing advice. Each theme consists of several subthemes that are presented as subheadings in the text. In addition to treatment components, several patient factors were distinguished by dietitians that interact with the various treatment components, as captured in Figure 2. Participants shared that although they sometimes notice patterns in patient factors, generalisation cannot and should not be made, as every patient is unique. Therefore, the points of attention for each patient factor related to the themes in Figure 2 are intended to provide general guidance for further exploration, rather than strict criteria. The patient factors are integrated throughout the text rather than discussed separately; however, this matrix illustrates their importance across every phase of treatment and across all themes.

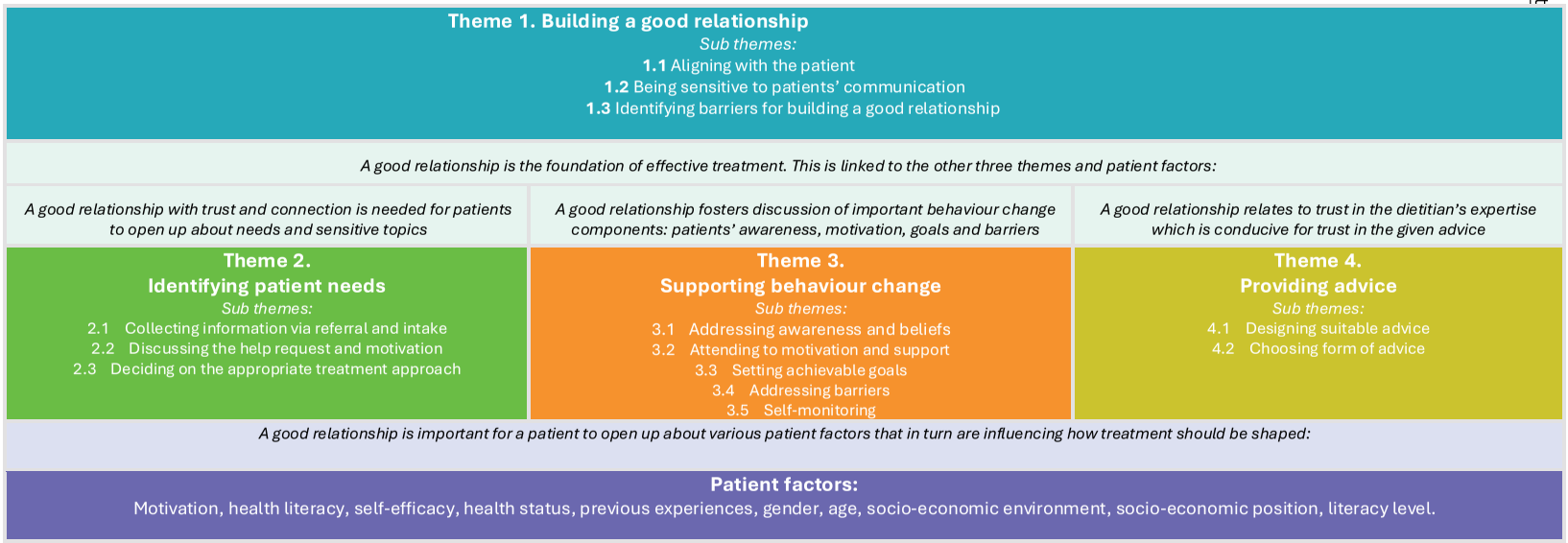


Figure 6. Overview of themes, subthemes and patient factors.

Patient factors	Identifying patient needs	Supporting behaviour change	Providing advice
Motivation	– May be intrinsic/extrinsic – May influence focus on role of dietitian (educator/ counselor)	– Can be explored via exercises and motivational interviewing – May increase by achieving (small) goals	– May influence the focus of advice
Health literacy	– May influence the need for the dietitian to act as accountability partner and the frequency of consultations	– May influence adapting speed and amount of information transfer – May influence need for extra support	– May influence the difficulty level of advice – May influence the speed and amount of information transfer – May influence preference for visuals
Self-efficacy	– May influence the need for the dietitian to act as counselor	– May be important to address by exploring patient's beliefs – May influence the need for support and achievable goals	– May influence type of advice given (focusing on addressing self-efficacy)
Health status	– May influence the help request and motivation	– May influence attuning goals to physical barriers – May influence the need for self-monitoring of health-related parameters	– May influence content of advice (with additional focus on the relation between health and diet)
Previous experience	– May entail insights on best treatment approach	– May influence beliefs, motivation, and self-esteem – May contain information on barriers in previous attempts	– May influence point of departure of advice – May be used to build on previous advice
Gender	– May influence type of approach, e.g. informative versus emotional-psychological	– May influence the preference to talk about feelings	– May influence role division in preparing meals and therefore need to extending advice to partner
Age	– May influence the preference for communication style (e.g. directive versus shared decision making)	– May influence the preference to discuss psychology	– May influence the preference for paper versus digital advice
Socio-cultural environment	– May influence the preference for communication style (e.g. directive versus shared decision making)	– May influence risk perception and motivational factors – May influence support system and the importance of social support	– May influence product choice in advice – May influence integration of socio-cultural factors in advice
Socio-economic position	– May influence the amount and frequency of consultations	– May influence financial barriers or possibilities	– May influence the adjustment of advice to financial capabilities – May influence the choice for suitable difficulty level of advice – May influence the choice of dietary monitoring
Literacy level	– Can be checked via referral, intake or at a later stage once trust is established	– May be a barrier in the uptake and processing of advice	– May influence the preference for visuals and audio – May influence the need for translation or the involvement of an interpreter

Figure 7. Matrix of patient factors that affect dietetic treatment with respect to identifying patients needs, supporting behaviour change and providing advice, according to dietitians

Theme 1: Building a good relationship

Participants perceived the interpersonal relationship between dietitian and patient to be the foundation and often a prerequisite for successful treatment.

> *'Super important, super important. My focus is on the relationship. First, I need to feel that that is good and then we can continue. For me that is fundamental. Very occasionally I think: it doesn't work. Well I can tell you [if the relationship is not good]: the whole treatment will not work.'* (Dietitian 18, interview)

Participants perceived that a good relationship forms the foundation for successful treatment and is linked to the other themes (Figure 2). First, having a good connection is pivotal in identifying patient needs (Theme 2), as a certain level of trust is needed for patients to open up, according to participants. When the patient requires the dietitian to adopt a counselling role in which emotions and psychology are discussed, the quality of the relationship was said to be highly important. On the other hand, when a patient predominantly seeks information, the interpersonal relationship was perceived to be of less importance. Second, to support behaviour change (Theme 3), patients need to feel safe and comfortable to share barriers, emotions, values and motivations that underly their behaviour, according to participants. Finally, participants shared that the relationship is important in providing advice (Theme 4), as they experience that patients tend to take the given information more seriously when a good relationship has been established with trust in the expertise of the dietitian.

Aligning with the patient

The first contact was viewed as an important starting point for gathering information about the patient and building the therapeutic relationship. It was pointed out that a moment of contact even prior to the first visit, by a short phone call for example, may help provide familiarity and take away possible anxiety to overcome 'the hurdle' of a first visit. Participants shared that sharing their own vulnerabilities and using humour in the conversation or talking about light-hearted topics before addressing treatment topics can help in the process to make the patient feel at ease and build rapport. Participants mentioned several success factors for building a strong interpersonal relationship. They stated that it is more important to remain open and receptive to the patient—eliminating one's own opinion and not discussing differences in beliefs. An important factor in building the relationship was connecting with a patient over common interests or characteristics, such as both being dog owners, speaking the same dialect or sharing other similarities. Participants reported that one can always find something to connect over; the key is to display openness, respect and interest in the patients' situation and perceptions.

> 'Then I tell them: I know a bit how rice dishes work [because] I'm from [that continent] myself. You notice that they get happy as their expectation was very low. I only say the word 'okra' [and] they know: 'Alright, we can just be transparent about our habits, y*ou feel the client's relief, you feel a 'she knows what she is talking*

about'. (Dietitian 18, interview)

Establishing trust

Participants indicated that once trust is established in the relationship, they feel that patients become more open and willing to share personal details about their circumstances.

> *'In itself, a personal connection is not necessarily essential, depending on the nature of the issue. For example, with emotional eating, people already feel vulnerable or judged in advance. Well, in that case, that personal connection really helps them to further open up. Well, the tissues are here, they are used a lot; there's quite a bit of crying happening here. So, I think it's important for people to feel safe enough.'* (Dietitian 10, interview)

Being sensitive to patients' communication

In building a connection, participants emphasised the importance of being sensitive to the individual traits of the patient to build understanding, trust and collaboration. They mentioned that dietitians should have attentive 'antennas' that enable them to pick up on nonverbal cues and verbal expressions. Based on these notions, participants shared that they adapt their communication to the patient by tailoring the amount of detail, language complexity and tone. Developing these 'antennas' often comes with experience according to participants in our study. Another enabler was communicating on a first-name basis and using informal forms of address.

> *'I think as a dietitian, you just need to be able to sense things. I mean, in any kind of communication with people, you do. But you just try to sense things. Like, how is someone reacting to the conversation? And sometimes you just let people share their stories. And also gently steer them back towards the direction you want to go as a healthcare provider.'* (Dietitian 9, interview)

Identifying barriers for building a good relationship

Participants indicated that building a strong personal relationship can be challenging at times. For example, differences in interest and communication styles, as well as instinctive sense of liking or disliking the other, were reported as obstacles. In addition, language barriers or the presence of an interpreter can be a barrier for building a good relationship. Identifying one's own personal preferences and annoyances can help to be aware of underlying causes of not feeling a personal connection, according to participants. Participants shared that they can often sense in early stages of the treatment whether there is a genuine connection. In situations where the interpersonal connection is difficult or lacking, indicated that it may be more effective for the patient's treatment to refer them to another dietitian.

> *'I sometimes have patients that I really don't feel a connection with. And then I tell them: well, maybe it is sensible that I will plan a consultation for you with my colleague, who can [better] help you further.'* (Dietitian 3, interview)

Theme 2: Identifying patient needs

Participants emphasised that properly getting to know the patient and their needs is pivotal in shaping successful dietetic treatment. From participants' perceptions, it is important to learn about a variety of patient factors (Figure 2) to tailor the patient's individual treatment trajectory.

> *'To take into account the needs and desires of the person in front of you, instead of a standard list. Yes, that is, I believe, for me the most important.'* (Dietitian 1, interview)

Collecting information via referral and intake

Multiple ways were shared by participants for getting to know the patient. First, contact with other health professionals, such as the general practitioner in case of referral, was considered to be a valuable way of gathering general information about the patient even before the first consultation, for instance about the patient's health status and literacy level. Second, participants reported that they use the first consultation and sometimes a questionnaire to learn more about the patient's background. Finally, participants noted that the first consultation serves as an important moment to discuss expectations and possible prejudices, barriers or anxiety related to the dietetic treatment. During this session, a wide variety of topics are often discussed, such as the patient's daily life and eating habits, his or her social–cultural environment, socioeconomic position, health status, previous experiences, treatment demands, and motivation. Participants shared that patients with different backgrounds might need different focuses during the first consultation. For example, a more thorough in-depth dietary assessment may be required for patients whose cultural background differs from that of the dietitian, according to participants. They noted that discussion of sensitive topics may be more appropriate to address at a later stage. For example, in the treatment of patients with a low literacy level, participants pointed out the importance of building trust, as in their experience, it takes time for patients to open up about having limited literacy skills. In addition, participants shared that simple tests can be used to assess the patient's literacy level. Finally, discussing expectations about treatment and, if necessary, redirecting these were viewed to be important.

> *'And I think what really often hinders people is having incorrect expectations regarding the pace of weight loss. And yes, I believe that I always make it very clear during the intake what a responsible and realistic pace is in general.'* (Dietitian 15, interview)

Discussing the help request and motivation

According to participants, it is essential to discuss expectations of the treatment and to define treatment goals, preferably together with the patient. They emphasised that the

'help request' (referring to the patient's reason for seeking support) should determine the treatment goal.

> *'Your [the dietitian's] directive is of course the patient's treatment demand. What does your patient hope to achieve? That is what you go along with. Also, when someone does not really have a treatment demand or is referred, then you investigate with the right questions: you are here now, where do you want to go? What is your direction? So maybe not a very concrete goal, but a general direction. That can also be enough. So, yes, the patient leads, and we [dietitians] follow.'* (Dietitian 9, interview)

It was reported that not all patients have a clear goal or a help request themselves that is intrinsically motivated. Therefore, participants stressed the importance of identifying the patient's true motivation and whether this is intrinsic or extrinsic. Referral via the general practitioner was said to contribute to intrinsic motivation for some patients, as they viewed the referral as a wakeup call, whereas other patients lack intrinsic motivation and only visit the dietitian because their general practitioner told them to do so, according to participants.

Deciding on the appropriate treatment approach

Participants highlighted that their treatment approach is shaped by the specific needs and expectations of patients. They reported that some patients primarily need knowledge and information on how to change their diet. In these cases, they reported to mainly act as information providers or educators, providing information on what to eat and why. Although information transfer is a standard component in every treatment, participants stressed that the emphasis differs per patient, as they have different knowledge and needs. An example given was that senior patients, in comparison to younger patients, frequently have had more experiences with losing weight and view weight loss more often as 'going on a diet', rather than a more holistic lifestyle change. On the other hand, participants observe that there is a group of patients who need the dietitian to act more as a motivational factor and counsellor. These patients do not only seek information but also rely on the dietitian for support, motivation and guidance. Participants gave account of differences in needs based on the patient's gender. In their experience, male patients more often benefit from a strong focus on practical instructions on diet and lifestyle changes compared to female patients, who generally require a stronger focus on emotional eating or other psychological factors behind their eating patterns.

> *'Some people really see the consultations as a form of accountability, while others have more of a mindset like; 'Well, what are you going to add in terms of information?' (...) So, it also depends on what role they expect from me, I think. I even see someone now who wants to come in every week just to weigh themselves. I let them come in quickly for five minutes, and after three visits of five minutes each I declare a quarter-hour session.'* (Dietitian 7, interview)

Participants shared that many patients see them as their extrinsic motivator. They reported that this role is in particular helpful for patients with low health literacy. These patients often benefit from more frequent consultations in which the dietitian can monitor progress, (re)motivate them, and redirect if necessary. However, in the long term, patients need to build intrinsic motivation, according to participants. Participants also mentioned the value of a shared decision-making approach which gives the patient the feeling of being equal and in a partnership. However, they also described situations in which they adopted a more directive approach based on patients' needs. For example, it was pointed out that senior patients may expect a more directive role from the dietitian, whereas younger patients prefer a collaborative decision-making approach. In addition, participants perceived that patients with a non-Dutch cultural background more often desire a more directive approach at the start compared to patients with a Dutch cultural background.

> *'At first, they expect: you are the health care professional, you are the expert (...) before you try to form an equal relationship, it is important to make sure that they trust you. And in order to trust you (...) it is somewhat top-down. (...) and only later you can get to the same level, step by step. (...) If I start with more interaction, so empowerment of the patient, I may create the idea that I am not enough of an expert.'* (Dietitian 5, interview)

Theme 3: Supporting behaviour change

Participants stressed that making dietary changes is a form of behaviour change. Therefore, it is essential to focus on supporting patients' behaviour change processes within dietetic treatment. Overall, they mentioned that successful treatment often is the result of a combination of facilitators at the patient level that enable them to start changing their behaviour. Figure 2 shows a matrix of patient factors that affect dietetic treatment.

> [Interviewer: 'What are the characteristics of the people who achieve weight loss compared to the rest?'] *Participant: 'A good education, intrinsic motivation, self-management skills, health literacy skills, truly understanding the importance and having the means as well. I think the wallet does play a bigger role than I initially expected when I started [working as dietitian] (...). And especially recognising the importance and being willing to take the time [for the behavioural change process].'* (Dietitian 17, interview)

Adressing awareness and beliefs

Patients' beliefs in their capacity to change behaviour, known as 'self-efficacy', was viewed as an important facilitator in behaviour change for some patients or as a barrier in others. Participants highlighted the value of further exploring the psychology behind the patient's behaviour. It was noted that this can be challenging, as not all patients are open to discussing psychology or simply do not expect this from a dietitian. Participants shared that asking the patient for permission to discuss topics around psychology or using exercises, such as conversation cards on values and beliefs, can be helpful to start the

conversation. Participants also mentioned home assignments focusing on the relation between emotions and eating habits as examples to explore the origin behind behaviour. Discussing awareness of patients' preferences, behavioural patterns and underlying reasons and thoughts was regarded to be crucial for behaviour change. Another important patient factor reported was previous experience with dieting and dietetic treatment, as this can provide insights on what does and does not work for a patient. For patients with failed previous attempts, dietitians stressed the importance of focusing on building self-esteem. Participants reported that patients with obesity more often than other patients struggle with low self-esteem and feel judged within their environment, which may negatively impact their belief in themselves.

> *'There are certain traits of people living with obesity, who have a lower self-esteem, or more self-judgement or are more troubled by the (views of) the outside world.'* (Dietitian A, focus group discussion)

According to participants, it is therefore important to discuss topics around stigma, feelings of shame, and the difficulty of losing weight. They underlined the importance of examining one's own conscious or unconscious prejudices and beliefs around obesity to properly support patients with obesity. Furthermore, they accentuated the importance of discussing the origin of behaviour by talking about mental health and psychology. Participants stressed that although this is important, there is a limit to what they can discuss in their role as dietitians and that in some cases, they need to refer patients to a psychologist.

> *'Sometimes, something else needs to happen, (then) people need to go work on themselves first. It is very confronting, but well. Sometimes you have someone in your practice who does not belong there (but with another health professional). There are clients who come here for their diet, because therein lies a problem, but behind the diet is an (psychological) issue that I cannot fix.'* (Dietitian 12, interview)

Attending to motivation and support

From the participants' perspective, motivation plays a crucial role in initiating and sustaining behaviour change, whereas successful behaviour change can, in turn, influence and enhance motivation. A patient's motivation was said to be very personal and could differ or evolve across the treatment process. Participants stressed that at the start, motivation is needed for patients to initiate the treatment and to make the first lifestyle changes. They shared that they use various techniques to identify patients' true motivation. Examples of these techniques include motivational interviewing and exercises designed to rate the motivation of the patient and discuss the patient's underlying motivation for change.

> *'We were discussing how health is often not a real driving force for people. Of course, they consider it important, but when you delve deeper, it's not their true motivation (...) It's often like, "I actually want to fit into that dress, but it doesn't fit*

> *anymore". You know, that's much more painful than health.'* (Dietitian 9, interview)

Sociocultural background can play a role in patients' motivation according to participants.

> *'I have the feeling that people with a non-western background respond better to risk perception. So like: what could go wrong? And that people with a Dutch background respond better to what opportunities they have [to prevent this from happening].'* (Dietitian 17, interview)

Participants reported that it can be effective to focus on examples of people in the patient's social environment who experienced positive or negative health outcomes related to their diet and discussing support from family and friends. They shared that encouraging the patient to share the weight loss process with others can help to create a more supportive social environment, especially for patients with a socio-cultural environment in which social norms and support systems are more pronounced. In addition, participants reported that patients vary in how easily they ask for support. In that case, it can help to discuss the value of asking for support and expressing their support to patients, by giving compliments and showing empathy, which can also be very motivating for patients according to participants.

Setting achievable goals

Setting realistic goals was reported to be highly important for successful behaviour change. Participants stressed the importance of assisting patients in setting realistic goals, including weight loss goals. Establishing realistic goals helps in maintaining patient motivation in the experience of participants. Furthermore, they underscored the importance of considering patients' individual factors in goal setting, taking patients' physical and mental capabilities into account. Participants agreed that patients with low health literacy benefit from a stronger focus on frequent evaluation, development of self-management skills and bite-size information transfer.

> *'If someone has a bit of a lower educational level, then you advise small bite-size steps that they can take. And then for the next consultation, decide on a clear agreement that suits them. If not, people will more often cancel the appointment.'* (Dietitian 6, interview)

Addressing barriers

Participants highlighted that for effective behaviour change, it is crucial to discuss patients' barriers in their behaviour change process and to find ways to deal with these.

> *'I hope that they understand that it will happen, you will get setbacks. It will simply happen. It is not realistic to expect it not to happen. So what do you want to do with it? (...) The only thing what we can do about it is to reflect and learn from it: alright, where did this originate from? What happened here? And what can you do*

differently next time? So above all, some insight in how things occur.' (Dietitian 10, interview)

Barriers that were reported include financial stress, limited time, money or headspace for behaviour change at the patients' end. Other important barriers to successful treatment were a lack of sustained motivation and priority at the patient's end. Participants reported that it is important to address the value of dietetic consultation during times in which patients deal with such barriers. In their experience, patients who stop visiting the dietitian temporarily in busy times often do not return, resulting in premature dropout. Participants highlighted that unrealistic goals and a hyperfocus on achieving weight loss or other results are important barriers. These can be redressed by focusing on self-compassion, setting achievable goals and focusing on the behaviour change process, rather than, for example, the number on the weighing scale. A final barrier to treatment effectivity that was pointed out is the maximum insurance coverage per year, resulting in (too) limited treatment time for some patients. Participants shared that they sometimes divide treatment time in more frequent short sessions to account for this limitation. However, this was often considered as insufficient for properly discuss a certain topic. Moreover, participants reported that some patients drop out when the insurance limit is reached and do not come back the next year. They noted that actively contacting patients when they cancel the next appointment may provide more insight into barriers to the continuation of treatment for patients and for dietitians to address these.

Self-monitoring

Participants mentioned that a focus on self-monitoring with tools such as a diet-tracking app is effective for patients with adequate digital skills to gain insight into their eating habits. On the other hand, diet diaries in a paper format were reported to be more appropriate for patients with low digital skills and health literacy. In addition, asking patients to take pictures of their food may help to complete a diet diary in patients with low literacy levels, according to participants.

'For some people it works very well to, for example, fill in the diet tracker very committedly, that they really become conscious of: 'this is what I eat every day and whether there is room for something extra or not'. (Dietitian 3, interview)

Monitoring diet or behaviour can be a point of departure for discussing behaviour and causes of preferable and undesirable behaviour according to participants. When patients fail to perform self-monitoring, reasons for this can be discussed as well, such as lack of motivation or confrontation with behaviour.

'I can think of some clients who do not honour their commitments or say, 'I was way too busy to keep such a food diary. Or to write down those emotions or…' So there is also a bit of: 'okay, what is the reason for that?'. I think that makes it more difficult to achieve goals.' (Dietitian 1, interview)

Theme 4: Providing advice

Participants shared important insights on how they tailor their advice to patients' needs. This included ways to design suitable advice and choosing the best form of advice.

Designing suitable advice

Participants stressed that for advice to be effective, it needs to be close to the patient's current behaviour to make the behavioural change as easy as possible. This is done by primarily suggesting small, easily incorporable adjustments to a patient's regular (eating) pattern.

> *'But why does it work [the treatment] for one person and not for another, that is something I find challenging. However, I do think that the greatest successes are achieved by people who indeed, simply maintain a reasonably normal eating pattern, with relatively minor adjustments, and who are patient and approach it seriously.'* (Dietitian 7, interview)

Participants named a sample menu that is close to the patient's normal diet, in combination with variation lists, information about healthy cooking and product knowledge as important basic components of their advice. These pieces of advice were seen as helpful for patients to work towards a healthy diet and vary between different options. Participants mentioned that for many patients, it is also important to discuss the setting in which they eat and provide advice related to the pace of eating, for instance, not to eat in front of a screen. In addition, participants stressed that diet is only one component of a healthy lifestyle and that it is important to pay attention to a wide range of other healthy lifestyle aspects, such as physical activity, sleep, stress, dealing with emotions and self-care. In the treatment of patients with limited financial means, participants highlighted that advice should be tailored to their financial capabilities for the advice to be followed up effectively, by only including products that are affordable. Finally, participants shared that it is important to explain important underlying mechanisms in dietary change in an understandable way. An example of such a mechanism that was frequently mentioned is the nutrition–blood glucose relation for patients with diabetes.

Choosing the form of advice

Participants highlighted that it is important to tailor the form in which they provide advice in a way that is understandable and practical for patients to use. They often share advice digitally but also on paper so that patients have a tangible copy somewhere in their house that they can more easily access and use to make notes. It was seen as important that information is practical, concrete and in simple language. Participants shared that it is important to assess per individual patient what form of information transfer is needed for patients to gain knowledge or develop skills related to achieving a healthier lifestyle.

> *'[Talking about patients with a low literacy level] Before I made entire pieces of*

> *advice with a lot of pictures of products that I cut out of the flyers from the super market. And then I thought, why not just go to the supermarket, and also do house visits.'* (Dietitian B, Focus group discussion)

Supermarket tours, house visits and cooking workshops were mentioned as examples of ways to increase patients' product knowledge and cooking skills. The importance of using visuals and sound, rather than written text, was emphasised in the interviews. Visuals were said to be especially useful when explaining complicated mechanisms such as the aforementioned interplay between nutrition and blood sugar.

> *'Visuals work for everyone, both highly educated as well as low educated.'* (Dietitian 8, interview)

Visual information was considered to be particularly important in consultations with patients who do not have fluency in the Dutch language or who have a low literacy level. Examples that were given include showing videos or pictures rather than text and giving patients the option to take pictures or record audio when tracking their diet. Other strategies included working with interpreters or online translators for patients who are literate in another language. In addition, dietitians shared that for patients who have low proficiency in Dutch, it is helpful to have someone who can translate to accompany them.

Discussion

This study aimed to identify key components relevant for successful dietetic treatment of patients with obesity from the perspective of primary healthcare dietitians in the Netherlands. We found that dietitians perceive that the dietitian's capability to connect to patient needs is the key to successful treatment. Four themes were identified: building a good relationship, identifying patient needs, supporting behaviour change and providing advice.

A good interpersonal relationship was found to be the foundation for successful treatment and crucial for creating a trusted and open environment in which patients feel comfortable sharing personal information and their needs. A recent scoping review also reported that good dietitian–patient collaboration is the foundation for successful treatment of patients with chronic disease (25). The importance of a positive dietitian–patient relationship has been recognised in previous studies (26–28) by both patients and dietitians, as well as other health professionals. A cross-sectional analysis of medical treatment of HIV patients even found that 'knowing the patient as a person' was independently associated with receiving and adhering to therapy and positive health outcomes (29). A positive relationship is one of the components of delivering patient-centred care (PCC) (30). A study that evaluated PCC in dietetic practice in Australia found that one-third of patients see different dietitians during treatment and highlighted the importance of consistent care by one dietitian to build

a strong patient–dietitian relationship (31). However, our study found that when a good connection is lacking, it can be beneficial to refer the patient to another dietitian.

According to participating dietitians in the Netherlands, another key component of shaping treatment effectively was the dietitian's ability to identify patient needs and accordingly take on the role of an educator or counsellor. A similar distinction was noted in a study of nutrition treatment adherence, which found that an approach that is primarily informative was a barrier for some patients to continue with treatment. The authors noted that specifically patients with obesity and chronic diseases have a greater need for longer term treatment and benefit from a stronger focus on behaviour change counselling (31). Dietitians in our study indicated that many key components of successful dietetic treatment also apply to patients with overweight and other patient groups. However, an approach focused on counselling is indeed especially important in patients with obesity, with special focus on psychology, self-esteem, feelings of shame and stigma. Accordingly, dietitians in our study highlighted the need to integrate psychological aspects in dietetic treatment. It is relevant that dietitians receive training in this area and refer patients with more significant psychological issues to another professional, such as a psychologist. Studies show that adding cognitive therapy to dietetic treatment is effective for long-term success and less relapse in obesity (32). The shift from nutrition educator to nutrition counsellor has been recognised by other researchers (33, 34), and more emphasis has been placed on behaviour change counselling in dietetics education in the last decades (35). Tailoring the counselling approach based on patient characteristics such as motivation, health literacy and self efficacy was considered to be crucial for effective behaviour change. A systematic review of 35 obesity interventions indeed showed that motivation and self-efficacy are important mediators for weight control (36). In addition, low health literacy is associated with obesity and specific nutrition skills such as estimation of portion size (37), understanding nutrition labels (38), searching for nutrition information and trust in information sources (39). A review of 33 studies on health literacy interventions found significant effects of using special education material on knowledge of patients with low health literacy and suggests using instruments to assess patients' health literacy. In this context, alignment with validated health literacy measures to assess the literacy levels of patients is important, as well as the use of readability assessment to match the literacy level of the target audience (40).

A major theme that emerged in the interviews was the observation by dietitians that patients view them as their extrinsic motivator and supporter. Although dietitians acknowledged that extrinsic motivation can be effective, they emphasised that, in their experience, focusing on increasing the patient's intrinsic motivation is essential in the path to a successful treatment. This aligns with other studies that stress the importance of intrinsic motivation (34, 41, 42). Previous literature has shown that support from the dietitian is one of the most important facilitators of successful weight loss programmes (43–46). In this, various forms of support are mentioned, including regular support, such as

face-to-face consultation, and support in the form of guidance and accountability to the dietitian. Together, support can significantly improve treatment adherence (47). Furthermore, dietitians recognised the importance of helping patients address barriers they encounter by setting realistic goals, focusing on motivation and self-care. They noted that these barriers do not only influence treatment outcomes but also the decision to (dis)continue treatment. By recognising and discussing possible obstacles, dietitians may offer timely support to help patients overcome these challenges and continue their treatment, ultimately improving patient outcomes, as treatment time is related to greater weight loss (48). Dietitians indicated that, from their perspective, individual patient factors often play a significant role in determining the success of the treatment and related treatment outcomes. However, as dietitians differ in their personal approach and abilities to tailor their treatment to individual patient factors and needs, patients may achieve different treatment outcomes with different treatment approaches.

It is important to note that the insights of our study reflect perspectives and experiences from the viewpoint of (Dutch) dietitians. It is equally important to investigate and incorporate the patients' viewpoints in research to ensure a comprehensive understanding of the factors influencing treatment success.

Strengths and limitations

This study has multiple strengths. First, two different data collection methods were used. The interviews allowed us to explore individual views on the topics in depth. These insights then shaped the focus group discussions, which focused on key themes from the interviews. Additionally, the focus group discussions were valuable because it provided participants the opportunity to build on each other's ideas. This collaborative environment resulted in broader and more dynamic conversations than we could have achieved in individual interviews alone. Moreover, the focus group discussions helped to gain insights on where participants agreed and disagreed on various topics. These differences were, for example, influenced by factors such as years of practice and the way in which different dietitians were educated. Second, the diverse backgrounds of the participating dietitians provided a broad spectrum of perspectives; the participants varied in age, geographic area of residence, training backgrounds from different universities of applied sciences and a range of professional experiences. Third, dietitians were selected based on their experience with patients varying in characteristics, leading to an exploration of important treatment components for various patient factors. During purposive sampling, special attention was given to include dietitians who treat patients with low and limited health literacy levels, as this patient group is often under-represented in research. Finally, although dietetic practice varies across countries, we believe that our results are relevant in a wider context and provide valuable insights on how to deliver treatment tailored to patient needs.

The study also has some limitations. Participants reported that they do not often treat patients with low literacy levels, which might have led to limited insights into crucial components of the treatment of patients with low literacy levels. Furthermore, participants

in our study often do not stay in contact with patients who dropped out; therefore, they could not report on patients' reasons for dropping out. Consequently, it was difficult to arrive at conclusions related to long-term treatment (in)effectivity.

Implications for practice and research

This study explored dietitians' perspectives on key components for dietetic treatment of patients with obesity. Future research is essential to confirm whether these perspectives indeed reflect components that affect the outcomes of dietetic treatment. Additionally, the study results suggest that there is a need for further investigation into the relationship between patients' individual characteristics and different counselling strategies. More quantitative data on these strategies are required to gain insight into their effect on both weight loss and the experiences of patients with different characteristics. Moreover, this study confirms the importance of incorporating counselling skills focused on promoting self-efficacy, motivation and behavioural change in educational curricula and professional platforms for dietitians. Dietetic education and guidance should include strategies for choosing from the wide variety of treatment components, based on individual patient needs. The results of this research can be used in the subsequent phase of the research project Dietetics building the future, in which important components in dietetic treatment will be translated into practical tools for dietitians to use in their daily practice. Additionally, interviews with patients living with overweight and obesity will be conducted in the next phases. Their experiences are crucial to gain deeper insights into the dietetic treatment experienced by patients and will inform the development of effective tools and strategies.

Conclusion

This study demonstrates that dietitians perceive the ability to build a trusted relationship, in which patient needs are properly explored and addressed, as the key to successful dietetic treatment of adults with obesity. From the perspectives and experiences of dietitians, four themes were identified: building a good relationship, identifying patients' needs, supporting behaviour change and providing advice. The dietitian's ability to build a trusted relationship in which patients' needs are properly explored and responded to is essential for successful treatment of patients with obesity. Important treatment components include adjusting the treatment approach to patients' self-efficacy, motivation and health literacy, and taking on the role of a counsellor to support behaviour change.

Statements and declarations

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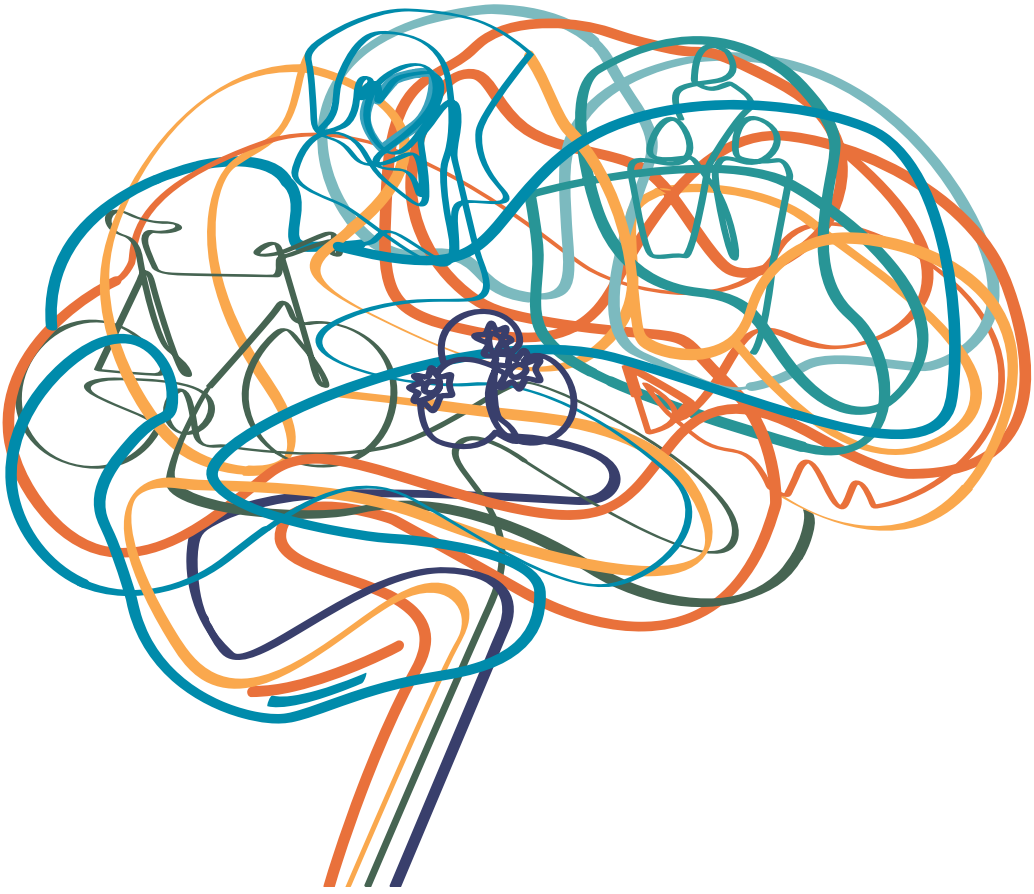
Ethics statement

Ethical approval specifically for this qualitative study was granted by the Research Ethics Committee of Wageningen University and Research (WUR-REC) under approval number 2023-034. The Committee concluded that the research deals with ethical issues in a satisfactory way and that it complies with the Dutch 'Code of Ethics' for research in the social and behavioural sciences involving human participants.

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CHAPTER 8

Perspectives and experiences of adult patients with obesity in dietetic primary health care: A qualitative study in the Netherlands

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Abstract

Background: Obesity is defined as a chronic, relapsing disease, characterised by its persistence and the frequent recurrence of weight gain following weight loss. It is linked to chronic diseases and reduced quality of life. Sustainable weight loss requires long-term dietary and behavioural changes. Dietetic treatment outcomes vary per patient, leading to differing success rates and effectiveness. Although understanding patient experiences is crucial for designing effective, patient-centered strategies, little is known about their lived experiences. This study aimed to obtain a better understanding of the perspectives and experiences of patients with obesity receiving dietetic treatment in primary health care in the Netherlands.

Methods: This qualitative interpretive study included 26 patients with obesity who were consulting or had consulted a dietitian. We performed purposeful sampling to ensure a sample diverse in socio-cultural background, region, age and health literacy. Semi-structured interviews were conducted using a predefined topic guide, with room for flexibility to explore emerging topics. We analysed the interview data using reflexive thematic analysis as described by Braun and Clarke.

Results: Four interconnected themes were constructed from what patients named to be important in dietetic treatment: 1) personalised treatment as a foundation for success, including feeling heard and receiving responsive and adaptive treatment 2) the personal impact of the dietitian on treatment, through the dietitian's attitude, professionalism, and background; 3) a personalised and holistic approach for lasting change, including clarity about the dietitian's ways of working, motivational and emotional support, attention to life context and guidance in developing sustainable habits; and 4) tailored and accessible advice, focusing on practical tools, understandable information, and consistency of advice.

Conclusions: This study highlights that successful dietetic treatment for adults with obesity depends on personalised support, a strong patient–dietitian relationship, and holistic attention to psychological and behavioural factors. Clear communication, involvement from the start, and practical, tailored advice help patients comply with treatment and apply recommendations in daily life. Findings emphasise the importance of aligning dietetic treatment with individual patient needs and expectations.

Introduction

Obesity is a complex chronic relapsing disease with globally 650 million people affected (1). In the Netherlands, 15% of the adult population was classified as having obesity (BMI ≥ 30 kg/m^2) in 2023 (2). Patients with obesity have a higher risk of having or developing a variety of chronic diseases, including cardiovascular disease and type 2 diabetes (3,4,5). Moreover, obesity is associated with a lower quality of life and mental health conditions (6,7,8,9). Weight loss in patients with obesity is associated with significant health improvements, including reduction of osteoarthritis, hypertension, type 2 diabetes, and cardiovascular risk biomarkers (10). Therefore, long-term changes in diet and behaviour are required to achieve sustainable weight loss and improved overall health outcomes. Managing obesity typically requires a multidisciplinary or even interprofessional approach, in which dietitians are key in facilitating patients' dietary and behavioural change. Dietetic treatment consists of a holistic interplay of medical considerations, dietary interventions, behavioral counselling, and attention to the patient's social context, all aimed at achieving sustainable weight loss and improving overall health outcomes. Dietitians also help to identify and treat risk factors for malnutrition and nutritional deficiencies (11).

Systematic reviews have shown that weight management interventions by dietitians are efficacious for treating adults with overweight or obesity (12,13). However, effectiveness in practice largely differs for each individual. A study using real-life practice data of patients with overweight in the Netherlands found that only a quarter of patients reached at least 5% weight loss during dietetic treatment. Furthermore, the recommended treatment duration of six months or longer was also only reached by a quarter of patients (14). Many studies focus on identifying the effect of a dietary intervention within dietetic treatment, rather than understanding why a treatment works or does not work for certain individuals. In these studies, quantitative measures (e.g., weight loss or health intermediates) were predominantly chosen as treatment outcomes (12,15,16). However, understanding patient experiences is crucial for designing effective, patient-centered (PCC) strategies (17). Yet, research exploring the lived experiences of patients with obesity remains scarce (18).

Many studies have shown the importance of PCC practices and stated the need for more research into patients' preferences and beliefs to design interventions to better cater to patients' unique needs (19,20,21). Individuals with obesity face specific and multiple challenges, including comorbidities, mental health, and stigma (22), highlighting the need to explore their experiences more in-depth. Obesity has an unequal distribution across societal groups and is more prevalent among individuals with lower socioeconomic backgrounds (23,24) and those with limited health literacy, which applies to a quarter of the Dutch population (25). Literature shows that people with limited health literacy more often struggle to navigate through healthcare. They have difficulty participating in consultations, assessing treatment options and managing health at home (26,27), calling for an elevated role of dietitians to address health literacy (28). A low socio-economic

position can hinder patients' capability to afford healthier foods (29) and is in turn associated with limited health literacy (30,31). In addition, obesity is more prevalent among people with a migration background, for example, Turkish, Moroccan, Surinam, or Antillean migration background in the Netherlands (32). Patients' cultural background influences their beliefs about what constitutes healthy food, the role of social environment, and their expectations of health care providers. For minority and ethnic groups across different countries, dietary guidelines may be difficult to reconcile with traditional cooking practices and cultural customs, such as the social importance of hospitality and shared meals. Studies from various contexts have shown that dietary advice may not always align with cultural food preferences and practices, creating additional barriers to adherence (33,34,35,36).

Understanding the factors behind treatment success in individuals with different backgrounds is key. Therefore, the aim of this qualitative interpretive study using reflexive thematic analysis was to understand the perspectives and experiences of adult patients with obesity on dietetic treatment in primary healthcare.

Methods

The current study is part of the four-year research project entitled 'Dietetics building the future' (Box 1). Findings are reported according to the Standards for Reporting Qualitative Research (SRQR) checklist (See Supporting Information File S1) (37). Ethical approval was provided by the Research Ethics Committee of Wageningen University & Research (WUR-REC) under approval number 2023-034.

Box 1. Description of research project Dietetics building the future.

The research project 'Dietetics, building the future' is a research collaboration of (applied) universities, practising dietitians and other relevant stakeholders in the Netherlands, to develop an evidence-based toolbox for personalised dietetic treatment for patients with obesity and comorbidities. The project addresses research questions regarding the optimisation of obesity treatment, improving effectiveness and patients' self-efficacy. Furthermore, the research project pays special attention to patients with low health literacy, stimulating behavioural change, and the application of innovative technologies. The project consists of quantitative analyses and statistical modeling to identify key components of dietetic treatment. Concurrently, qualitative studies, such as the study on perspectives of dietitians on successful dietetic treatment (38) have been conducted, along with the current study. The results of these studies will be used for the development (co-design) and testing of a toolbox, offering personalised interventions based on various individual patient factors. A summary of the project can be found on the website of ZonMw, the organisation that funded this research (39).

Participants

This study was carried out throughout the Netherlands. Participants were approached by their primary care dietitian, who invited them to participate in the study. These dietitians were reached via the researchers' networks and various organisations, such as 'Stichting lezen en schrijven', the Dutch foundation that focuses on promoting literacy skills. Patients were eligible to participate in the study if they had obesity (BMI ≥ 30 kg/m2) at the start of treatment and had consulted a dietitian within the past year for weight loss. Dietitians were asked to inform eligible patients about the study and provide interested patients with information about the study. If patients expressed interest in participating, they either filled out an online registration form via Qualtrics, contacted the researchers directly, or authorised the dietitian to share their contact information with the research team. For registration, patients provided their name, age category, place of residence, and contact details. Interested patients received further study information, and interviews were scheduled at a location of their choice if they agreed to participate. Dietitians were asked to only invite adult patients with obesity (BMI ≥ 30 kg/m^2) to participate in the study. However, BMI values were not verified with the participant prior to inclusion.

We aimed to include 25 participants in this study. To estimate the required number of participants, we reviewed similar studies (40-42), as well as the recommended range in literature for qualitative studies, varying from 5 to 25 (43). We strived for the upper end of the range, to reach a group of participants with a diversity in demographic characteristics, such as place of residence, socio-cultural background, and age (see Data Collection—Questionnaire). There were no inclusion criteria regarding the number or frequency of dietetic consultations. Participants were included regardless of whether they were still receiving treatment or had discontinued care, as the study aimed to capture a wide range of experiences, including those of patients with limited and more extensive contact with dietitians. Purposeful sampling was applied to achieve a study sample that is representative of the patient population of primary care dietitians. At the end of each interview, the participant completed a questionnaire to collect demographic information. Throughout the research process, the results of this questionnaire were evaluated to identify gaps in the study population. Special attention was given to recruiting participants with low health literacy, difficulties with reading and writing, and patients with a migration background.

Data Collection

Questionnaire

The questionnaire included the following items: age, gender, postal code, household situation, attained education, work situation, receipt of government allowance, migration background, duration of dietetic treatment, number of visited dietitians during lifetime, reason for referral to dietitian, weight at the start of treatment, current weight, satisfaction with results, literacy, and health literacy. We aimed to include participants from different regions and from both urban and rural areas. The degree of urbanisation was assessed

using the urbanisation score from the Dutch Central Bureau of Statistics (CBS), which was calculated based on data for each neighbourhood (44, 45). Information on education level was presented via the International Standard Classification of Education (ISCED) (46). Receipt of social allowance was used as a proxy for socio-economic position, as financial information was considered to be too sensitive for the purpose of this study. The migration background was defined based on the CBS definition, distinguishing between first-generation (born outside of the Netherlands and at least one of the parents born outside of the Netherlands) and second-generation (at least one of the parents born outside of the Netherlands) migration backgrounds (47). The participant's satisfaction with the results of the treatment was assessed using the following question (translated from Dutch): 'Are you achieving the desired results/the results you had in mind?'. Literacy level was asked with the question, 'We know that many people find it difficult to read and/or fill out forms. How is that for you?'. Health literacy was assessed via three questions that we translated from screening questions for limited health literacy in a large outpatient population (48).

Topic guide

A topic guide was constructed based on preliminary results of interviews with dietitians (38), and themes that were identified in scientific literature, related to important components of dietetic treatment (41, 49). The topic guide consisted of questions related to dietetic treatment, including dietetic guidance, expectations and goals, duration and frequency of consultations, changing diet and habits, communication, support, advice, self-monitoring, social surroundings, preferences, and expectations for the future. For each topic, several example questions were included in the topic list; examples are provided in Box 2. The supporting information includes the full topic list.

Box 2. Examples of probing questions for two topics in the topic guide

Topic	Probing questions
Expectations & goals	What were your hopes/expectations for the dietetic treatment?
	Did this come true?
	Why/why not?
	When is the guidance successful for you?
	What was/is your goal?
Treatment & guidance	Can you tell us something about the guidance from the dietitian?
	What did you discuss with the dietitian during the consultations?

The topic list was tested in the first two interviews with both the first and second authors present to ensure consistency and refine the approach. The interviews were semi-structured, meaning that the main topics were discussed in all interviews while allowing space for additional topics (50).

Conducting the interviews

The face-to-face interviews took place between December 2022 and January 2024. Interviews were conducted in Dutch by the first two authors, both having a background and expertise in the fields of human nutrition, health sciences and/or dietetics, along with two fourth-year Nutrition and Dietetics students. These students observed an interview before conducting the interview themselves. Most participants chose to be interviewed at their homes. The informal interview setting made it easier to build rapport, create a comfortable environment for participants, and observe social and non-verbal cues (51). One interview was conducted at a neighbourhood centre, upon the request of the participant. The interviews were scheduled with a maximum duration of approximately 60 min, to avoid placing too much burden on participants, while allowing sufficient time for in-depth discussion of their experiences. Interviews only continued beyond this time when participants indicated they were comfortable doing so.

Participants were informed about the interview aim and procedure via phone, email, and an information letter. They were reminded of the study details and had the opportunity to ask questions before the interview began. All participants provided consent before the start of the interview. This was done in writing or, for those who had difficulty reading and writing, the informed consent was read out loud by the interviewer, and consent was given verbally and audio recorded. At the start of each interview, we built rapport by introducing the study and interviewer, emphasising that the interview was an open conversation and participants could skip any question. After concluding the interview, participants were given the aforementioned questionnaire to fill out. The interviewer assisted with questions that were not clear to participants. For those with reading or writing difficulties, the questionnaire was administered verbally. Participants received a 25-euro voucher as reimbursement for their time and effort to participate in this study. After completing the interviews and transcripts, summaries of their individual interviews (member checks) were sent to participants, for their review and feedback, which made sure that the representation of their perspectives as written in the summary were correct (52). Participants could also contact the researchers by phone if they preferred to provide feedback verbally or had questions about the summary. All participants agreed with the summaries. We acknowledge that the written format may have been challenging for some participants with difficulties in reading or writing, which is discussed as a limitation in the Discussion section.

Reflexivity

The background of the research team played a role in this study exploring the experiences

of people living with obesity who received dietetic treatment. All authors have an academic background in Nutrition and Health. AvdR, EN, HJ, LMH and MdvdS are registered dietitians and provided expertise on dietetic treatment and professional practice. RO's extensive experience in qualitative research supported depth and reflexivity during data collection.
EN, HJ and MdvdS hold senior research positions and have extensive experience in conducting qualitative research in dietetics, contributing to reflexive discussions about the data and its interpretation. Reflexive discussions were held throughout the research process to reflect on the researchers' assumptions and professional perspectives, and how these may have influenced data interpretation. AvdR and RO were PhD candidates throughout the study and gained additional knowledge about obesity through their involvement in other studies within the project (see Box 1). AvdR, who conducted most of the interviews, had prior experience providing dietetic treatment to people living with obesity and participated in several training sessions on obesity, socio-economic position, diverse cultural backgrounds, and low (health) literacy, which supported her in interviewing participants with different characteristics. She followed training in qualitative research and had prior experience in conducting interviews.

Data analysis

The audio recordings from the interviews were transcribed verbatim using Amberscript software. The interviews were analysed following the six-step approach by Braun and Clarke (53, 54). This framework guided the entire analytic process, from familiarisation with the data to generating, reviewing, and defining themes, and reflects an interpretive approach in which meaning was co-constructed between researchers and participants. Following Braun and Clarke's reflexive approach (54), themes were not viewed as passively emerging from the data but were actively developed by the researchers through a process of interpretation and reflexive engagement. Initial codes were generated inductively from the data, and through iterative discussion and review, these codes were grouped and refined into overarching themes that best represented the dataset. First, the transcripts were read by the researchers to become familiar with the data. Second, initial codes were assigned to text fragments, using the program ATLAS.ti Web (version 5.20.0). To ensure consistency, the transcripts of the first three interviews were coded by the first three authors (AvdR, RO, LMH) and during a session, differences in coding were discussed, after which consensus was reached regarding the coding approach. Coding was done inductively, meaning that the researchers gave a code to text fragments without a predefined framework. Nonetheless, codes often aligned with the topics in the topic guide. Third, the codes were reviewed in multiple review sessions by AvdR and LMH and initial themes were constructed. Fourth, themes were discussed by AvdR, LMH, HJ and EN. Fifthly, themes were refined and defined, ensuring that the most important code groups under the themes were represented and subthemes were formulated. In addition, we analysed whether we could see patterns in findings with background characteristics of participants, such as their age or gender. In the sixth and final step, quotations were

reviewed to best support the overall findings. These were translated from Dutch to English and reviewed by a colleague native in Dutch and English.

Results

In total, 26 interviews were conducted. The characteristics of the participants are presented in Table 1. The participants lived across the Netherlands, covering 9 out of the 12 provinces. After including 17 participants, we made extra efforts to recruit an additional 9 participants with reading and writing difficulties and a migration background, as they were not yet sufficiently represented in the study sample. One participant in this study spoke limited Dutch, which affected her ability to elaborate on certain topics, but she was still able to share insights into her experiences and perspectives. The interviews lasted on average 50 min, with a range of approximately 30–70 min. The duration of dietetic treatment varied widely among participants, ranging from 1 month to 10 years. Because of this large variation, the mean duration was 28 months, while the median was 9 months

Table 4. Characteristics study participants

Characteristics		N (%)		N (%)		N (%)		N (%)		N (%)
Sex	Female	16 (62%)	Male	10 (38%)						
Age	30-44 years	5 (19%)	45-60 years	15 (58%)	> 60 years	6 (23%)				
Education level[1]	Low	5 (19%)	Medium	9 (35%)	High	11 (42%)	Unknown[2]	1 (4%)		
Urbanisation level of place of residence participant[3]	Very strongly or strongly	19 (73%)	Moderately	5 (19%)	Slightly/ none	2 (8%)				
Social welfare allowance	Yes	8 (31%)	No	17 (65%)	Unknown	1[2] (4%)				
Migration background	Yes, first generation	6 (23%)	No	20 (77%)						
Number of dietitians visited before current dietitian	0	7 (27%)	1	6 (23%)	2-3	7 (27%)	>3	6 (23%)		
BMI (kg/m2) at start of treatment	24-30[4]	2 (8%)	30-35	9 (35%)	35-40	6 (23%)	>40	6 (23%)	Did not know	3 (12%)
Reason for referral *(multiple answers possible)*	Overweight/ obesity	23 (88%)	Type 2 diabetes	10 (38%)	High blood cholesterol	6 (23%)	Hyperten-sion	2 (8%)	Other[5]	2 (8%)
Achieved desired results	Yes	18 (69%)	No	3 (12%)	Other[6]	5 (19%)				
Literacy Whether patients indicated to have difficulty with reading and writing	No difficulty	19 (73%)	Sometimes difficulty	4 (15%)	Often difficulty	3 (12%)				
Health literacy - whether patients asked for help with filling out forms	Never	13 (50%)	Sometimes	10 (38%)	Often	3 (12%)				
- how often patients needed help reading information from the dietitian or other health professional	Never	17 (65%)	Sometimes	5 (19%)	Most of the time	2 (8%)	Always	2 (8%)		
- how often patients had issues reading and understanding forms from the dietitian or other health professional	Never	19 (73%)	Sometimes	4 (15%)	Most of the time	1 (4%)	Always	2 (8%)		

Participant perspectives on dietetic treatment as discussed in the interviews were captured in four main themes and several subthemes (Figure 1). The themes were described with supporting quotations from participants, including participants' age and gender. When participants had difficulties with reading and writing and/or a migration background, this is also indicated after the quotation.

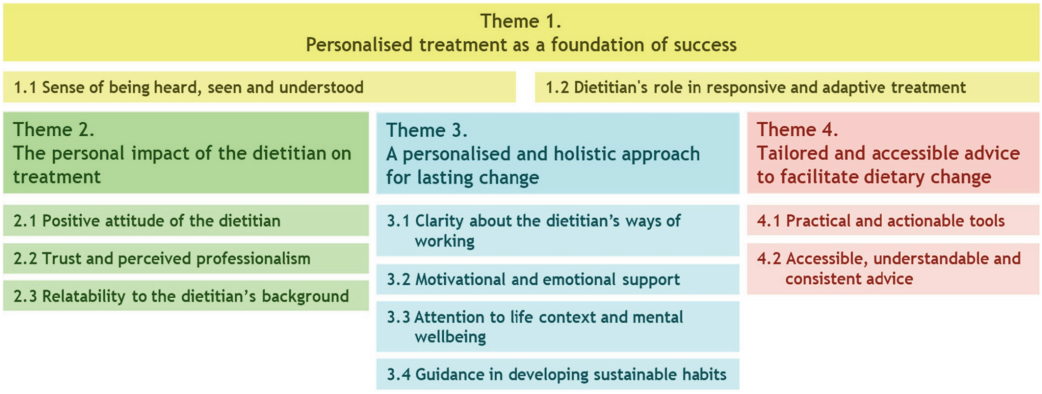


Figure 8. Themes and subthemes

Theme 1. Personalised treatment as a foundation of success

1.1 Sense of being heard, seen and understood

Participants indicated that a good relationship with their dietitian contributed to feeling supported and more comfortable, and being open and asking questions. According to participants, this facilitated the treatment approach to go beyond nutritional advice by also discussing personal topics and psychological barriers for lifestyle change. Participants identified various factors that contributed to a sense of personal connection, yet they also noted that this connection was often difficult to pinpoint and was more of a feeling than something they could explain.

> [A good connection], *'I do find that important. It's not like I've never really not clicked with someone, but I have the idea I really do with [name dietitian], and whether that's because of her way of guiding or just who she is as a person, that's a bit hard for me to judge, but I do feel like she truly sees me. She sees what I'm struggling with, she sees what it does to me notices how it affects me, and what kinds of problems I run into. I feel like she takes me by the hand and supports me.'*
> (Female, 54 years of age)

Participants sometimes mentioned dietitians' background characteristics (Theme 2.3) when they talked about whether or not they felt a connection, such as the dietitian's age or weight. Factors that foster this connection included feeling seen and heard, the dietitian having an eye for the patient's everyday life and struggles, and offering support in these areas. A lack of personal connection was mentioned by participants as a reason to stop seeing the dietitian.

1.2 Dietitian's role in responsive and adaptive treatment

Participants stressed the importance of dietitians aligning their treatment approach and advice with the patient's individual needs. Discussing these preferences, needs, experiences and skills and knowledge levels at the start of treatment was mentioned as being important for feeling heard, getting the right 'diagnosis' and receiving tailored treatment.

> *'That's just something a dietitian should check in advance, in one of the first conversations. That you just ask: so, what do you prefer? Do you like it when I'm really strict, or a bit more relaxed, or what? With both (dietitians) I didn't really have an introduction or intake conversation (...) not like: okay, what would you prefer? What should we be working towards, or anything like that.'* (Male, 53 years of age)

Participants pointed out that they often know their own pitfalls but need guidance and support on how to overcome them.

> [Interviewer: 'What is important for dietitians to improve obesity treatment and make it better suited to patients?'] *'Maybe something like, you know, a learning style test like Kolb's,* [explanation: Kolb's test categorises four types of learners: diverging, assimilating, converging, and accommodating]. *And then have a look at what category someone more or less falls into, and what kind of treatment or support would be appropriate. Because well, I've been at this for four years now, and have since come to know my pitfalls. But actually making changes, that still isn't working, and that's a shame.'* (Female, 34 years of age)

Participants mentioned that they did not always share all relevant personal circumstances with the dietitian at the beginning, such as challenges with reading and writing. According to participants, it is important for the dietitian to explore needs that might be sensitive in a subtle manner. Participants noted that limited finances can hinder initial or continued visits to the dietitian beyond insured consultation hours and they appreciated the dietitian taking this into account.

> *'You can ask it in the first conversation: how do you fill things in, or can you read things? (...) But you have to ask it in the right way, not immediately say: 'Do you have difficulties with reading and writing?' But more like: how do you read the products? Do you understand the products, do you know what the products are, because then you understand the calories.'* (Male, 52 years of age, difficulty with reading and writing)

Participants expected the dietitian to be able to change the treatment approach in case of changing needs or when progress stagnated. Changing the approach was considered necessary when the same issue was discussed repeatedly without new insights or results, according to participants. They reported not always knowing what the dietitian could do differently as they lacked information on treatment options.

Participants described how feeling heard, seen, and understood was essential for engaging with other elements of the treatment process. This initial sense of recognition enabled

them to build trust in the dietitian (Theme 2), feel supported in a personalised and holistic way (Theme 3), and make use of tailored advice in daily life (Theme 4). When this foundation was lacking, the overall treatment experience was perceived as less positive and supportive.

Theme 2. The personal impact of the dietitian on treatment

2.1 Positive attitude of the dietitian

Participants appreciated a positive attitude from the dietitian, highlighting qualities such as empathy, respect, humour and an open, non-judgmental approach. The feeling of being heard and listened to was described as essential for feeling treated as a unique individual.

> *'She did manage to motivate me more [than the other dietitian]. (...) Maybe also because she was so enthusiastic. If I had lost weight, she'd say: wow, how did you do that? Did you walk more, or did you, what did you do, because it's going so well? That kind of thing.'* (Female, 68 years of age)

Furthermore, a curious attitude was much appreciated by participants as a sign of genuine interest from the dietitian. Participants shared that they disliked the dietitian's attitude when it felt impersonal, shallow, or when the dietitian was lecturing in a negative manner.

> *'That was something I missed with my previous dietitian, it felt a bit clinical: you go there, you tell your story, and of course in the beginning that stays quite superficial. And if no further questions are asked, and I'm also not the kind of person who just lays everything out there, then you don't get to that deeper level. And that's exactly what I needed to be able to take those first steps in changing my lifestyle.'* (Female, 52 years of age)

Participants shared examples of how past experiences with dietitians shaped their perception of the dietitian. Negative encounters were said to contribute to resistance and distrust towards dietitians, according to participants. These experiences were sometimes intertwined with broader societal stigma around weight and health.

> *'Back then, you went to the general practitioner and they referred you to a dietitian, and I never found them friendly. Not at all, 'no, you have to do this, you're not allowed that'. That was the mentality back then, and it really created resistance in me. (...) I quit, I just started eating again (...) Well, that lasted a long time, because I developed such a dislike of dietitians. Because of how they approached the diet and how they treated me, and of course also the outside world.'* (Female, 55 years of age)

2.2 Perceived professionalism and trust

Participants expressed appreciation for the professionalism and expertise of dietitians and linked this to their trust in the dietitian's treatment approach. They felt that it was not essential for dietitians to know everything immediately but valued the dietitian's initiative

in seeking answers and information. Participants had mixed views on the dietitian's age; some associated a young age with lower perceived expertise, and some were surprised by the quality of advice provided by a young dietitian.

> *'I do notice that she* [current dietitian] *is really driven, very professional, because I have seen [a dietitian] before, two years ago (...) and that girl just didn't have that much experience yet. (...) When I got home, I called and said, well, I'm not coming back, because (...) yeah, yeah, putting together a quick menu, I can also do that myself.'* (Male, 52 years of age)

Some participants linked trust in the dietitian's expertise to their weight, feeling that being too thin or overweight affected their ability to relate and trust the dietitian regarding advice on weight loss. Participants also mentioned that the appearance and equipment of the dietetic consultation room also influenced their impression of the dietitian. A visually informative consultation room contributed to the sense of the dietitian's expertise, contrasting with less engaging, sterile spaces, according to participants. They expressed frustration when essential equipment in the consultation room was repeatedly unavailable.

> *'One of the dietitians had her own room in a health center, and it was full of food examples and posters about nutrition topics, and well, it was like walking into some kind of food heaven. That's the feeling I got, it somehow gave an impression of expertise. That was quite different from when I saw another dietitian who was located in a very sterile room within the care hotel where I was staying. I don't know, but apparently a room like that also makes an impression.'* (Female, 44 years of age, migration background)

2.3 Relatability to dietitian's background

Participants had varying perspectives on the relevance of a dietitian's (cultural) background. For individuals with a migration background, a shared cultural background was valued by some for reducing language barriers and a shared understanding of specific dietary customs or treatment style. Others reported that they found the dietitian's cultural background less relevant because they adhered mainly to a Dutch eating pattern.

> *'You don't have that in Turkey, when you see a dietitian, that they don't perform any blood tests before starting. I find that quite strange, because a lot of things could be related to that.'* (Female, 36 years of age, migration background)

> *'I think that if my father were to get advice from a Turkish dietitian, for example, he might be more likely to accept it, because a Turkish dietitian might have a better understanding, knowing the dietary pattern. (...) But for me it wouldn't matter what the dietitian's background is. (...) My son and I also consume Dutch foods, just a sandwich, meat, vegetables, you know.'* (Female, 47 years of age, migration background)

Other characteristics mentioned in the interviews included whether the dietitian was extravert and the dietitian's age that made the patient feel like the treatment would work or

not. Furthermore, the dietitian's weight was mentioned as something that participants could or could not relate to.

> *'I noticed that that* [the personal connection*] was actually quite important. I didn't really have that with her. And she was also super slim. So going there wanting to lose weight, you think: 'why are you so slim?' You know, that doesn't feel fair (laughs). (..) I joked to friends that she was 21 and could fit through a keyhole, you know, that was how it felt for me. I just did not really have a click with her.'* (Female, 50 years of age)

Theme 3. A personalised and holistic approach for lasting change

3.1 Clarity about the dietitian's ways of working

Participants who lacked a clear idea about treatment approaches expressed the need for information on how dietitians work, in order to help them choose a dietitian and an approach that best fit their needs.

> *'Yeah, and most dietitians do have information about: this is my education, I'm this age, and I live here or something like that, but a lot less about what their guidance style is. Or like, what their highlights are. That way, you could be much more targeted, and it would save you from having to meet with a lot of different people first.'* (Female, 34 years of age)

A clear understanding of the dietitian's ways of working and expertise was reported to enhance the connection between patient needs and the treatment approach, making it easier for patients to able to express their needs related to treatment focus.

> *'There just had to be a match with where I was at, you know? And I've been lucky with that, but also just by pushing and asking and saying: No, I don't want it like that, because otherwise I'll stop seeing this dietitian too, because for me, it would just be another story from the Middle Ages.'* (Female, 58 years of age)

Several treatment approaches were discussed, among which Acceptance and Commitment Therapy (ACT) was mentioned multiple times as a treatment approach that can help with exploring underlying psychological mechanisms of behaviour. Participants who received dietetic treatment with more emphasis on psychological support and counselling often described this as having a particularly meaningful impact on their experience of treatment.

> *'I've seen other dietitians in the past, where it was very much focused on nutrition and keeping track of lists (...). But I was really looking for someone who could support me with the mental aspect of it. Because every time I struggle, when I'm not feeling good or something emotionally intense happens, I experience setbacks with the dietary pattern. So I was really looking for someone who didn't just focus*

on lists and diets, but really looked at what's behind it all.' (Female, 54 years of age)

However, other participants shared that they felt hesitant to discuss matters with a psychological focus. They expressed discomfort with exposing personal aspects of themselves or felt that this was not the role of a dietitian, or shared examples of having to do exercises that just did not match their style.

3.2 Motivational and emotional support

Participants valued the different roles a dietitian can fulfill, particularly emphasising the role of an external motivator. This role was described by participants in various ways: merely being there once in a while to check in but also offering support and encouragement. When asked whether another person or health professional could fulfill this role, participants reacted negatively, expressing that they preferred their dietitian to take on this supporting role.

'Well, a lot of people still say: 'Yeah, you don't really need a dietitian, actually.' And yeah, maybe that's true. But for me, I mostly did it to have someone to hold me accountable.' (Male, 57 years of age)

Another role of the dietitian that was mentioned was to hold up a mirror and support participants become aware of their behaviour.

'And she did mention to me, like: maybe you should start moving more. But for me, that's not the way to go. (...) No, I don't want to be told what to do, and then I'm quick to dig my heels in. Yet somehow, she's really good at seeing through that. And she said: 'Hey, I see you've got a smartwatch'. Then I thought, oh yeah, I could actually use that, and since then, I've really been keeping track of things: cycling a bit, or when at the gym, on the treadmill or the cross trainer.' (Female, 52 years of age)

3.3 Attention to life context and mental wellbeing

Participants shared their need for dietitians to take a holistic approach by paying attention to a wide range of personal factors that are related to living with obesity rather than focusing only on diet.

'When someone is often stressed, you can give them all kinds of nice little things. But first you have to deal with the stress. (...) Not just at the dietitian's, but already with your general practitioner, because they are the one referring you. But why do you have stress? It could be debts, it could be other things, it could be something in your private life. That's something a doctor should already know, so they can record it in the paperwork: you have stress because of this and that, and that should be looked into.' (Male, 52 years of age, sometimes difficulty with reading and writing)

Participants emphasised the importance of discussing mental wellbeing and the underlying causes of eating and lifestyle behaviours with their dietitian, noting that this was sometimes lacking in their treatment. Furthermore, they reported barriers for weight loss included self-image and confidence to go out in society and to the gym or swimming pool for example. Learning how to view oneself with kindness was mentioned as an important element in improving mental state and confidence.

> *'Well, when you're overweight, you feel unhappy, and you start to exclude yourself from society. You stop going to things, and because of that, you end up moving even less. Or if you feel unhappy, you might actually start eating more. That really is a pattern.'* (Female, 58 years)

To facilitate these subjects, they mentioned the possibility of having different health professionals involved, maintaining communication between each other, and ensuring continuation of treatment across different health services. Participants gave examples such as the connection with the general practitioners for identifying lifestyle issues, as well as involvement of a psychologist or mental health worker in the general practice for support with stress and mental health.

> *'I think she [current dietitian] had already been somewhat informed by the [other] dietitian at *institution* about what we were doing back then, and that we've now been able to more or less continue from there, and I really appreciate that.'* (Male, 41 years of age)

> *'When it came to food, I could work on that in a practical way with the dietitian. And with the mental health worker I was able to give space to the mental side of things.'* (Female, 52 years of age)

3.4 Guidance in developing sustainable habits

Participants stressed that lifestyle change is difficult and gave examples of various facilitating and hindering factors for behavioural change. They stressed that their motivation was an important facilitator in their lifestyle change. The dietitian's support was reported to be valuable to stay motivated in the process. Participants shared that the dietitian had helped them to discover their true motivation, and how important this was for them to persevere in their lifestyle change trajectory.

> '[Motivation is] *necessary if you want to achieve something, and it's not easy: changing behaviour and losing weight. So I think motivation deserves more attention. Because I went there to lose weight, that was my motivation, but actually, it was about my health and my hip, and I never really realised that. If I had had that clearer in mind, I might have been able to stick with it longer. (...) I think it's very easy to get bogged down in nutritional advice and the details, and to lose sight of the bigger picture, the motivation, along the way.'* (Female, 47 years of age, migration background)

Getting more insight into their own behavioural patterns was mentioned by participants to be an important aspect of dietetic guidance. In addition, participants valued their dietitian's guidance in dealing with setbacks.

> *'It's mainly about becoming aware (...): like what's happening, why are you putting that in your mouth? Did something happen beforehand, what does it do to you? And just through Acceptance and Commitment Therapy and [name dietitian], we look at it like: okay, that happened, you can't undo it, but what did go well? (...) That awareness really gives me a lot of support.'* (Female, 54 years of age)

Participants recognised the importance of adopting an eating pattern designed for the long term to help prevent weight cycling. Participants highlighted that the dietitian's integration of social context into their guidance, was supportive in their treatment process.

> *'You can start counting calories and lose some weight in a short time, but when you go back to eating 'normally', quotation marks, it tends to comeback quickly. So I really had the feeling I wanted to do something that would work in the longer-term.'* (Female, 50 years of age)

Theme 4. Receiving tailored and accessible advice to facilitate dietary change

4.1 Practical and actionable tools

A wide range of tools that dietitians used were evaluated by participants as helpful in changing their diet. These tools included example menus, variation lists, recipes, food swaps, and general information about healthy eating. Participants listed methods to reduce portion size, such as how to differently divide food over the plate and smaller portions by measuring. In general, being aware of current eating habits through eating diaries and evaluating this with the dietitian was considered to be insightful for becoming aware of unhealthy patterns.

> *'What I especially liked was that list, actually. I have to say that in the end, that list turned out to be my biggest tool. In that conversation, we also went through my daily menu, like, what do you eat in a day and what kind of food switches can you make?'* (Female, 50 years of age)

Different needs were described by participants regarding the content of the advice, such as the level of detail and length of the advice. The dietitian helping them to take small steps was pointed out as an important facilitator for staying motivated and achieving goals.

> *'And small steps, and that's what actually made it very manageable, very easy because of those small steps. You reached your goals easily. That really motivated me, you know? Serotonin is released, we keep going!'* (Female, 52 years of age)

Participants again stressed that it is crucial that the dietitian's advice aligns with their current eating pattern and culture. Not being sensitive to personal eating culture and having to adopt a new eating pattern too different from the current pattern was often described as a dealbreaker for participants and a reason to discontinue treatment.

> *'At the dietitian back in Turkey that year, I actually got a list with exact times, like in the morning I had to eat this, in the afternoon that, but here in the Netherlands I didn't get that. (...) Having fixed times does help with structure, which I like, but of course it also takes a lot of preparation to eat those specific things. So I'm a bit torn about it, I think.'* (Female, 36 years of age, migration background)

Apart from advice related to dietary changes, examples were given of advices on how to deal with the food environment, such as where to find healthy products in the supermarket.

> *'I used to buy my stuff in the middle aisles of the supermarket. But that's where the soups, the chips, the cookies are, all the bad stuff. (...) I'm a bit angry at the food industry for being allowed to do that, that they get the chance in this free country to do it. (...) I was at an airport last week and I thought: what if I wanted to eat healthily here? How would I even do that?'* (Male, 67 years of age)

4.2 Accessible, understandable and consistent advice

Participants appreciated different forms of advice such as information on paper, in books and social media accounts with nutrition information, and the use of pictures. The alignment of materials to individual needs was regarded crucial. They emphasised the importance of ensuring that the content was easy to understand, concise, and visually supported with images and pictures, especially for those who struggle with reading and writing. While apps were considered effective for digitally literate individuals, others found them difficult to navigate. Apart from content and length, the design of materials was mentioned as well as being important.

> *'Speaking is difficult for me. With support from my son or daughter, it's okay. But in the past, they always gave a book with pictures, for bread, for food. What I should eat. How much, 100 grams, 150? That was before, [at the dietitian in the hospital], but not anymore. (...) The dietitian is all good, I just want pictures. The pictures are important for me, because I cannot read.'* (Female, 66 years of age, migration background, difficulty with reading and writing)

The material that is given to patients to fill out can also be used by the dietitian to assess whether the form and level is appropriate, as pointed out by one participant:

> *'Then they're told to keep a diary, and yeah, people don't know how to write it down properly, so what do you get? They just keep writing the same things over and over. I always tell everyone: take that booklet, go through it carefully. Because that's how you also pick up on people from other cultures or people who have difficulties.*

> *A lot of people won't say that they have low literacy.'* (Male, 54 years of age, sometimes difficulty with reading and writing)

Participants stressed that inconsistent advice was confusing for them. Examples were provided of both inconsistent advice from one dietitian, and no continuity of advice between different dietitians.

> *'What I find difficult is that I've had different dietitians now, and the one from about 6 months ago said:* [Product X], *well, that's almost the devil, because it contains sugar. And then another one says: no,* [Product X] *is a perfectly fine option. And then at some point, you just don't really know anymore.'* (Female, 34 years of age)

Discussion

The aim of this interpretative qualitative study was to understand perspectives and experiences of adult patients with obesity on dietetic treatment in primary healthcare. We found that patients experience personalised treatment as a foundation for successful dietetic treatment (Theme 1). Feeling heard, seen and understood, and receiving responsive and adaptive support, were described as essential to building trust and engaging with the treatment process. This experience was closely connected to how patients perceived the dietitian as shaping their overall treatment experience (Theme 2), including the importance of the dietitian's attitude, professionalism, and background. Patients also valued a personalised and holistic approach that supported lasting change (Theme 3) and described tailored and accessible advice as crucial to putting treatment into practice in daily life (Theme 4). These four themes are interrelated and together shape how participants experienced and evaluated dietetic treatment.

Patients considered strong alignment with their personal circumstances, needs and wishes to be crucial for good dietetic treatment. Feeling heard and a strong connection with the dietitian were central to building trust and engagement. This aligns with previous research highlighting the importance of the therapeutic relationship, communication and provider approach as core components of patient-centred care (PCC) (55]. A review of therapeutic alliance in obesity care showed that few interventions integrate such elements, underlining the need for more attention to this in dietetic practice (56]. In our study, the quality of the connection was shaped by perceived expertise, advice, treatment style, and even characteristics such as the dietitian's weight, age and experience. This reflects what others have described as the perceived ability of the professional to assist (57]. Patients valued the dietitian as an external motivator and counsellor, rather than just an information provider, a view also expressed by dietitians in our previous study [38]. Although patients appreciated a counselling role, their preferences varied regarding the extent to which psychological topics should be addressed by the dietitian. Other studies have noted that while some patients prefer information over counselling, a purely informative approach can hinder continued engagement in treatment [58, 59]. Patients also reported limited

awareness of available treatment options or different working styles among dietitians, reflecting low levels of shared decision-making, a pattern confirmed in earlier research [60, 61]. Introducing shared decision-making early in the process may strengthen collaboration and improve the therapeutic relationship [62]. Information provision and attentive listening are key determinants of how patients perceive shared decision-making in the management of chronic illnesses (63). Shared-decision making in turn is an important component of PCC (21) and is linked to patients' self-efficacy, behaviour change (64-66) and improving patients' understanding and confidence in managing chronic diseases (67). This supports a broader shift in dietetic care from prescriptive advice to a more collaborative approach (68).

Our study indicates that patients value the dietitian's ability to understand and respond to their individual reality and needs. A clear need for tailored treatment emerged from the interviews, independent of patient background. However, several points of attention were raised for specific patient needs. These include the need of ensuring the accessibility of information for individuals with literacy challenges and tailoring interventions to align with cultural contexts. This is consistent with other studies on patient needs among ethnic minorities in the Netherlands, in which respondents expected a more technical medical approach to dietetic care (33) and an approach reflecting the healthcare culture in their country of origin (69). In addition to a tailored approach, patients expressed their appreciation of advice and information material, which needed to be clear, practical and consistent, aligning with previous research (41, 70).

Many findings from our study apply to a broad group of patients, but there are key considerations specifically for patients living with obesity. Patients valued dietitians who went beyond providing dietary advice, instead addressing broader lifestyle and psychological factors while integrating dietetic treatment into overall healthcare. These findings are supported by literature indicating that patients with obesity require holistic long-term support focused on both diet and a therapeutic counselling approach, integrating behavioural and lifestyle guidance (59, 71, 72). The need for attention for psychological factors found in our study can be explained by various psychological challenges that particularly are present in patients with obesity, such as dealing with stigma (73), and using food as a coping mechanism (74), which has been related to weight gain or loss (75). Patients in our study who received dietetic care with a stronger focus on psychology and counseling shared that this had an important impact on their experience of care. Studies have indeed noted the need to focus on self-acceptance and intrinsic motivation (76) to address the effects of stigma (74, 77) in treatment of patients living with obesity. Although many aspects valued by patients reflect current best practice principles, our findings suggest that these are not always realised in daily practice. Patients pointed to factors such as limited consultation time, variation in counselling approaches, and differences in communication style as possible explanations for this gap.

Strengths and limitations

This study is the first qualitative study in the Netherlands, and one of the few internationally, that explored the perspectives of patients with obesity on dietetic treatment in primary care, offering unique insights into their experiences. The inclusion of participants with diverse backgrounds strengthened the study by capturing a broad range of perspectives. Despite differences in how dietetic treatment is organised across countries, the insights from this study are highly relevant to dietetic practice and offer valuable perspectives for broader healthcare contexts. As with all qualitative research, the interpretation of the data was influenced by the backgrounds and perspectives of the research team. The researchers' experience in dietetics and qualitative research contributed to the depth and contextual understanding of the findings, while reflexive discussions throughout the study helped to minimise potential bias and strengthen the credibility of the analysis. The study included only a limited number of patients who discontinued care early, which restricts our understanding of their experiences. Another limitation was that the summaries of individual interviews (member checks) were sent in writing, which might have impacted the reviewing ability of participants had difficulty with reading and writing.

Practical implications and future research

This findings of this study highlight the need for a strong emphasis in dietetic treatment on the relationship between dietitian and patient, to significantly enhance treatment experience. Additionally, dietetic treatment for patients with obesity should prioritise personalised sustained support and long-term behavioural change, with a focus on addressing the psychological aspects that are essential for managing obesity as a chronic condition. Future research should focus on investigating the diverse needs of patient subgroups to more thoroughly understand their unique perspectives, including factors such as health literacy, socio-cultural and economic background, as well as patients' motivation and self-efficacy. In addition, future studies could develop and evaluate specific tools that support delivering a personalised treatment. As part of the Dietetics Building the Future research project, a first step has been taken through the development of a toolbox designed to help dietitians address diverse patient needs in daily practice.

Conclusion

The aim of this interpretative qualitative study was to understand perspectives and experiences of adult patients with obesity on dietetic care in primary healthcare. This study shows that effective dietetic treatment for adults with obesity in primary healthcare is grounded in personalised support and a strong therapeutic relationship. A sense of being acknowledged and understood fosters trust and engagement. The dietitian's attitude, professionalism, background and ability to connect play a central role in how patients experience treatment. A holistic approach that incorporates psychological factors contributes to sustainable lifestyle changes. Practical, tailored advice enhances patients'

ability to integrate treatment into their daily lives. These findings underscore the value of responsive, personalised treatment, starting with clear information and involvement even before treatment begins. Future research should focus on strengthening communication and developing different strategies that align treatment with each patient's needs and expectations.

Statements and declarations

Acknowledgements

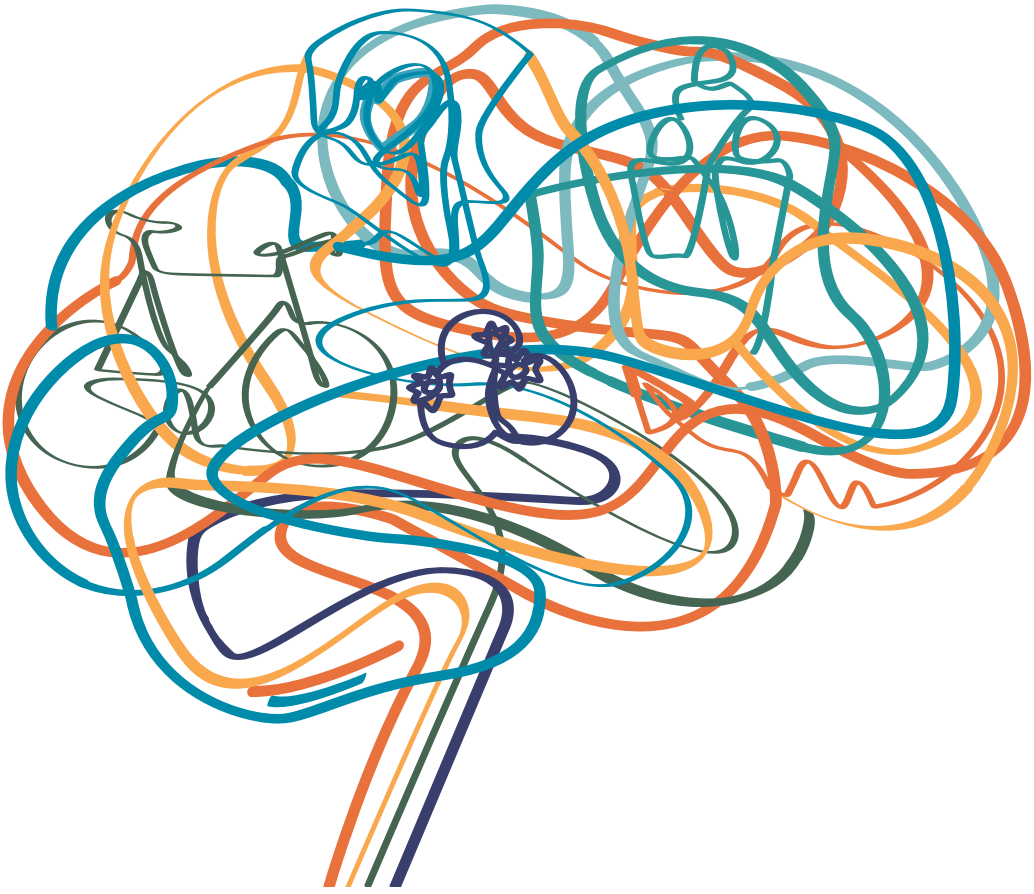
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CHAPTER 9

General discussion

Outline of discussion

The studies in this dissertation explored the factors affecting the effectiveness and long-term sustainability of lifestyle interventions for cognitive health and health behaviors, with a particular focus on healthy dietary behaviors. Together, these studies enable a dialogue between evidence from the controlled FINGER-NL intervention trial and insights from real-world dietetic practice. The results indicate that both personal and environmental factors influence how people engage with lifestyle change, how well they adhere to it, and whether they can maintain these behaviors over time. They also highlight the practical challenges people encounter when trying to implement and maintain healthier habits in everyday life.

In this chapter, the findings of this dissertation are presented and interpreted within a broader context. First, I structure the main results around the research objectives presented in the introduction, and discuss and reflect on the findings. These objectives were organized into two tracks. **Track 1** focuses on dementia prevention, using the FINGER-NL study to understand how older adults participate in and experience a multidomain lifestyle program. **Track 2** shifts the focus to dietetic practice, drawing on insights of dietitians and the experiences of their patients to explore how behavior change unfolds in everyday care. Second, I address the methodological considerations of this dissertation, including both the specific methods and approaches used and broader aspects related to design and validity. I then discuss several reflections, followed by an exploration of how the insights from this dissertation can support the translation of research into practice, with particular attention to the opportunities and challenges involved in implementing lifestyle interventions such as FINGER-NL on a broader scale.

Main findings and interpretation

Track 1 - Examining older adults' experiences of lifestyle interventions for dementia prevention

Research objective 1

To explore why older adults choose to take part in the FINGER-NL lifestyle program and what motivates them to engage.

Initial motivations provide an important starting point for understanding how individuals engage with lifestyle interventions and how this engagement develops over time. The findings in Chapter 2 show that most FINGER-NL participants join the program out of a strong motivation to maintain cognitive health and to prevent dementia. Experiencing dementia in their families often provides an additional personal motivation to take action. A minority of participants mentioned public interest or contributing to a broader societal solution for dementia as reasons to engage in dementia risk reduction. This is in line with earlier work showing that dementia risk–reduction behaviors are typically driven by personal relevance, or fear of developing dementia; for example, a recent study by Khalil

and Shaala (1) showed that personal dementia fear was significantly positively associated with motivation to change lifestyle and health behaviors. Previous research has also shown that providing care for an older adult with dementia influences perceptions of dementia risk and motivation to engage in preventive behaviors (2). These motivations were also reflected in our later interviews, presented in Chapter 3, and in the ideal-type analysis presented in Chapter 4, in which we categorized participants into different trajectories representing typical patterns of behavior change, adherence, and underlying motivations.

Overall, these findings suggest that the motivations driving participation in dementia-focused lifestyle interventions differ from those typically seen in general lifestyle programs. People who join programs for weight loss, cardiometabolic health, or general well-being often have more concrete, short-term, or physically oriented goals and motivations (3), as we also showed in Chapters 2 and 3. In contrast, motivations related to dementia prevention tend to be more abstract and long-term, and often involve uncertainty about personal risk. This phenomenon is sometimes referred to in the literature as "dementia worry," defined as an emotional response to the perceived threat of developing dementia (4, 5). This uncertainty may affect a range of behaviors relevant to lifestyle interventions, including how individuals interpret cognitive changes, anticipate and plan for their future, and engage in preventive behaviors.

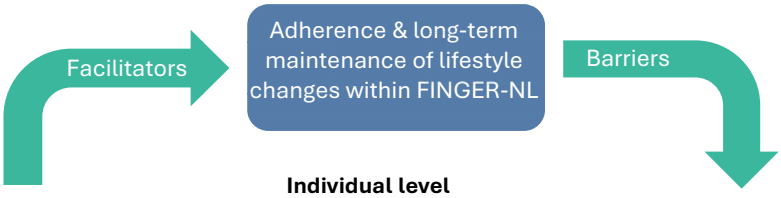
The interpretation of differing motivational patterns between dementia-focused interventions and general lifestyle programs aligns with our qualitative findings in Chapters 7 and 8, where people seeking dietetic treatment usually reported very concrete and immediate goals, such as losing weight, improving a specific health value, or managing physical symptoms. These findings help to clarify why engagement in general lifestyle programs is often driven by more actionable motivations. Dietitians described how these clear goals, often broken down into small, achievable steps during treatment, help guide behavior change and keep motivation stable over time. This is consistent with broader behavior change literature showing that proximal (short-term) and clearly defined goals facilitate self-regulation and sustained engagement (6). In contrast, such comparable proximal and tangible goals are more difficult to establish in the context of dementia risk reduction, where the potential benefits are uncertain and vary from person to person. Earlier studies have also shown that this uncertainty makes it harder for people to remain motivated and to link preventive actions to their daily routines (7, 8).

Research objective 2

To identify the factors that help or hinder attendance, engagement and adherence to the intervention and the maintenance of lifestyle changes.

To move beyond initial motivations and examine how engagement is maintained, it is necessary to identify the factors that facilitate or hinder attendance, engagement, and adherence over time. In the FINGER-NL study, participants were assigned to either a high-intensity intervention (HI-group) with structured, ongoing support across lifestyle domains,

or a low-intensity (LI) intervention (LI-group) that mainly provided general lifestyle advice with limited guidance. In Chapter 2, we described the barriers and facilitators that participants expected to encounter during the two-year trial. These anticipated barriers were mostly general lifestyle obstacles, such as physical health issues, time constraints (especially among working participants), long-standing habits, and financial limitations. In Chapter 3, we present the results of interviews with participants one year into the intervention, showing that these generic anticipated barriers often shifted toward more personal and concrete barriers, related to specific elements of the study design or to personal factors. An overview of the facilitators and barriers mentioned by participants in the HI- and LI-groups in Chapter 3 is presented in Figure 1. Most facilitators and barriers were reported by participants in the HI-group, unless otherwise specified.



Facilitators	Barriers
Individual level	
• Strong intrinsic motivation (fear of dementia, family history) • Visible health improvements (weight, blood pressure, strength) • Knowledge gains and risk awareness • Development of habits/routines • Autonomy through selective adherence	• Declining motivation over time • Physical limitations (injuries, chronic conditions) • Financial constraints (expensive foods; fish, berries) • High cognitive load (tracking food, routines) • Low perceived novelty or relevance of information (mainly in LI-group) • Personal preferences (taste, dislike of activities)
Interpersonal level	
• Supportive relationship with lifestyle coach • Accountability and encouragement • Peer support in group meetings	• Social mismatch within study group (feeling out of place, younger or less motivated) • Group allocation (mainly in LI-group)
Program level	
• Personalized coaching and tailored focus areas • Structured modules (diet, physical activity, cognition etc.) • Accessible group format (online + on site) • Annual health measurements proving feedback	• Time burden and logistical challenges • Intervention not aligned with working life obligations • Travel time vs. perceived value • Complex program demands (multiple domains)
Technology level	
• Convenience of digital tools (Teams meetings, Ivido, apps) • Walking apps adding motivation	• Login difficulties, 2-factor authentication • Discomfort with being monitored/tracked
Study-related factors	
• Commitment to the study (altruism; wanting to 'finish what they started') • Desire to contribute to science	• Feeling under-supported (mainly in LI-group) • Unclear personal benefits (mainly in LI-group) • Expectations not met (mainly in LI-group)

Figure 9. Summary of the main facilitators and barriers identified in the high-intensity and low-intensity groups, as described in Chapter 3.

The shift from anticipated to experienced barriers highlights that engagement in lifestyle interventions is shaped not only by participants' expectations, but also by the practical realities of everyday life and by characteristics of the intervention itself. Together, these individual-level facilitators and barriers can also be interpreted in the light of established theoretical models of behavior change, consistent with earlier applications of the Health Belief Model to understand facilitators and barriers to preventive health behavior (9-11). For example, in Chapter 5, we use the Motivation to Change Lifestyle and Health Behaviors for Dementia Risk Reduction questionnaire (the MCLHB-DRR), which is based on the Health Belief Model (HBM), a widely used framework for understanding preventive health behavior and for illustrating the key cognitive constructs of health-related behavior change (12) (Figure 2).

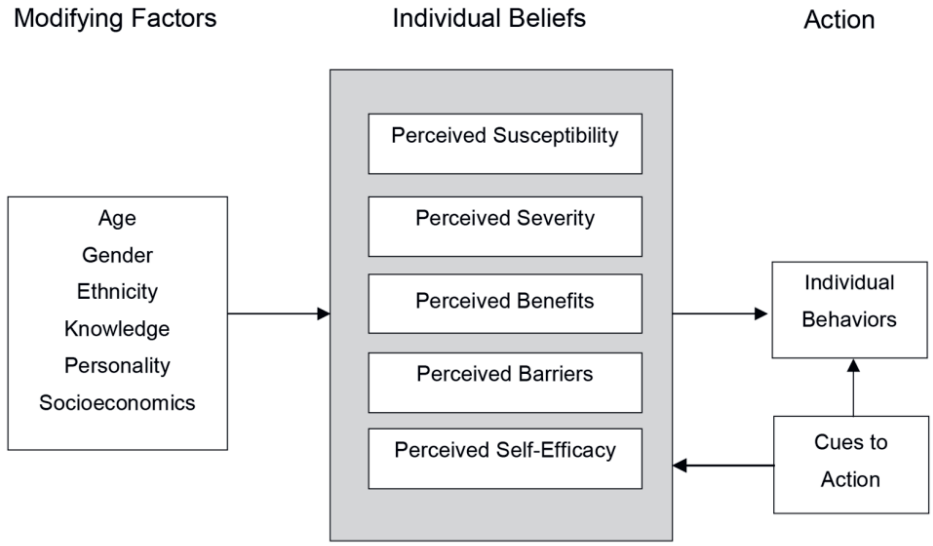


Figure 2. General components of the Health Belief Model (HBM). Adapted from Glanz et al. (13), as presented in Colley et al. (14).

Developed in the 1950s, this model focuses on how people perceive their own risk of illness, how serious they think a condition is, the expected benefits of taking preventive actions, and the barriers they experience in doing so, shape their choices and behaviors. The facilitators and barriers described in Chapter 2 and 3 can, for the most part, be linked to these psychological constructs. For example, strong motivation driven by perceived susceptibility (such as fear of developing dementia) or by perceived benefits (such as noticing improvements in health) fits well within the HBM. Practical, physical, or technological difficulties participants reported can similarly be understood as perceived barriers.

At the same time, several limitations of the HBM should be noted. The model mainly focuses on cognitive beliefs and individual perceptions, and pays relatively little attention

to emotions, habits, social relationships, and broader cultural or structural factors that also play a major role in health behavior. It largely assumes that if people feel at risk, recognize the seriousness, and believe in the benefits, they will act accordingly, suggesting a rather rational and linear process (15). As described in Chapter 5, the psychological subscale scores of the MCLHB-DRR, grounded in the HBM, were only weakly related to the presence of dementia-related lifestyle risk factors among FINGER-NL participants at baseline. This suggests that the explanatory scope of the HBM is limited when it comes to understanding the presence of dementia-related lifestyle risk factors. At the same time, working with a clearly delineated cognitive model helps to make visible where beliefs and risk perceptions shape behavior, and where additional influences begin to matter, as the Health Belief Model remains useful for highlighting cognitive drivers of action but is limited in accounting for emotional, social, and contextual influences on behavior (15). In practice, the step from belief to behavior appears to be influenced by many additional factors, such as daily routines, physical limitations, financial constraints, and the social and technological context people live in.

Research objective 3

To examine how participants implement the program in their daily lives across different lifestyle areas, such as diet, physical exercise, cognitive training, social engagement, sleep, and stress management.

Moving from participation and engagement toward actual behavior change requires insight into how participants translate the intervention into their daily lives across different lifestyle domains. Key findings from Chapter 3 and 4 show that diet and physical activity were the lifestyle areas in which participants made the clearest and most consistent changes. This uneven uptake across lifestyle domains is consistent with findings from multidomain lifestyle interventions, which show that participants tend to adopt dietary and physical activity changes more readily than cognitive, social, or psychosocial components (16, 17). In the interviews, HI-group participants described concrete changes in diet and physical activity, such as increasing their intake of vegetables, fish, and olive oil, reducing sugar consumption, and incorporating more walking or short daily exercise sessions into their existing routines. Other lifestyle domains were integrated more selectively. Cognitive training showed a mixed pattern: some participants built BrainHQ into a weekly routine, while others found it difficult to prioritize or did not enjoy the activity. Sleep and stress were mainly discussed by participants who experienced difficulties in these areas. This problem-driven engagement may be indicative of a broader pattern in preventive health behavior, where lifestyle changes tend to be initiated in response to experienced problems, rather than solely for future risk reduction (18). In particular, sleep was primarily seen as a concern by those who felt they slept too little, whereas participants who perceived their sleep as ‘sufficient’ rarely considered it an area for change, despite evidence suggesting that both very short and very long sleep durations can negatively affect cognitive functioning (19). Altogether, across the two-year FINGER-NL intervention, participants integrated the FINGER-NL program into daily life in uneven, selective, and individualized

ways. This integration differed between lifestyle domains, between groups (HI and LI), and over time.

To better capture these differences over time, Chapter 4 describes how participants could be grouped into different trajectories using ideal-type analysis (20) , each showing a distinct pattern in how lifestyle changes developed over time. For HI-group participants in the *consistent adherence* and *slow adoption* trajectories, dietary changes gradually became part of daily life. At the end of the intervention, many described them as "automatic" or "just the way we do things now." HI-group participants in the *early peak* trajectory usually started very intensively, trying to change many habits at once in a very short period of time, but found it harder to sustain this effort. As a result, these participants often realized that it was not realistic to change so much and experienced a drop in motivation. Participants in the self-directed trajectory made their own changes, inspired partly by the study, whereas passive participants did not develop new behaviors despite admitting that it would have been relevant to change their behaviors. These distinct trajectories reflect a pattern seen in health behavior research, where the factors that help people start making changes are not always the same as the ones that help them keep those changes going over time (21, 22). It makes clear that being actively supported by the intervention does not automatically lead to sustained lifestyle change, but that the absence of strong external pressure does not necessarily hinder change either.

Research objective 4

To provide insights that can help improve the design and delivery of multidomain lifestyle interventions for cognitive health in the Dutch context.

Taken together, the findings of this dissertation point to three key elements that are relevant for improving the design and delivery of future lifestyle interventions. First, information about barriers and facilitators should be actively used to anticipate and address challenges in everyday life. As discussed in Chapters 2 and 3, the motivations, barriers, and facilitators that participants described provide a clear basis for understanding what an intervention needs to offer. Many participants started with strong personal motivation, often because of a family history of dementia or a general wish to age healthily. However, practical issues such as time pressure, costs, technology, and physical limitations strongly influenced what they could realistically do in daily life. These findings indicate that interventions should be tailored to individual circumstances, addressing both personal motivations and real-life barriers. Rather than rely on providing information alone, interventions need to support participants in fitting new behaviors into the everyday situations in which they live and make decisions. From the participants' perspective, a human support component, such as a lifestyle coach, played a particularly important role, as participants in Chapter 3 and, to a lesser extent, Chapter 4, emphasized the importance of personal contact. This centrality of personal contact was also evident in Chapters 7 and 8 in the context of the dietitian–patient relationship. Digital aids may complement this support by offering personalized feedback, and are increasingly promising, but are, yet, unlikely to fully replace the

relational aspects of behavior change (23, 24). Especially for older adults, recent work suggests that digital and blended delivery formats can support behavior integration, but engagement and retention remain key challenge (25, 26).

Second, based primarily on the findings of Chapter 4, the results indicate that participants followed different trajectories, and that recognizing these trajectory-based subgroups may help to better understand how support within the intervention was experienced and taken up. The Ideal-Type Analysis (20) in Chapter 4 was included to bridge theory and practice by showing that participants do not move through lifestyle change in a single, linear way. Instead, they follow distinct but recognizable patterns. By clustering individual experiences into a limited number of recognizable trajectories, such as early intensive engagement followed by decline, gradual adoption, stable adherence, self-directed change, passive participation, or disruption by major life events, the analysis moves beyond individual anecdotes without reducing behavior change to a single pathway. Although this represents only a first step, bringing together many individual stories into a small number of broader trajectories may help lifestyle coaches recognize common patterns and tailor behavior change techniques accordingly, rather than having to respond to a large number of individual pathways in isolation. In addition, these findings suggest the value of embedding standardized, recurring checks within lifestyle interventions to monitor motivation and adherence over time. Such monitoring is also supported by earlier work, which shows that motivation and engagement fluctuate during long-term behavior change and that regular assessment can help detect early signs of declining adherence and inform timely adjustment of support (27).

Third, the design of interventions aimed at maintaining cognitive health can build on insights from broader lifestyle interventions, explored in Track 2. In contrast to the large body of evidence from weight-loss and cardiometabolic programs (28, 29), there are still relatively few multidomain trials that focus specifically on cognitive health. Yet these general lifestyle interventions address a similar complexity of behavior change, requiring sustained adjustments across multiple lifestyle domains. In Chapter 6, we used Qualitative Comparative Analysis (QCA) to examine which components contribute to success in weight-loss interventions. Our results made clear that across the interventions included in the analysis, no single component was sufficient on its own; rather, successful outcomes depended on specific combinations of intervention elements. Across the interventions analyzed, the combination of dietary change, physical activity, and a behavioral change strategy appeared most consistently in successful cases, whereas group setting and an intervention duration of six months or longer were not sufficient on their own. Although weight-loss interventions are not the same as cognitive-health interventions, methods like the QCA can help in analyzing the interaction between intervention components. The results of the QCA on weight-loss interventions show that success often depends on the accumulated and combined effect of different components, and that design choices like group or individual sessions are not only design choices, but also function as active components of the intervention (30, 31).

Track 2: Exploring lifestyle change beyond the research setting: dietitian and patient perspectives

Research objective

The objective of the second part of this dissertation was to better understand how lifestyle counseling and treatment techniques can support (sustainable) behavior change in the daily life setting, building on the expertise of dietitians and the experiences of their patients.

Against this background, the final chapters bring together the perspectives of dietitians and participants to describe how dietetic care is shaped and experienced in everyday practice. Dietitians' and participants' experiences described in Chapter 7 and 8 point in the same direction; effective dietetic care is not defined by a specific protocol or technique, but by how well treatment is personalized, embedded in a trusting relationship, and translated into small, workable steps and goals in daily life. Dietitians in Chapter 7 described how they try to balance guideline-based advice with the realities of patients' lives: limited time, financial constraints, comorbidities, family context and fluctuating motivation. Similar tensions between evidence-based guidelines and everyday life constraints have been reported in other studies of primary care and dietetic practice (32, 33). Dietitians in our study saw their role increasingly as more than that of an 'information provider': they act as coach, sounding board and external motivator, helping patients to set realistic goals, adjust expectations, and persist when progress is slow. Broader studies of outpatient dietetic care suggest that patients' experiences and preferences are shaped not only by the content of dietary advice, but also by the interpersonal qualities of the dietitian and the way care is delivered, highlighting the role of accessibility and personalized interaction alongside informational input (34). In addition, motivational interviewing and related counseling frameworks are increasingly discussed as part of dietetic practice, as they provide structured ways of supporting empathic communication and patient autonomy in behavior change processes (35).

At the same time, dietitians reported clear barriers such as short consultations, fragmented care, limited reimbursement, and the feeling that they are expected to address everything in a few sessions, sometimes with patients who actually need long-term, holistic support. These barriers are consistent with findings from recent qualitative studies on nutrition care delivery, which describe how resource constraints, time pressure, and limited integration within care systems shape the possibilities for providing holistic, patient-centered care (33).

Patients, on the other hand, emphasized in Chapter 8 that their experiences of dietetic care were strongly shaped by the relationship with the dietitian. Patients described effective treatment as personalized from the start: being heard, seen and taken seriously, and receiving support that fits their own situation, rather than generic lists of things. They valued

dietitians who looked beyond dietary habits alone and acknowledged psychological factors, stigma, and the emotional side of living with obesity. Practical, tailored advice, concrete and comprehensible examples, simple tools or apps, materials that are suitable for their literacy level and cultural background helped them to actually use the advice in everyday life. Broader studies of dietetic counseling similarly indicate that patient engagement depends on both the content and the delivery of advice (36). Importantly, the interviews with patients point to tensions with more weight-centered and prescriptive approaches to dietetic care. While many clinical frameworks emphasize weight-related outcomes and adherence to dietary targets, patients in this study described how a narrow focus on weight, limited attention to their personal context, or predominantly directive advice could undermine motivation and sustainability. This observation is consistent with a growing body of critical literature that questions weight-normative models of obesity care and describes how stigma, moralization of weight, and an emphasis on numerical outcomes may adversely affect patient engagement and wellbeing (37).

In relation to the research question, the effective components of dietetic treatment that support sustainable behavior change are, in the end, less about specific diets or single techniques, and more about how counselling is delivered, which is also supported by the literature (38). Across the two chapters, three elements stand out. First, a strong, trustworthy dietitian–patient relationship in which patients feel recognized and safe to talk about struggles, setbacks and sensitive topics. Second, genuinely personalized, holistic care: connecting dietary advice to someone's broader life, health problems, emotions, culture and daily routines, rather than treating food in isolation. Third, small, realistic steps with ongoing, responsive support, instead of one-off advice or an all-or-nothing focus on weight. Together, these same elements are also highly relevant beyond dietetic care. In the context of dementia risk reduction, these findings suggest that sustained uptake of lifestyle advice for brain health may depend not only on what is advised, but also on how such advice is delivered, with relational, personalized, and practical elements playing an important role in supporting translation into everyday life.

Methodological considerations

While the methodological considerations of each study are discussed in detail in Chapters 2 to 8, this section addresses broader, overarching aspects, including study design, sample characteristics, and the strengths and limitations of qualitative and quantitative methods. The methodological considerations are organized into two parts. First, I address the specific methodological tools and analytical approaches used, including qualitative research, qualitative comparative analysis, and ideal type analysis. Second, I discuss broader design and validity considerations, such as issues of blinding and generalizability.

Added value of qualitative research in RCTs

This dissertation includes a strong qualitative component. Although the value of incorporating qualitative research alongside randomized controlled trials (RCTs) is widely acknowledged, relatively few trials meaningfully integrate qualitative methods in practice. As a results, there remains a need for improved guidance, funding, and structural support to embed qualitative approaches in clinical trials of complex interventions (39, 40). Recent methodological research recognizes the value of combining qualitative and quantitative research methods (41) and provide guidance on how to integrate these approaches (42). In their scoping review, Costa and Macedo (43) describe multiple ways in which qualitative research can enhance RCTs, including by improving interpretation of outcomes, identifying implementation challenges, and explaining heterogeneity in intervention effects. The qualitative studies presented in Chapters 2–4 and 7–8 therefore add important context to the intervention outcomes. Although a fully integrated mixed-methods analysis was not feasible within the timeframe of this dissertation, as quantitative outcome data were still being analyzed at the time of writing, the qualitative findings offer important explanatory context. For example, participants described how major life events, such as bereavement, directly affected their ability to engage in physical activity or complete intervention assignments, independent of their motivation or intentions. Without such qualitative insight, changes in behavior risk being attributed solely to the intervention, while the findings presented here illustrate how external life events and personal circumstances can play a decisive role in shaping intervention engagement and outcomes.

Do we measure what we want to know?

In line with this, insights from the qualitative data also raise the question of whether the primary outcome of FINGER-NL measures what we intend to measure. This question is particularly relevant in trials aimed at cognitive health. Unlike outcomes such as weight or blood pressure, cognition is not a single objective marker but is inferred from performance on cognitive tests, which differ in how accurately they capture different aspects of cognition (44). The neuropsychological test battery (NTB) used in FINGER-NL is a validated instrument and composed of different subtests covering the cognitive domains of attention and executive functioning, processing speed, and memory (45). While this test battery is theoretically well-grounded, the interviews suggest that its use in practice may be more problematic: several HI-group participants were highly aware of what they would be tested on, and some even mentioned practicing certain tasks or felt that BrainHQ helped them train exactly the skills that later appear in the outcome measures. This raises concerns about the extent to which observed changes reflect genuine cognitive change versus improved test performance. This fits with what has long been discussed in cognitive ageing research: improvements on neuropsychological tests may partly reflect practice effects, test familiarity, or better strategies, rather than actual cognitive change (46).

Design choices in complex interventions: QCA and ITA

In Chapter 6, we used Qualitative Comparative Analysis (QCA) to explore how different intervention components interact in weight loss interventions for adults with obesity. This method was chosen because it allows for the examination of complex interventions composed of multiple components. At the same time, it is important to acknowledge the limitations and potential methodological questions this approach may raise. As Parrott et al. (47) phrased it, QCA 'may be uncomfortably nonspecific for readers who are accustomed to the specificity of standard meta-analysis.' This non-specificity reflects that QCA identifies multiple sufficient configurations rather than estimating average effects, which may be less familiar to readers accustomed to effect-based analytical approaches. In this context, QCA should be understood as a methodological approach for examining how combinations of intervention components relate to outcomes, rather than as direct empirical evidence for the effectiveness of specific components. While QCA is one of the few methods for comparing interventions that are otherwise difficult to compare directly, our findings mainly reinforce a broader lesson: the search for a universally effective 'recipe' for behavior change is likely illusory. Across the studies in this dissertation, it becomes clear that human behavior cannot be fully captured within predefined intervention designs that are assumed to work for everyone. Ultimately, effective interventions require tailoring to the needs, preferences, and circumstances of individuals. The decision to use Ideal Type Analysis (ITA) in Chapter 4 reflects the same pragmatic and interpretative standpoint, aimed at identifying patterns without assuming uniformity. ITA is a scientifically grounded approach, but also a practical way to make sense of an overwhelming amount of qualitative data by grouping individual trajectories without pretending that these groups are rigid or uniform.

Blinding within lifestyle interventions

One of the core principles of a randomized controlled trial is keeping participants (and researchers) blinded to group allocation (48). In the FINGER-NL publication of the study design it was stated that 'To promote blinding and adherence, and inspired by U.S. POINTER (U.S. Study to Protect Brain Health Through Lifestyle Intervention to Reduce Risk (49)), we deliberately avoid the label 'control group', instead designating both groups as receiving some form of lifestyle intervention, differing, however, in structure and intensity. Personnel collecting the primary outcome measures (cognition) and researchers conducting the statistical analyses are blinded to group allocation' (45). Implementing blinding in lifestyle interventions comes with different challenges compared to pharmaceutical trials. Lifestyle interventions often involve visible and concrete changes, such as eating differently or becoming more physically active, which makes it difficult to keep participants unaware of which group they are in (50). Indeed, the interview data in this dissertation showed that almost all participants were aware of their allocation within the FINGER-NL intervention.

The consequences of this awareness are not entirely straightforward. On the one hand, one could argue that in this type of prevention research, full blinding of participants is less

critical, as the focus lies on voluntary behavior change rather than involuntary physiological effects triggered by medication. On the other hand, there are strong reasons to believe that participants' perceptions of their group allocation do matter. Awareness of being in a less intensive intervention may reduce motivation, engagement, and adherence, while perceiving an intervention as active or personalized may enhance effort and perseverance, regardless of its actual content. Moreover, research from other domains indicates that expectations themselves can influence outcomes; participants' belief in the effectiveness of an intervention can lead to measurable improvements in cognitive functioning through expectancy effects, including placebo effects, potentially affecting attention, alertness, motivation, or persistence (51, 52). At the same time, the qualitative studies showed that some participants in the low-intensity group still took extra steps on their own, even though they knew they were in the less active arm. This shows that group allocation influences behavior, but does not fully determine what people do. As Younge et al. (53) point out, giving a 'placebo lifestyle intervention' to a control group may actually underestimate the effectiveness of the active intervention compared with what might happen in real-world practice. Rather than trying to isolate the 'pure' effect of the intervention, the additional expectancy or placebo effect should be seen as part of how a lifestyle intervention naturally works outside a trial.

Research participation effects

One important consideration in research participation is the potential influence that the act of participating itself may have on participants and, consequently, on their behavior within the intervention. These influences are collectively referred to as Research Participation Effects (RPEs) (54). A well-known example is the Hawthorne effect, discussed in Chapter 3, in which individuals change their behavior simply because they are aware of being observed or monitored (55). Such effects are generally understood as relatively passive responses to observation and measurement. Participation in qualitative interviews represents a different, more interactive form of research involvement, which may influence participants in other ways. Rather than merely being observed, participants are actively invited to reflect on their experiences, articulate challenges, and give meaning to their participation. The literature remains inconclusive about whether and how participants are influenced by taking part in qualitative interviews, but there are some indications that such effects may exist. In the qualitative studies presented in this dissertation, for example, none of the interviewed participants in the low-intensity (LI) group dropped out, despite a relatively high dropout rate in the LI-group within the broader FINGER-NL intervention [data to be published]. In contrast, there were some dropouts in the HI-group interview sample, which fits with the broader dropout pattern seen in FINGER-NL. During the interviews, several participants indicated that they appreciated having the opportunity to share their experiences within the intervention. Being able to talk about challenges or frustrations in this context allowed them to place these experiences within a broader research perspective, which seemed to make it easier to accept aspects of the intervention that could not be changed within the constraints of the trial setting. Although this was not the goal of the interviews, the use of qualitative interviews within lifestyle or behavior change

interventions could potentially serve as a supportive element to promote participant engagement and adherence throughout the intervention process.

Generalizability

Chapters 2 and 3 have already touched on this issue briefly, but the generalizability of the results should nevertheless be interpreted with caution. The study population of FINGER-NL, and consequently the sample for the qualitative studies, differs from the general population on several characteristics. First, participants were selected based on the presence of one or two non-modifiable risk factors (a family member with dementia or subjective memory decline). This selection is defensible, as the primary aim of an RCT is to demonstrate a causal effect (efficacy), which is best achieved in populations in whom the largest effect is expected (56). Nevertheless, it is still important to take this into account when interpreting the results and considering their applicability to the general population. In addition, the overall participant population of FINGER-NL was generally more highly educated than the Dutch average. This is important to consider, as higher-educated individuals differ not only in their health behaviors but also in their approaches to behavior change. Previous research has emphasized that participation in many health behaviors is associated with individuals' social status and their access to resources, which in turn shapes their opportunities to engage in such behaviors (57). While the use of specific recruitment strategies to include underrepresented groups in scientific research is now widely recognized as important, in practice it continues to be a persistent challenge.

Reflections

The findings in this dissertation show both the possibilities and the difficulties of using lifestyle interventions to prevent dementia. Along the way, this project also raised some broader reflections, both about the place of lifestyle change in later life and about the practical realities of implementing personalized interventions.

Ethical and conceptual reflections on lifestyle change and prevention

While lifestyle changes can contribute to improved quality of life, they also demand a great deal from the individuals trying to put them into action. In scientific research, we are inclined to emphasize the potential of prevention, especially when it concerns modifiable risk factors, such as diet, physical activity, sleep, and stress, which, at least in theory, can be adjusted through lifestyle change. On the other hand, it is worth questioning whether some so-called 'modifiable risk factors' are actually modifiable by individuals at all. Factors like educational level or exposure to air pollution are often treated as modifiable in the literature, but in practice lie largely outside people's direct control. This point has also been raised in previous research (58).

Daly and Olluri (59) further question whether it is ethically justified to offer intensive lifestyle interventions specifically and explicit for brain health when the evidence for their

effectiveness is still under investigation. A key point they make is that clear communication is essential, so that participants do not develop unrealistic expectations or false hope. More generally, it is important to avoid presenting lifestyle recommendations as if health were a goal that should override all other values in life. Health-related priorities should be discussed alongside non-health priorities, such as work demands or family responsibilities, which may be equally important to individuals, allowing lifestyle changes to be integrated in daily life in a way that feels balanced and realistic. This is not to suggest that lifestyle interventions reduce quality of life, but rather that the intervention needs to fit the person's own situation, preferences, and values in order to be sustainable. In the context of prevention in later life, as in the FINGER-NL population, it is therefore relevant to take a pragmatic approach to lifestyle changes, that can be integrated without asking people to give up aspects of daily life that are meaningful to them. The point is not that the 'pleasures of life' (as one of the participants called it) should be abandoned, but that the trade-off between possible health benefits and enjoyment differs for each person, and interventions need to take this into account.

Practical reflections on the gap between research and real-world practice

Although in this dissertation we aimed to apply insights from dietetic practice, derived from non-controlled real-world studies, within a controlled research setting, it became clear that these contexts differ in several important ways. The barriers and facilitators described in the qualitative studies are shaped by the specific context of FINGER-NL, which lies much more on the explanatory end of the explanatory–pragmatic trial continuum as described by Patsopoulos (60). Explanatory trials aim to test whether an intervention *can* work under controlled, optimized conditions. This means strict protocols, fixed schedules, standardized materials, and limited (room for) flexibility. Participants in FINGER-NL therefore received relatively intensive guidance, regular monitoring and structured meetings, with support that was delivered in the same way to everyone. All of this influenced how participants experienced the process of behavior change.

Routine dietetic care, by contrast, is much closer to the pragmatic end of the continuum. Although support is often less intensive, and reimbursement is limited by basic health insurance, dietitians have much more freedom to tailor their approach to respond to individuals' preferences , priorities, and pace, as described in Chapters 7 and 8. The goals of these contexts also differ. Dietetic practice typically focuses on weight loss, often in relation to other physical complaints, whereas FINGER-NL participants were primarily motivated by concerns about long-term cognitive health. While the FINGER-NL intervention aimed to offer tailored support, the conditions under which this tailoring occurred, such as strict study protocols, limited time, and reduced professional flexibility, differed substantially from those in routine care. This makes it clear that 'tailoring' within a trial setting is not equivalent to tailoring in everyday practice These differences help explain the rationale for combining the two tracks in this dissertation. Track 1 provides insight into how older adults engage with a highly structured, evidence-based lifestyle intervention aimed at cognitive health under controlled conditions, while Track 2 sheds light on how behavior

change is supported in routine care settings where flexibility, personalization, and long-term relationships play a central role. Moreover, the patient–practitioner relationship, which came forward in Chapters 7 and 8 as one of the most important factors for engagement and motivation, cannot easily be replicated in a trial such as FINGER-NL. In those chapters, we aimed to identify concrete, effective components of dietetic care, and what stood out most was the relationship itself. The way dietitians listen, adapt, follow the client's pace, and provides support is not just an 'add-on' to the treatment, to a large extent it constitutes the treatment. Such relationships are difficult to foster within the more rigid and protocol-driven structure of FINGER-NL, where flexibility and continuity are inherently limited. The findings from both tracks illustrate that understanding lifestyle change requires attention not only to intervention content and outcomes, but also to context, delivery, and relationships.

Rethinking adherence in real-world contexts

A related reflection concerns how adherence and engagement are conceptualized within dementia prevention research. In intervention studies such as FINGER-NL, adherence is typically operationalized using researcher-defined, quantitative indicators, such as attendance, completion of intervention components, or compliance with prescribed activities (61, 62). The qualitative findings in this dissertation suggest that participants often relate to adherence in a fundamentally different way. Rather than engaging with the intervention as a fixed package, participants actively select, adapt, and combine elements of the program to fit their daily lives, priorities, and preferences. From their perspective, engagement is less about completing all components and more about integrating those aspects that are perceived as meaningful and feasible within their own context. This interpretation aligns with recent work showing that members of the public understand adherence to dementia risk reduction interventions as a dynamic and personally meaningful process, rather than as passive compliance with research protocols (27). Such perspectives help to interpret the selective uptake and uneven engagement observed in this study without framing these patterns as a lack of motivation or commitment. At the same time, they point to an important methodological tension: when adherence is defined narrowly in terms of protocol fidelity, meaningful forms of engagement and sustained lifestyle change risk being overlooked in trial-based evaluations.

Overall these differences do not mean that research and everyday practice are incompatible. Rather they mainly show the distinct contributions of each setting. Trials such as FINGER-NL helps us understand what may work under controlled conditions, while routine care shows how these kinds of changes can actually be supported in the complexity of daily life. The qualitative findings in this dissertation suggest that future interventions will gain the most by combining both approaches: the structure and evidence base from research, and the flexibility, personal attention, and longer-term relationship that are characteristic for dietetic and other primary care settings. In this sense, the gap between research and practice is not just a problem but also a starting point; it shows what needs to be adjusted so that interventions become both effective and workable in real life.

From research to practice

The FINGER-NL study is part of the MOCIA research program (Maintaining Optimal Cognitive function In Ageing), which aims to identify individuals at increased risk of cognitive decline and improve prevention through personalized lifestyle interventions. Beyond evaluating single interventions, MOCIA explicitly seeks to understand how lifestyle-based approaches can be supported and sustained in everyday life. It is important to recognize that lifestyle interventions like FINGER-NL are made possible through research funding, which allows different experts and researchers to contribute to the project. However, in its current form, with a mix of online sessions, in-person meetings and quite a lot of external support from researchers and lifestyle coaches, a program like FINGER-NL is not very realistic, or cost-effective, and unlikely to be feasible or cost-effective to implement at scale in routine practice, especially when individuals are expected to keep these routines up on their own at home for longer periods of time (63). At the same time, the lifestyle behaviors targeted in FINGER-NL are relevant not only for cognitive health but also for a range of chronic conditions, as key behaviors such as diet, physical activity, smoking, and alcohol use have been shown to influence the risk of diabetes, cardiovascular disease, and certain cancers (64-66). This makes it worthwhile to think about ways to support these behaviors on a larger scale, but in a simpler and more feasible way. In the following paragraphs, several possible directions are discussed, such as building on existing care structures, using digital tools, or working with population-level campaigns.

Integrating in existing care

A practical question that follows from this work is whether dementia-prevention efforts could be placed within existing care. The research team of the original Finnish FINGER study has already examined barriers and facilitators to implementing the intervention in clinical practice, from the perspective of healthcare professionals (67). In addition, Sindi et al. (68) argue that successful implementation of multidomain lifestyle interventions requires coordination across several levels of the health system; community settings, primary care, and specialist services such as memory clinics. dietetic care seems a logical point of entry for at least the nutrition-related components of dementia prevention, given dietitians' preventive focus and their role in supporting long-term dietary behavior change. Primary care, in turn, provides an accessible setting for the delivery of lifestyle interventions (69).

At the same time, dementia prevention can be considered a form of selective prevention, which raises the broader question of professional responsibility and coordination. Individuals differ in the lifestyle domains that pose the greatest challenge to them; diet, physical activity, sleep, stress, or a combination of these. Accordingly, the coordinating role in dementia risk reduction does not necessarily have to lie with one specific profession. Depending on an individual's primary needs at a given moment, this role could be taken up by a physiotherapist, dietitian, lifestyle coach, or another primary care

professional. This perspective aligns with broader discussions on interprofessional collaboration in primary care, which emphasize organizing care around the individual rather than each operating in their own bubble (70).

Interprofessional collaboration (IPC) is often seen as a response to the increasing complexity of care needs, particularly in ageing populations (71). (72, 73). At the same time, IPC in primary care is not always straightforward: financial and time constraints, unclear responsibilities, and overestimation of one's own collaborative skills can all get in the way, but when it does work, it creates a more coherent and supportive environment for clients with multiple needs (71). Importantly, embedding interventions in routine care through such collaboration also offers a positive route forward: it reduces the dependence on intensive, costly research programs like FINGER-NL and makes it possible to reach more people without requiring major extra resources. However, considering the existing workload in primary care, further research is needed to determine whether embedding dementia-prevention efforts in routine primary care is feasible and adds meaningful value.

Digital tools

Another potential way to better support independent, at-home engagement with a multidomain approach is through the development of a fully digital intervention. Sharma and Ludden (74) published as part of the MOCIA consortium, '*Schouderklopje'* presented as a self-managed, user-centered digital lifestyle toolkit. It combines multiple lifestyle factors, and the design specifically considered how older adults use and interact with digital interventions. The study also explored the challenges and motivations that affect whether people actually use such tools, based on interviews with experts and lifestyle coaches, including researchers from FINGER-NL. The main takeaways are that education and training are crucial to support lasting lifestyle changes, interventions should be personalized to fit individual goals and preferences, and users need enough autonomy to make their own choices. The toolkit should also be simple, accessible, and trustworthy to encourage long-term use. This approach complements the work presented in this dissertation. While digital interventions are increasingly seen as a practical and cost-effective alternative to face-to-face programs, the findings from Chapters 2–4 show that in-person support remains important for participants, who often report challenges and barriers around using technology. In this context, it is also important to consider the life stage of the target population. Participants in FINGER-NL were between 60 and 80 years old, whereas the generation below, who will likely be the target users of the yet-to-be-developed *Schouderklopje* app, is likely to experience fewer barriers to digital engagement.

National campaigns

A commonly suggested option in the literature is to roll out nationwide campaigns to raise awareness about dementia and its prevention (75). A Danish campaign showed that while overall awareness did not significantly increase, those exposed to the campaign had better recognition of risk factors and were more motivated to implement lifestyle changes (76). Specifically in the Netherlands, a campaign in Limburg showed that exposure to the

campaign was associated with greater awareness and motivation for behavioral change (77). The advantages of national campaigns are clear, but public health campaigns often face challenges. To be effective, they also need to target specific subgroups that are often overlooked in research, such as individuals with low socioeconomic position and low health literacy (78). Achieving a population-level increase in overall awareness is difficult, and motivating people to actually change their behavior is even more challenging. As discussed earlier, awareness is an important first step in behavior change, but it is not always enough to get people to take action. In short, national campaigns cannot be a 'scattergun' approach; they need to be carefully designed and targeted.

Overall conclusion

In conclusion, this dissertation shows that lifestyle change aimed at supporting cognitive health is not simply a matter of providing information or prescribing behavior. Although lifestyle change is often framed in terms of general health, motivations related to cognitive health and dementia risk appear to be shaped by different concerns and considerations. Across the studies, it becomes clear that many people are genuinely motivated to live healthier lives in order to protect their cognitive functioning, often driven by personal experiences with cognitive decline or dementia in their social environment, concerns about aging, or the desire to maintain independence. At the same time, acting on this motivation and sustaining change over time proves to be far from straightforward, particularly when the anticipated benefits for cognitive health are perceived as distant or uncertain.

By combining qualitative and quantitative perspectives, this dissertation contributes to a more nuanced understanding of lifestyle change in the context of cognitive health. Rather than approaching interventions as fixed programs with predefined components, it highlights lifestyle change as a dynamic and ongoing process. The findings show that psychological factors such as motivation, beliefs, and intentions are relevant, but insufficient on their own. Sustainable change depends on how these factors interact with people's living conditions, available resources, social environment, and the way support is organized and delivered.

Across the studies, a recurring theme is the importance of support that fits the person. Feeling understood, receiving guidance that aligns with one's own life and priorities, and working toward realistic and meaningful goals appear central to engagement and persistence in initiating and maintaining lifestyle change. This applies both within structured research interventions and in routine care settings, where long-term relationships, flexibility, and personalization play a key role.

Taken together, this dissertation does not identify a single 'best' intervention for promoting cognitive health. Instead, it clarifies which personal and structural elements matter in supporting sustainable lifestyle change and where interventions can be adapted to better

align with the realities of everyday life. These insights point toward the need for support systems, within healthcare, community settings, and digital environments, that move beyond standardized advice and take seriously how people live, what they value, and what they need to be able to act on their intentions over time.

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Intermezzo 3

Taxi bestuurders in Londen

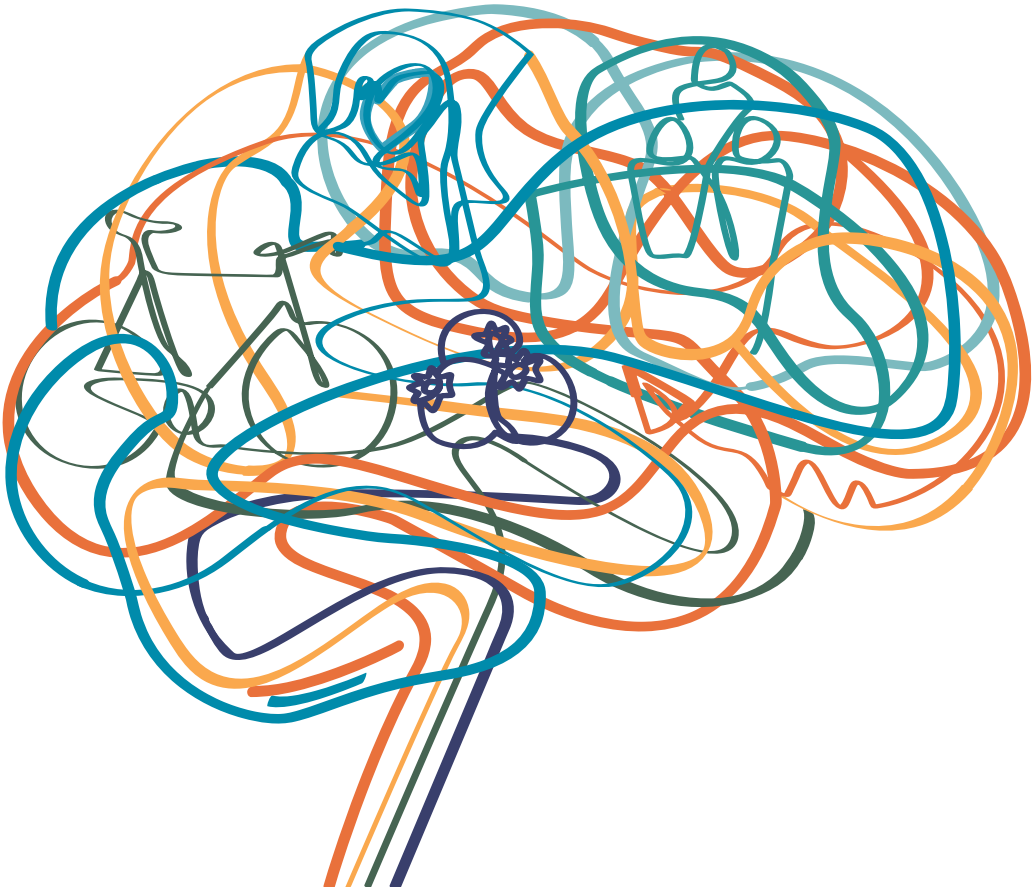
Je zou kunnen denken dat je brein rond je vijfentwintigste wel ‘af’ is: de turbulentie van kindertijd en puberteit ligt achter je, en je identiteit lijkt gevormd. Maar gelukkig; ook daarna blijft het brein zich ontwikkelen, aanpassen en verfijnen, iets wat wetenschappers aanduiden als ‘neuroplasticiteit’. Met andere woorden: wat je doet, ervaart en leert, laat blijvend sporen na in hoe je brein is opgebouwd.

In het hart van Londen bevindt zich een bijzonder cognitief experiment dat zich dagelijks op straat afspeelt. Londense taxichauffeurs, bekend als ‘black cab drivers’, moeten slagen voor een intensief en berucht examen: The Knowledge of London. Dit examen vereist dat kandidaten meer dan 25.000 straten, 20.000 bezienswaardigheden of belangrijke plekken uit hun hoofd leren; van theaters tot hotels en ambassades, sportvelden. Kortom; elke plek waar een klant naar toe zou kunnen willen.

Gemiddeld besteden kandidaten drie tot vier jaar aan studeren, waarbij ze de stad systematisch doorkruisen en routes uit hun hoofd stampen. Het leren van de ‘Knowledge’ is zo zwaar dat ongeveer 66% van de studenten ermee stopt. Wie het volhoudt, wordt een echte ‘Knowledge Boy’ of ‘Knowledge Girl’. Ze rijden op scooters of motorbikes, met een klembord vastgemaakt aan het stuur, vol met kaarten en routes die ze die dag aan het leren zijn.

Deze langdurige en intensieve training vormt niet alleen hun gedrag en professionele competentie, maar laat ook meetbare sporen achter in de structuur van hun brein. Neurowetenschappelijk onderzoek, met name studies uitgevoerd aan University College London, heeft aangetoond dat de hippocampus, het hersengebied dat verantwoordelijk is voor ruimtelijk geheugen en navigatie, significant verschilt bij ervaren taxichauffeurs in vergelijking met controlepersonen. Ze ontdekten dat het achterste deel van de hippocampus van de taxichauffeurs was groter dan bij mensen die geen taxi reden. En hoe langer iemand als chauffeur werkte, hoe groter dat deel werd. Deze uitkomsten zijn een prachtig voorbeeld van neuroplasticiteit: het vermogen van het brein om zich structureel en functioneel aan te passen aan langdurige cognitieve eisen.

De hersenen van taxichauffeurs worden als het ware getraind door de complexiteit van de stedelijke omgeving en de noodzaak om flexibel te navigeren zonder externe hulpmiddelen zoals GPS. In een tijdperk waarin digitale navigatie steeds dominanter wordt, roept dit natuurlijk ook vragen op over de toekomstige ontwikkeling van onze cognitieve vermogens. Wat gebeurt er met het brein wanneer dit soort intensieve vormen van ruimtelijke training verdwijnen en we (ik zeker ook...:) alleen maar vertrouwen op Google Maps?



APPENDICES

English summary

Nederlandse samenvatting

Acknowledgements | Dankwoord

About the author

English summary

This dissertation examines how older adults engage with, experience, and implement lifestyle interventions aimed at maintaining cognitive functioning and reducing dementia risk. It focuses on barriers and facilitators encountered in daily life, as well as on how participation in these interventions develops and is sustained over time. Using the FINGER-NL study as a central case within a structured research setting, it combines insights from controlled lifestyle intervention research with perspectives from routine dietetic practice in everyday care, to better understand how participation in lifestyle interventions is shaped, supported, and maintained over time in everyday contexts.

Lifestyle change is widely promoted as a way to support long-term health, and there is growing recognition that lifestyle behaviors are also relevant for cognitive health. However, although evidence-based lifestyle guidelines are well established and multidomain lifestyle interventions have shown promising effects on cognitive outcomes in controlled research settings, many individuals struggle to translate these recommendations into sustainable habits in daily life, suggesting that sustained behavior change may be influenced by both individual-level factors and the design and context of lifestyle interventions. This challenge is increasingly relevant in the context of population ageing and a rising chronic disease burden. Against this background, this dissertation aims to identify factors that influence engagement with lifestyle interventions, the feasibility of behavior change, and the maintenance of lifestyle changes over time.

This research is organized into two complementary tracks that together cover key phases of the lifestyle change process, ranging from engagement with structured interventions to the implementation and maintenance of lifestyle changes in everyday life.

The first track (Chapters 2–5) focused on older adults' experiences within the FINGER-NL multidomain lifestyle intervention, addressing motivation, engagement, and the feasibility of implementing lifestyle changes in daily life. The second track (Chapters 6–8) shifted the focus to routine care, exploring how lifestyle changes were supported, adapted, and maintained over time from the perspectives of dietitians and their patients.

Chapter 2 explored why older adults chose to participate in the FINGER-NL lifestyle intervention and what they expected would help or hinder their initial engagement. The findings showed that participation was mainly motivated by personal relevance and perceived personal gain, particularly the desire to maintain or improve cognitive health, often shaped by concerns about developing dementia and experiences in participants' social environment. Public interest played a more limited role. Knowledge about dementia risk reduction was generally limited and largely informed by personal experiences. Participants also identified anticipated barriers and support needs, suggesting that motivation alone was insufficient to ensure engagement.

Chapter 3 examined lived experiences one year into the intervention. The findings showed that engagement and adherence varied over time and between participants in both the high-intensity (HI) and low-intensity (LI) groups. Among HI-group participants, motivation was not static: some experienced declining motivation when encountering barriers, while others became more motivated as they noticed positive effects or integrated new habits into daily routines. Diet and physical activity remained the most salient lifestyle domains and were also the areas in which participants reported the most changes. Participants frequently described making selective choices about which intervention components to follow, often supported by lifestyle coaches, and experienced this flexibility as helpful for sustaining engagement. In the LI-group, participants often expressed disappointment about limited guidance, yet some initiated lifestyle changes independently, influenced by study participation and concerns about cognitive decline. Across both groups, participants were generally aware of their group allocation, illustrating the practical challenges of blinding in lifestyle interventions.

Building on these findings, **Chapter 4** examined how engagement and lifestyle change developed over time by identifying distinct participation trajectories using ideal-type analysis of the longitudinal interview data collected at baseline, 12 months, and 24 months. Six trajectories were identified across the high-intensity (HI) and low-intensity (LI) groups. These trajectories illustrated different patterns of change, ranging from early enthusiasm followed by decline, to gradual adoption and consistent adherence in the HI-group, to self-directed change and passive participation in the LI-group. Across both groups, some participants were characterized by trajectories interrupted by major life events. Rather than representing fixed categories or stable groups, the trajectories were used as an analytical tool to illustrate the dynamic and fluctuating nature of engagement over time. Participants differed not only in which lifestyle behaviors they changed, but also in how they responded to the support provided. In the HI-group, structured guidance and regular contact helped sustain motivation across domains, while in the LI-group, information alone was often insufficient to prompt or maintain change. Across both groups, major life events frequently disrupted engagement, regardless of initial motivation. These findings showed that sustained lifestyle change followed multiple trajectories and required support that could adapt to changing circumstances over time.

Chapter 5 built directly on insights emerging from Chapters 2–4, showing that participants' decision to take part in the FINGER-NL trial was mainly driven by concerns about cognitive decline and dementia rather than by general health goals. These insights raised the question of how such dementia-related beliefs and motivations related to the presence of modifiable, lifestyle-related dementia risk factors at baseline. Chapter 5 therefore focused on motivation and beliefs regarding dementia risk reduction, assessed with the Motivation to Change Lifestyle and Health Behaviors for Dementia Risk Reduction (MCLHB-DRR), a questionnaire that captured how people thought and felt about dementia risk, including perceived risk, concerns, and motivation to address lifestyle-related risk factors. Only a

limited number of psychological factors were associated with specific lifestyle-related dementia risk domains, and these associations differed across domains. Motivation- and belief-related subscales showed weak and inconsistent associations with dementia risk profiles. Overall, the presence of dementia-related lifestyle risk factors appeared to be more related to sociodemographic characteristics than to individual motivation and beliefs. These findings aligned with the qualitative results from Chapters 2–4, which showed that such risk factors were closely linked to everyday routines, habits, and social circumstances.

Track 2 began in **Chapter 6** by examining general lifestyle interventions for obesity to draw methodological insights relevant to understanding complex behavior change. By doing so, we aimed to draw on existing knowledge in this field to better understand how different intervention components interacted in more general lifestyle change contexts. Chapter 6 addressed the question of which components were truly relevant, or even indispensable, when designing a lifestyle intervention. Using Qualitative Comparative Analysis, this chapter showed that successful population-level weight loss emerged from specific combinations of intervention components rather than from any single element. The co-occurrence of dietary change, physical activity, and behavioral change strategies was most consistently associated with success, whereas none of these components alone was sufficient or necessary. These findings highlighted the multifaceted and context-dependent nature of lifestyle interventions and showed that effectiveness was shaped by how components worked together rather than by isolated elements such as intervention duration or group setting. As such, this chapter illustrated the methodological value of configurational approaches for studying complex lifestyle interventions, rather than providing direct evidence for cognitive-health intervention design and was therefore guiding for the analysis in Track 1.

In **Chapters 7 and 8**, we continued Track 2 by focusing on dietetic treatment of adults with obesity in primary health care. Chapter 7 examined which components dietitians considered key to successful treatment, shifting attention from intervention design to everyday clinical practice. Based on interviews and focus group discussions with Dutch dietitians, the findings showed that building a trusted relationship and connecting treatment to individual patient needs were seen as central to success. Several interrelated components related to relationship-building, behavior change support, and tailored advice were identified. The findings highlighted the importance of the dietitian's counselling role, particularly in addressing motivation, self-efficacy, health literacy, and experienced barriers, and showed how patient characteristics influenced the choice and use of treatment strategies.

Chapter 8 shifted the focus from the dietitians to the lived experiences of patients with obesity receiving dietetic treatment in primary health care. Patients perceived personalized treatment as the foundation of successful care, with feeling heard, understood, and supported described as central to their engagement. A strong patient–dietitian

relationship, shaped by the dietitian's attitude, professionalism, and way of working, was described as crucial for building trust and motivation. Patients emphasized the importance of a holistic approach that extended beyond dietary advice alone, including attention to psychological factors, life context, and long-term behavior change. Clear, practical, and tailored advice was also seen as essential for translating recommendations into daily life. Taken together, Chapters 7 and 8 showed substantial overlap between dietitians' and patients' perspectives, suggesting that effective dietetic treatment for obesity depended on approaches that were responsive to individual needs and circumstances rather than standardized protocols alone.

In **Chapter 9**, the findings of this dissertation were brought together in a general discussion reflecting on what lifestyle interventions aimed at supporting cognitive health could, and could not, achieve by integrating insights from both research and routine care. The discussion integrated insights from studies conducted in controlled research settings with findings from Track 2, which examined lifestyle change beyond the research context from the perspectives of dietitians and patients in routine care. Across the dissertation, a consistent picture emerged: while lifestyle change in support of cognitive health was possible, it was also complex and demanding. Participants were often strongly motivated by concerns about cognitive decline, but acting on this motivation depended on practical, emotional, social, and contextual factors.

Across chapters, motivation alone appeared insufficient to sustain behavior change, and no single intervention component proved decisive. Instead, behavior change emerged from the interaction of daily routines, available resources, personal circumstances, and the organization of support. A clear contrast emerged between research-based lifestyle interventions, which emphasized structure and standardization, and routine care, which relied more on flexibility, personalization, and long-term relationships. Across both contexts, relational aspects, such as feeling heard and receiving advice that fit one's own life, played a key role in sustained engagement.

Chapter 9 concluded by considering the practical implications of these findings. While an intensive research-driven intervention such as FINGER-NL was not easily transferable to routine practice in its current form, the lifestyle behaviors it targeted were relevant beyond dementia prevention alone. In the general discussion, these findings were briefly placed in a broader context, with some reflection on how attention to cognitive health might be embedded within existing care structures, for example through digital support and interprofessional collaboration, and how this could relate to everyday life.

Nederlandse samenvatting

Veel oudere volwassenen zijn gemotiveerd om hun gezondheid te verbeteren, zeker als het gaat om het behoud van hun geheugen en denkvermogen. Toch blijkt het in de praktijk niet eenvoudig om leefstijlveranderingen vol te houden. Dit proefschrift onderzoekt hoe oudere volwassenen omgaan met leefstijlinterventies gericht op het verminderen van het risico op dementie, hoe zij deze interventies ervaren en in hoeverre zij leefstijlveranderingen daadwerkelijk in hun dagelijks leven weten te integreren. De FINGER-NL leefstijlinterventie, waarin wordt onderzocht wat het effect is van leefstijlverandering op cognitieve gezondheid, vormt hierbij de centrale casus binnen een gecontroleerde onderzoekssetting. De bevindingen uit deze studie worden verbonden met inzichten uit de reguliere diëtistische praktijk in de eerstelijnszorg.

Leefstijlverandering wordt breed gezien als een belangrijke pijler voor gezondheid op lange termijn en speelt ook een rol in cognitieve gezondheid. Hoewel wetenschappelijk onderbouwde leefstijlaanbevelingen beschikbaar zijn en multidomeininterventies in gecontroleerde settings veelbelovende effecten laten zien, blijkt het voor veel mensen lastig om deze aanbevelingen om te zetten in blijvende gewoonten in het dagelijks leven. Deze spanning wordt relevanter in het licht van vergrijzing en een toenemende ziektelast. Dit proefschrift laat zien dat motivatie hierbij een belangrijke rol speelt, maar op zichzelf onvoldoende is voor duurzame gedragsverandering. Daarom wordt onderzocht welke factoren betrokkenheid beïnvloeden, hoe gedragsverandering zich ontwikkelt in de tijd en onder welke voorwaarden veranderingen behouden blijven.

Het onderzoek bestaat uit twee samenhangende lijnen (‘Tracks’). De eerste lijn (Hoofdstuk 2–5) richt zich op de ervaringen van deelnemers binnen de multidomeininterventie van FINGER-NL. De tweede lijn (Hoofdstuk 6–8) plaatst deze inzichten in de context van de dagelijkse zorgpraktijk en bestudeert leefstijlverandering vanuit het perspectief van diëtisten en hun patiënten.

Hoofdstuk 2 laat zien waarom oudere volwassenen deelnemen aan de FINGER-NL-interventie en welke factoren zij verwachten dat hun betrokkenheid beïnvloeden. Deelname wordt vooral gedreven door persoonlijke relevantie, met name de wens om cognitieve gezondheid te behouden of te verbeteren. Zorgen over dementie en ervaringen in de directe omgeving spelen hierbij een belangrijke rol. Algemene interesse in gezondheid blijkt minder bepalend. De kennis over risicoreductie van dementie is doorgaans beperkt en gebaseerd op persoonlijke ervaringen. Deelnemers benoemen daarnaast verwachte barrières en ondersteuningsbehoeften.

Hoofdstuk 3 laat zien hoe deelnemers één jaar na de start van de interventie hun betrokkenheid en naleving van de richtlijnlijnen ervaren. In plaats van een stabiel patroon blijkt betrokkenheid een dynamisch proces, dat zich in de tijd ontwikkelt en sterk verschilt

tussen personen. In de hoog-intensieve (HI) groep verandert motivatie gaandeweg, onder invloed van ervaren barrières en, soms, de positieve effecten van nieuw aangeleerde gewoonten. Met name in de domeinen voeding en lichamelijke activiteit worden de meeste veranderingen gerapporteerd. Dit zou samen kunnen hangen met het feit dat deze gebieden voor deelnemers herkenbaar zijn en aansluiten bij bestaande ideeën over wat 'gezond leven' inhoudt. Deelnemers maken daarbij bewuste keuzes in welke onderdelen van de interventie zij actief volgen. Juist deze mogelijkheid tot selectieve deelname, ondersteund door begeleiding, lijkt hen te helpen om veranderingen in te passen in hun dagelijks leven. In de laag-intensieve (LI) groep wordt het gebrek aan begeleiding vaker als een gemis ervaren, hoewel sommige deelnemers op eigen initiatief veranderingen in gang zetten. De meeste deelnemers waren zich bewust van hun groepsindeling, en wie in de LI-groep zat, rapporteerde soms enige teleurstelling over de beperkte ondersteuning. Wat beide groepen gemeen hebben, is dat deelnemers voortdurend afwegingen maken tussen wat wenselijk is en wat in hun persoonlijke situatie haalbaar blijkt.

Hoofdstuk 4 verdiept dit beeld door de ontwikkeling van betrokkenheid over twee jaar te analyseren. De analyse onderscheidt zes verschillende participatietrajecten, die uiteenlopen van aanvankelijk enthousiasme met later afnemende betrokkenheid tot geleidelijke, stabiele integratie van leefstijlveranderingen in het dagelijks leven. Deze trajecten laten zien dat gedragsverandering geen lineair proces is, maar wordt beïnvloed door wat mensen in hun leven meemaken. In beide groepen worden trajecten onderbroken door ingrijpende levensgebeurtenissen. Gestructureerde begeleiding en regelmatig contact ondersteunen het behoud van betrokkenheid in de HI-groep, terwijl informatie alleen in de LI-groep vaak onvoldoende blijkt. Duurzame verandering vraagt daarmee om ondersteuning die kan meebewegen met veranderende omstandigheden.

Hoofdstuk 5 bouwt voort op de inzichten uit hoofdstukken 2-4 en onderzoekt hoe motivatie en overtuigingen rond dementierisico samenhangen met leefstijlgerelateerde risicofactoren bij aanvang van de studie. De resultaten laten zien dat slechts een beperkt aantal psychologische factoren verband houdt met specifieke leefstijldomeinen, en dat deze verbanden bovendien wisselend zijn. Over het algemeen blijken motivatie en overtuigingen in dit geval slechts een zwakke voorspeller van daadwerkelijk gedrag te zijn. Interessant is dat de aanwezigheid van leefstijlgerelateerde risicofactoren sterker samenhangt met sociodemografische kenmerken dan met individuele motivatie of overtuigingen. Dit bevestigt dat leefstijlgedrag niet alleen een kwestie is van willen, maar sterk verweven is met gewoonten en sociale context.

Om deze bevindingen te begrijpen in de context van de dagelijkse zorg, verschuift de tweede onderzoekslijn naar de eerstelijnspraktijk. Het startpunt in **Hoofdstuk 6** is een methodologische analyse van leefstijlinterventies gericht op obesitas, met de vraag welke factoren daadwerkelijk bijdragen aan succesvol gewichtsverlies. Met behulp van Qualitative Comparative Analysis (QCA) wordt zichtbaar dat succesvol gewichtsverlies voortkomt uit specifieke combinaties van interventiecomponenten. De analyse laat zien

dat positieve uitkomsten vooral optreden wanneer voedingsverandering, lichamelijke activiteit en gedragsveranderingsstrategieën samen worden ingezet. Geen van de onderzochte interventie-elementen blijkt op zichzelf voldoende of noodzakelijk; het is juist de manier waarop ze samen worden toegepast die effectiviteit mogelijk maakt.

Hoofdstuk 7 zoomt in op de behandeling van volwassenen met obesitas door diëtisten in de eerstelijnszorg. Diëtisten benadrukken dat het opbouwen van een vertrouwensrelatie en het afstemmen van begeleiding op de individuele behoeften van de patiënt cruciaal zijn voor succes. Effectieve behandeling beperkt zich niet tot het geven van voedingsadvies; het gaat om een samenhangende combinatie van relatieopbouw, ondersteuning bij gedragsverandering en persoonlijke afstemming. De rol van de diëtist blijkt daarbij essentieel: door motiverend te begeleiden, het zelfvertrouwen en de zelfeffectiviteit van patiënten te versterken, en hen te helpen omgaan met barrières, kan duurzame verandering worden ondersteund.

Hoofdstuk 8 beschrijft hoe patiënten deze behandeling ervaren. Voor hen vormt gepersonaliseerde zorg de basis voor betrokkenheid en motivatie. Zich gehoord en begrepen voelen blijkt een voorwaarde om adviezen daadwerkelijk toe te passen in het dagelijks leven. De relatie met de diëtist speelt hierin een centrale rol. Patiënten benadrukken het belang van een benadering die verder gaat dan voedingsadvies alleen en ook aandacht heeft voor psychologische factoren en levenscontext. Praktisch, haalbaar en op maat gemaakt advies helpt om verandering vol te houden.

Hoofdstuk 9 brengt de bevindingen samen en geeft een helder beeld van wat nodig is voor effectieve leefstijlinterventies gericht op cognitieve gezondheid. Verandering van leefstijl is mogelijk, maar alleen wanneer interventies aansluiten bij het dagelijks leven van mensen en ruimte bieden voor flexibiliteit over de tijd. Zorgen over cognitieve achteruitgang en het risico op dementie blijken vaak een sterke motivatiebron, maar motivatie alleen is onvoldoende; duurzame gedragsverandering vereist passende ondersteuning, context en integratie in iemands dagelijks leven. Dagelijkse routines, beschikbare hulpbronnen en ingrijpende levensgebeurtenissen beïnvloeden sterk in hoeverre veranderingen kunnen worden volgehouden.

Er tekent zich een duidelijk verschil af tussen onderzoeksinterventies zoals FINGER-NL en de dagelijkse praktijk van diëtetische zorg. In gecontroleerde studies ligt de nadruk op structuur en standaardisatie, terwijl in de diëtistische behandeling juist flexibiliteit, maatwerk en langdurige professionele relaties cruciaal zijn om leefstijlverandering effectief te ondersteunen en zo cognitieve gezondheid te bevorderen.

Een intensieve interventie zoals FINGER-NL kan niet één-op-één worden overgenomen in de dagelijkse praktijk. Implementatie vraagt daarom om aanpassing: om kosten te beheersen en tegelijk effectief en relevant te blijven voor deelnemers. Tegelijkertijd zijn de onderliggende leefstijldomeinen (voeding, fysieke activiteit, cognitieve uitdaging en

gedragsstrategieën) breder relevant dan enkel dementiepreventie. Voor toekomstbestendige interventies gericht op het behoud van cognitieve gezondheid betekent dit concreet: interventies ontwerpen die passen bij het dagelijks leven van deelnemers, gebruik van blended of digitale ondersteuning, en nauwe samenwerking tussen zorgprofessionals.

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And **Natasha,** from being one of 'my' MSc students, you have grown into a valued colleague. I wish you all the best for the future!

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Esther, wat een geluk als een vriendin collega wordt. Onze geschiedenis begon al in de collegezalen back in 2013, aan de Acacialaan en met de stdnt-zkt-food app. Ik waardeer je om wie je bent; betrokken, eerlijk, vrolijk en down-to-earth. Dank dat je als paranimf naast mij wilt staan, en dat ik dat bij jou mocht doen; een betere afsluiting van onze periode als collega's is er niet. Op naar nog veel mooie jaren vriendschap! **Annemieke**, het voelde echt als een verrijking om met jou op te trekken binnen onze PhD's. We hebben uren samengewerkt binnen Dietetics, building the future. Ik heb van jouw manier van werken geleerd; je bent secuur, hebt oog voor detail, én oog voor de mens. Maar daarnaast ben je een goede vriendin geworden en dat maakte kantoordagen leuk en onze reis naar Malaga ronduit geweldig. En **Auke,** ook jij bent naast collega een goede vriendin geworden. Bedankt voor je praktische tips; je adviezen bij mijn R scripts, het meedenken over concrete oplossingen als ik even vastliep, maar ook voor de goede gesprekken over niet-werk gerelateerde onderwerpen. Sorry, not sorry voor je Vinted-affiniteit. En wat ben ik blij dat jullie in Ede komen wonen, perfect voor borrelavondjes!

Mijn (oud-)kantoorgenoten; **Birgit, Ina, Merel, Luc, Lotte, Isa, Lieke** maar ook andere (oud-)collega's binnen HNH; **Sonja, Iris, Marjolein**; dank voor elke keer dat de koffiemomentjes, lunchen en wandelingen (met Iris zelfs in Nijmegen) de dagen leuker maakten. Specifiek mijn kantoorgenoten heb ik goed leren kennen; de perfect getimede wijze opmerkingen van **Merel,** het gevoel van humor van **Birgit** en de betrokkenheid van **Lotte** maakte ons kantoor toch echt de leukste. En alle andere collega's die ik niet met naam noem; dank voor de gesprekjes op de gang, de lunchwandelingen en alle andere momenten die het PhD-leven maakten.

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Zoveel studenten hebben, ieder op hun eigen manier, bijgedragen aan dit onderzoek en mijn werkplezier. Allereerst **Eline en Marjolein**, die hielpen bij de eerste MOCIA-interviews, en daarna de masterstudenten van de WUR: **Maaike, Karlijn, Natasha, Simone en Lilianne**, bedankt voor jullie hulp en de fijne samenwerking. **Lilianne**, ik bewonder hoe je je MSc combineert met werk en gezin; het ga je goed!

En nu ik mijn periode op de HAN en WUR achter mij heb gelaten voor mijn nieuwe functie bij het RIVM wil ik ook mijn nieuwe collega's noemen voor het warme welkom, de interesse en de (nu al) fijne samenwerking. Met name **Anne**; een betere inwerkbuddy had ik niet kunnen wensen, dankjewel. En alle anderen; door jullie heb ik zin in mijn werk.

Voor alle dingen naast mijn werk kan ik altijd rekenen op een groep mensen om mij heen: mensen van vroeger en nu, waarbij ik vooral niet over mijn werk hoef te praten, maar die dagelijks een significante bijdrage leveren aan mijn kwaliteit van leven.

Alle individuele leden van mijn (vrienden)kring en hun counterparts: **Anne-Dieke & Kees (en Vieve), Anne (& Matthias), Johanneke (& Jasper met Lieuwe en Victor)**, **Thom (& Rineke) en Janno (& Esther)**. Mijn dank aan jullie gaat verder dan mijn promotietraject, hoewel jullie met interesse luisterden naar verhalen over onderzoek en congressen en zelfs linkjes met relevante info doorstuurden. Ik ben enorm dankbaar voor jullie in mijn leven. Nu zelfs allemaal (zelfs Thom!) op een acceptabele fietsafstand, wat een geluk. Dank voor de goede gesprekken, de fijne avonden Bijbelkring, de weekenden weg, de borrel- en spelletjesavonden en alle momenten daaromheen.

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Debora, van brugklasser tot burger; de inhoud van onze gesprekken mag dan veranderd zijn, de frequentie door de jaren heen af en toe ook, maar mijn waardering hiervoor in ieder

geval niet. Van vakanties tot weekenden weg, spraakberichten en telefoongesprekken: jouw veelheid aan random kennis, van cultuur tot linguistics, maakt je tot een van mijn meest geliefde gesprekspartners. En nu; jij dokter, ik doctor, but one of these 'actually means something here, Ross!'. **Wendel**, we delen hetzelfde gevoel voor humor en kunnen dat in gesprekken goed combineren met inhoud en het bespreken van levensuitdagingen. En dat allemaal onder het genot van goed eten; de beste combi. Al met al een mooi resultaat van iets dat begon met de combinatie van een scalpelsetje regelen tijdens onze studententijd, een opeenvolgende achternaamletter en Arabinose-muffins.

En een groep vriendinnen die allemaal op hun eigen manier vormgeven aan onze vriendschap; **Pauline, Jantine, Mirjam, Hilde en Gerjanne**. Ik waardeer het enorm dat jullie er elke keer weer zijn om samen bij te praten, samen te werken, te borrelen en leuke dingen te doen.

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Lieve **Jesse**. Klein blij ei. Voor jou bestaat werk (nog) niet. Jouw komst heeft het leven anders gemaakt, gerelativeerd en een hoop extra blijheid gegeven. Jouw verhalen, grapjes en knuffels zijn mij meer waard dan een afgerond promotietraject. Dankjewel dat je vooral niets hebt bijgedragen aan dit proefschrift; precies zoals het hoort. Dankjewel voor alle dagen waarop we samen uren boekjes lazen, speelden en tijd voorbijvloog; het zijn mijn favoriete dagen.

Lieve **Ties**. Ik zal mij hier in moeten houden om mijn word-count niet te overschrijden ^^. Ik wil je graag bedanken, alleen al omdat je ondertussen al 11 jaar naast me staat en het leven samen met jou zo enorm veel leuker is. Ons gedeelde gevoel voor humor zou ik niet willen missen en werkt relativerend, net als onze gezamenlijke liefde voor klussen en wielrennen (tegenwoordig met Jesse in de fietskar achter jou). Je bent er als ik hulp nodig heb, soms in oplossingen, soms door alleen instemmend te knikken als ik je daar specifiek om vraag. Voor dit proefschrift waardeer ik vooral je kritische blik en onze inhoudelijke discussies, die het geheel echt naar een hoger niveau hebben getild. Je weet me uit te dagen, af te remmen en te motiveren en dat allemaal meestal op het goede moment. Je bracht me zelfs op het idee voor de propositie over de bergen; exemplarisch voor je briljante ingevingen. Op naar nog heel veel (berg)toppen samen; ik zie uit naar de toekomst samen met jou en Jesse!

Tot slot. Alle dank aan God. Aan Hem, die is, die was en die komen zal.

About the author



Curriculum vitae

Rebecca Otte (1995) was born in Emmeloord (in Flevoland for anyone from the middle of the Netherlands and below). She grew up there with her older sister, Anne-Matthea.

After completing her secondary school diploma, she started the Bachelor's programme in Nutrition and Health at Wageningen University & Research (WUR) in 2013. In 2015, she made a brief detour to Rotterdam, where she completed a minor in Gastrointestinal Diseases. Back in Wageningen, she not only continued her studies but also became actively involved in student life, taking on a board year as an abactis (secretary) at Dei Gratia, C.S.F.R. Wageningen. In 2017, Rebecca continued with the Master's programme in Nutrition and Health, specialising in Food Digestion and Health. During her Master's, she conducted her thesis research as part of the Biolyse study, investigating the optimal endpoint of haemodialysis in patients with chronic kidney failure. She then completed an internship at Nivel (Nederlands Instituut voor Onderzoek van de Gezondheidszorg), where she carried out a study on affective (emotional) communication between healthcare professionals and patients with limited health literacy in the palliative phase. This work later formed the basis of her first scientific publication.

After completing her studies, Rebecca remained affiliated with WUR, where she began working as a lecturer within the chair group Strategic Communication. Shortly after her appointment, the COVID-19 pandemic led to a national lockdown, and she was closely involved in the rapid transition to online and digital education. During this time, she began working towards her University Teaching Qualification (UTQ), which she completed later during her PhD.

In 2021, she started as a PhD candidate at HAN University of Applied Sciences and WUR. She joined the research group (lectoraat) Nutrition, Dietetics and Lifestyle, and worked under the supervision of her promotor Marian de van der Schueren and co-promotors Elke Naumann and Anja de Kruif, in collaboration with the chair group Global Nutrition at WUR. The majority of her work was conducted within the MOCIA project (Maintaining Cognitive Function in Ageing), and partly within the project Dietetics, Building the Future.

Within her PhD project, Rebecca conducted several studies, which are described in this dissertation. She presented her findings at various conferences, including the European Congress on Obesity in Málaga and the Annual Conference of the European Health Psychology Society in Groningen. During her PhD trajectory, she enjoyed supervising MSc students during their thesis and internship projects and assisted in various educational activities at both HAN and WUR.

After finishing her PhD thesis, Rebecca started working as a scientific researcher with expertise in qualitative research within the Department of Behaviour and Health at the National Institute for Public Health and the Environment (RIVM), a position she really enjoys.

Author contributions

Chapter 1 | *General introduction*. I defined the research objectives of this thesis. I explained how these objectives follow from the existing literature by identifying the research gap, defining the focus of the thesis, and outlining the structure of the thesis. The text was revised based on feedback from my prom
otor and co-promotors.

Chapter 2 | The concept of conducting a qualitative study parallel with the quantitative FINGER-NL trial was proposed by M. de van der Schueren and A. de Kruif as part of the MOCIA grant application. I planned and executed the data collection and analysis for this chapter. I maintained contact with the FINGER-NL team to recruit participants, conducted all interviews, and wrote the first draft of the manuscript. I received feedback from my co-authors twice on different parts of the manuscript and submitted the manuscript to the journal. I also wrote the rebuttal myself, on which I again received feedback before resubmitting the manuscript.

Chapter 3 | For this chapter, I again performed the interviews and coordinated and supervised several MSc students conducting the remaining interviews in collaboration with A. de Kruif. I was primarily responsible for the data analysis, in which K. van der Staaij assisted. I wrote the initial manuscript, received and incorporated feedback, first from my promotor and co-promotor, and in the final round from all the authors involved. I submitted the manuscript and wrote the rebuttal.

Chapter 4 | I proposed the specific type of data analysis used in this chapter, making use of a relatively uncommon method in this field: ideal case analysis. I conducted the data analysis, and S. van Houdt, as second author, collaborated with me during the reflexivity and finalization phase of the research. I wrote the manuscript, including the results and the presentation of the cases. On this, I received feedback from S. van Houdt and from my promotor and co-promotor A. de Kruif. In the final round, all other co-authors provided feedback, after which I finalized the paper.

Chapter 5 | For this chapter, I proposed the research question based on our earlier findings. I set up a collaboration with N. Smidt from the University Medical Center Groningen and submitted a data request. I performed all data analyses, assisted by feedback from N. Smidt. I interpreted the data and wrote the manuscript, including the final discussion. My promotor and N. Smidt were closely involved in providing feedback, and all other authors gave feedback or consent to include this manuscript in my dissertation.

Chapter 6 | The study design for chapters 6-8 was predefined in the ZonMw-funded research protocol. For this chapter, I worked closely with A. van de Riet, sharing first authorship on this chapter. For the analysis I completed a training in Qualitative Comparative Analysis and received a certificate. Together with A. van de Riet and N. Mwala, I formed the core group for the main analysis. F. Hirzalla assisted with the data analysis. Sharing responsibility, A. van de Riet and I jointly wrote the main manuscript, presented and interpreted the results, and wrote the discussion. The other co-authors were involved in different rounds of feedback.

Chapter 7 | I designed the study together with A. van de Riet and selected the methods. We developed study materials (topic guides, flyers), obtained permission from the Research Ethical Committee (REC), and recruited participants. I also conducted interviews and supervised students involved in this research. Together, we performed the data analysis and wrote the manuscript. H. Jager-Witteman and E. Naumann were the main people for feedback and discussion, while all authors contributed to the remaining rounds of feedback. We submitted the manuscript, wrote the rebuttal, and revised the manuscript prior to publication.

Chapter 8 | Together with the first author of this chapter (A. van de Riet), I developed the chapter outline and research question, obtained REC approval, and conducted a minority of the interviews. I contributed to the data analysis and provided multiple rounds of feedback on the results, their interpretation, and the discussion. I also provided feedback on the rebuttal prior to acceptance.

Chapter 9 | *General discussion*. I developed an outline for the general discussion based on the key topics and arguments. I discussed this outline with my promotor and co-promotors and incorporated their feedback when drafting the General Discussion. Following further feedback and discussions, I revised the text twice.

During the preparation of this work, I used generative AI (ChatGPT) in some chapters in order to improve readability of the text. After using this, I have reviewed and edited the content as needed and take full responsibility for the content of the publication.

Overview of completed training activities

Discipline specific activity	Organizing institute and location	Year
Annual MOCIA symposium and poster presentation	MOCIA	2021-2025
Cursus kwalitatief onderzoek: verdieping	EpidM, afdeling Epidemiologie & Data Science Amsterdam UMC	2022
32nd European Congress on Obesity	European Association for the Study of Obesity, Malaga	2025
Annual Conference of the European Health Psychology Society	European Health Psychology Society, Groningen	2025

General courses	Organizing institute and location	Year
VLAG PhD week	VLAG, Baarlo	2021
Project and Time Management	Wageningen Graduate Schools	2021
Philosophy and ethics of Food Science and Technology	Wageningen Graduate Schools	2022
Brain based teaching	Education Support Centre	2022
University Teaching: Putting theory into Practice	Education Support Centre	2022
VLAG PhD on track	VLAG, Wageningen	
WGS PhD workshop Carousel	Wageningen Graduate Schools	2024
Career Perspectives	Wageningen Graduate Schools	2025

Teaching and supervision activities	Organizing institute and location	Year
Minor ‘Behave yourself!’	HAN University of Applied Sciences, Nijmegen	2022
Research Methods in Dietetic Practice (guest lectures)	WUR, Wageningen	2024 2025
Supervising MSc students	WUR, Wageningen	2021-2025
Supervising BSc students	HAN University of Applied Sciences, Nijmegen	2022-2024

Other activities	Organizing institute and location	Year

Research proposal and rebuttal VLAG	VLAG & WUR, Wageningen	2021
Publication in Medisfeer	Medi-Sphére – Medi-Sfeer, België	2025
Peer reviewing scientific manuscript	Plos-One	2025
Member of Newtrition; newsletter of HNH PhD's, RA's and Postdocs	WUR, Wageningen	2021-2022
Internal scientific meetings	WUR (chairgroep Global Nutrition)	2021-2025
Masterclass Monday HAN	HAN University of Applied Sciences, Nijmegen	2023-2025

List of publications

Peer-reviewed publications in this thesis

Otte, R., De Kruif, A., Naumann, E., & De van der Schueren, M. (2025). *Exploring older adults' pre-intervention motivations, attitudes, expectations, and barriers to participation in the FINGER-NL lifestyle intervention to maintain optimal cognitive functioning: A qualitative interview study*. *Ageing International*. https://doi.org/10.1007/s12126-025-09597-w

Van de Riet, A., Otte, R. S., Maree-Hulsbergen, L., Naumann, E., De van der Schueren, M. A. E., & Jager-Wittenaar, H. (2025). *Perspectives and experiences of adult patients with obesity in dietetic primary health care: A qualitative study in the Netherlands*. *Journal of Human Nutrition and Dietetics*. https://doi.org/10.1111/jhn.70179

Van de Riet, A., Otte, R. S., Jager-Wittenaar, H., De van der Schueren, M. A. E., & Naumann, E. (2025). *Dietitians' perspectives on key components relevant for successful dietetic treatment of adults with obesity in primary health care: A qualitative study in the Netherlands*. *Journal of Human Nutrition and Dietetics*. https://doi.org/10.1111/jhn.13387

Peer-reviewed publications not included in this thesis

Otte, R. S., Thissen, V. T. M., & Mulder, B. C. (2023). *(Dis)continuation of the oral contraceptive pill: A focus group approach in the Netherlands*. *Heliyon*. https://doi.org/10.1016/j.heliyon.2023.e19405

Otte, R., Schouten, B., Roodbeen, R., Boland, G., Noordman, J., & Van Dulmen, S. (2022). *Affective communication with patients with limited health literacy in the palliative phase of COPD or lung cancer: Analysis of video-recorded consultations in outpatient care*. *PLOS ONE*. https://doi.org/10.1371/journal.pone.0263433

Submitted manuscripts

Otte, R. S., De van der Schueren, M. A. E., Van der Staaij, K., Beers, S., Broersen, L. M., Deckers, K., De Heus, R. A. A., Köhler, S., Smidt, N., Soons, L., on behalf of MOCIA consortium, FINGER-NL consortium, & A. J. Th. C. M. de Kruif (submitted). *Engagement and adherence in the FINGER-NL lifestyle trial: A qualitative study*. *(Manuscript submitted for publication)*.

Otte, R. S., Van Houdt, S., De van der Schueren, M. A. E., Deckers, K., Heutz, R., Smidt, N., on behalf of MOCIA consortium, FINGER-NL consortium, & A. J. Th. C. M. de Kruif (submitted). *Participant typologies in a multidomain dementia prevention trial: An ideal-*

type analysis (ITA) of longitudinal interviews from FINGER-NL. (Manuscript submitted for publication).

Van de Riet, A., & Otte, R. S., Mwala, N. N., Hirzalla, F., Van der Meij, B. S., De van der Schueren, M. A. E., & the Dietetics Building the Future consortium. *Using Qualitative Comparative Analysis to identify components for successful weight loss interventions. (Manuscript submitted for publication).*

Publications in preparation

Otte, R. S., Smidt, N., Deckers, K., Oosterman, J., on behalf of MOCIA consortium, FINGER-NL consortium, & De van der Schueren, M. A. E. (in preparation). *Associations between the Motivation to Change Lifestyle and Health Behaviors for Dementia Risk Reduction (MCLHB-DRR) and dementia risk factors in older adults. (Manuscript in preparation).*

Soons, L. M., Deckers, K., Sikkes, S., Smidt, N., De Heus, R. A. A., Otte, R. S., De van der Schueren, M. A. E., et al. *Social support, loneliness and their associations with cognitive performance in older adults at risk of cognitive decline: Baseline. (Manuscript in preparation).*

Other Publications

Otte, R. S., & Van de Riet, A. (2025, 22 juli). *Factoren voor succesvolle dieetbehandeling van obesitas* [Artikel gebaseerd op eigen publicatie]. *Voeding & Visie*. https://voedingvisie.nl/factoren-voor-succesvolle-dieetbehandeling-van-obesitas/

Otte, R. S. & Van de Riet, A. (2025, 23 april). *Hoe een dieetbehandeling laten slagen? Medisfeer*. https://flipflashpages.uniflip.com/3/61981/1136083/pub/html5.html#page/39

Colophon

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