Time to tip the scales

Tackling overweight and obesity in primary care

Willemijn J. van den Hout

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The work in this thesis was conducted at the department of Public Health and Primary Care of the Leiden University Medical Center.

ISBN: 978-94-6522-725-2

Cover design: Noortje van den Hout
Lay-out and printing: Ridderprint | www.ridderprint.nl

Financial support for printing this thesis was kindly provided by the SBOH (employer GP trainees in the Netherlands).

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Proefschrift

ter verkrijging van
de graad van doctor aan de Universiteit Leiden,
op gezag van rector magnificus prof. dr. S. de Rijcke,
volgens besluit van het college voor promoties
te verdedigen op vrijdag 16 januari 2026
klokke 11.30 uur

door

Willemijn Julia van den Hout
geboren te Utrecht
in 1992

Promotor:	Prof. dr. M.E. Numans
Co-promotores:	Dr. P.G. van Peet Dr. D.O. Mook-Kanamori
Leden promotiecommissie:	Prof. dr. M.A. Adriaanse Prof. dr. S.C. Cannegieter Prof. dr. G.J. Geersing, Universiteit van Utrecht Prof. dr. ir. J.C. Seidell, Vrije Universiteit van Amsterdam

Contents

Chapter 1

General introduction

General introduction

Obesity is a growing global health problem affecting many countries, and it is recognised as a chronic disease (1). In the Netherlands, almost half of the adults are classified as overweight, with around fifteen percent considered obese (2). According to the World Health Organization, a body mass index of ≥25 kg/m^2 is classified as overweight and a body mass index ≥30 kg/m^2 is classified as obesity (1). Body mass index is defined as a person's weight in kilograms divided by the square of their height in metres (kg/m^2) (3).

Obesity is associated with various health problems, including type II diabetes, cardiovascular disease, mental health problems, joint complaints, and certain cancers (4-6). The rise in obesity-related diseases is placing an increasing burden on the healthcare system and has broader societal consequences. Healthcare costs are rising due to the need for ongoing treatment, medication, and medical appointments (7-9). Furthermore, individuals with obesity contribute less to society due to lower labour force participation, more unhealthy years of life, and an increased risk of premature mortality (10-12). These burdens on the healthcare system and society underscore the need to adapt to the growing prevalence of obesity, with the ultimate goal of preventing it: *Time to tip the scales on obesity and find balance.* To help to address these issues, this thesis aims to provide a contribution to the improvement of obesity management in primary care. In this introduction, we first describe key professionals and organisations involved in addressing obesity alongside an overview of how primary care is organised in the Netherlands. Furthermore, we describe the complexity of obesity, and the challenges involved in identifying high-risk patients with obesity. Finally, we present the aims and outline of the thesis, along with an overview of the studies included.

Professionals and organisations involved in addressing obesity

Various healthcare providers and organisations are involved in addressing obesity at macro- meso- and micro-levels.

Macro-level

In the Netherlands, the Ministry of Health, Welfare and Sport sets nationwide health policies and regulations, and funds large-scale preventive initiatives. One such initiative is the combined lifestyle intervention programme, which aims to promote healthier lifestyles among individuals with overweight or obesity. The programme promotes weight loss and reduces the risk of chronic diseases by encouraging behavioural changes in nutrition, physical activity, sleep, and stress management (13-15). Since

January 2019, the government has included the combined lifestyle intervention programme in the health insurance package, meaning that health insurances now reimburse this intervention for individuals with obesity and an increased risk of health-related risk (16). Other organizations at the macro-level include the pharmaceutical industry, which plays a role by researching and developing medications and treatments for weight management and obesity-related diseases. This is particularly relevant at present, given the emergence of promising new medications for weight loss (17).

Meso-level

The municipal public health services (*Gemeentelijke Gezondheidsdienst, GGD*) play a key role in monitoring public health, providing community-based preventive programmes, and promoting lifestyle interventions at the local level, for example initiatives in school settings, collaborations with primary care and social services, walking groups and community exercise programmes. The GGD also contributes to public awareness campaigns, early detection of health risks, and the development of supportive environments that facilitate healthy choices (18).

Micro-level

Various healthcare providers are involved in identifying and managing patients with obesity. General practitioners play a crucial role in this, as they are often the first point of contact for patients seeking help. They can provide essential guidance and referrals for weight management. Other healthcare providers involved in obesity management include the dietitians, psychologists, physiotherapists, social workers, lifestyle coaches and clinical specialists (Figure 1). In particular, the dietitian, physiotherapist, and lifestyle coach play an important role in the implementation of the combined lifestyle intervention. A person's socio-economic position, including their income, access to healthy food, opportunities for physical activity, and cultural attitudes towards weight, also plays an essential role in the development and management of obesity.

The Dutch primary healthcare system

In the Dutch primary healthcare system, general practitioners act as gatekeepers. They manage patient access to specialised care and coordinate overall healthcare services. More than 75% of patients contact their general practitioner at least once a year, with a mean of about five points of contact per year. However, this frequency varies based on age and health status (19). Patients with chronic diseases, including obesity, visit their general practitioner more frequently, thereby increasing the burden on primary care (20-22). This increase in visits results in a higher workload for general practitioners, requiring them to invest more time. However, this increased interaction

with patients also allows general practitioners to identify and manage obesity. Their main tasks in addressing obesity include discussing weight, diagnosing obesity, and referring patients with obesity based on their presumed health risk. In daily practice, many general practitioners fail to address obesity and experience difficulties adhering to practice guidelines (23, 24). Previous research has shown that body mass index measurements are underreported in the electronic health records (25-29) and less than half of the general practitioners refer patients with obesity to a weight management professional (27, 30). In addition to healthcare providers perceiving difficulties, patients with obesity often encounter a social stigma in healthcare settings (31-36). This stigma causes these patients to avoid support from their general practitioners, thereby reducing opportunities for general practitioners to address obesity (35, 37, 38). However, research has shown that patients want support with weight management from their healthcare providers, albeit in a non-stigmatizing manner (39, 40). This highlights the importance of examining the barriers that healthcare providers face when addressing obesity.

Complexity of obesity

According to the World Health Organization, obesity is recognised as a chronic disease (1) which induces metabolic dysfunction and inflammation of adipose tissue (41, 42). Obesity involves not only an increase in subcutaneous fat but also, and more critically, an increase in visceral adipose tissue. This visceral adipose tissue is often dysfunctional, leading to insulin resistance, hypertension, an adverse lipid profile, and excessive blood clotting (43, 44).

In the past, obesity was believed to be simply a matter of an imbalance between calorie intake and physical activity. However, obesity is now recognised as a complex, multifactorial condition (45). Although lifestyle factors such as a poor diet and physical inactivity are important contributors, these factors exist within a broader context. The development of obesity involves an interplay of biological, behavioural, social, and environmental influences (46). Other contributing factors include the side-effects of certain medications, socioeconomic disadvantage, psychological factors, hormonal and hypothalamic dysregulation, and genetic predisposition (Figure 1) (46-48).

The psychological factors are receiving increasing attention in obesity research, particularly regarding the association between anxiety, depression, and stress, and the development of obesity. The association between anxiety and obesity remains unclear. In a systematic review by Gariepy et al. (2010), an association was found between obesity and anxiety. However, the reverse relationship, whether anxiety leads to obesity

is inconsistent, and requires further research (49). Studies investigating the bidirectional relationship between depression and obesity have shown that the presence of one increases the risk of developing the other (50, 51). Stress can also contribute to obesity and is often triggered by negative life events such as a divorce, the death of a family member, or unemployment (52). Stress is defined as a negative emotional experience associated with biochemical, physiological and behavioural changes (53). It induces unhealthy eating behaviours that can lead to weight gain (52, 54), as well as metabolic changes that may influence the regulation of appetite and body weight (55). In addition to the factors that contribute to obesity, there are also important consequences of obesity (Figure 1) (5). The most prevalent of these are cardiometabolic complications. Among all these cardiometabolic conditions, the risk of type II diabetes is highest (5), but other cardiovascular diseases are also common (4, 5). However, these are not the only associated conditions with obesity. Obesity can lead to various other health problems, e.g., sleep apnoea, osteoarthritis, cancer, gastroesophageal reflux disease, and fatty liver disease (5). In conclusion, obesity is not just a weight issue; it is a complex condition that can affect the overall health in many ways.

Identification of high-risk patients with obesity

As described above, general practitioners are considered as key figures in identifying patients with obesity (56). Obesity is a complex condition, and it can be challenging to determine which patients are at increased risk. Until recently, body mass index was the main parameter used to identify obesity. Although body fat distribution is an important risk factor in the development of cardiometabolic diseases (57), body mass index alone does not accurately reflect body fat distribution (58). Consequently, relying solely on body mass index may overlook patients at relatively high risk of developing obesity-related diseases. Furthermore, individuals with a high muscle mass, which is generally considered healthy, may be incorrectly classified as being at risk.

Measuring waist circumference is an easy method to assess visceral adipose tissue that can be performed in a clinical setting (58-60). A normal measurement of waist circumference is defined as ≤ 94 cm for men and ≤ 80 cm for women, while an increased waist circumference is defined as > 94 cm for men and > 80 cm for women (61). Despite previous studies showing an association between an increased waist circumference and cardiovascular disease and mortality (62-66), the current body mass index-centric approach remains deeply embedded in clinical practice. This influences not only diagnostic criteria, but also treatment protocols, medication prescriptions, and reimbursement policies for general practitioners and patients. Recently, however, there has been a shift towards a more comprehensive approach in clinical practice.

Some updated guidelines suggest that waist circumference should play a more prominent role in obesity management.

Current guidelines in the Netherlands

In the Netherlands, the management of obesity and its associated cardiovascular risk in primary care is guided by two key guidelines: the national multidisciplinary guideline *obesity* and the guideline *cardiovascular risk management* of the Dutch College of General Practitioners (NHG). While both guidelines aim to identify patients at risk to enable early treatment and ultimately prevent cardiovascular disease, they differ in their approach to using waist circumference to identify those at risk of obesity-related diseases.

The national multidisciplinary guideline *obesity* (updated in 2023) from the Netherlands advises assessing the weight-related health risk of obesity-related diseases. This risk is estimated based on body mass index, in combination with waist circumference and the presence or absence of certain comorbidities (Table 1) (67). Treatment recommendations can be provided based on the category the patient belongs to, e.g. lifestyle advice, combined lifestyle interventions, bariatric surgery and pharmacological treatment.

The guideline of the Dutch College of General Practitioners (NHG) *cardiovascular risk management* (updated in 2024) recommends performing a cardiovascular risk assessment on patients with certain risk factors (e.g. patients with obesity (BMI≥30 kg/m^2), diabetes mellitus or chronic obstructive pulmonary disease), in order to identify those at high risk of developing cardiovascular disease (68). Although waist circumference is part of the general physical examination in this guideline, it is not specifically used to determine eligibility for a cardiovascular risk assessment.

The differences between the guidelines highlight a gap in the current approach to managing obesity and cardiovascular disease. This discrepancy presents an opportunity for further research to ensure effective identification and management of high-risk patients in primary care.

Table 1 Weight-related health risks in adults

	Normal waist circumference or absence of comorbidity	Increased waist circumference Men ≥102cm, women ≥88cm	Comorbidity*
Overweight BMI ≥25 and <30kg/m²	Slightly increased risk	Moderate increased risk	Moderate increased risk
Obesity class 1 BMI ≥30 and <35 kg/m²	Slightly increased risk	Increased risk	Increased risk
Obesity class 2 BMI ≥35 and <40 kg/m²	Increased risk	Extremely increased risk	Extremely increased risk
Obesity class 3 BMI ≥40 kg/m²	Extremely increased risk	Extremely increased risk	Extremely increased risk

* Comorbidities include an increased cardiovascular risk, chronic kidney disease, metabolic syndrome, type II diabetes, cardiovascular disease, respiratory diseases, diagnosed gastro-intestinal reflux disease, metabolic-dysfunction associated steatotic liver disease (MASLD), diagnosed cox/gonarthrosis, fertility problems, obesity-related comorbidities for which weight loss has or is likely to have a positive effect (67).

Aim of this thesis

This thesis aims to provide a contribution to the improvement of obesity management in primary care by focusing on 1. the current practices of obesity management in primary care and 2. the identification of patients with obesity at increased risk of further long-term weight gain or cardiovascular disease.

I. Current practices

Although all levels of healthcare (micro-, meso- and macro-level) are involved in tackling the obesity pandemic, general practitioners play a key role in managing patients with obesity at the micro-level. It is important to examine current practices in primary care to support general practitioners in effectively managing these patients. The first aim of this thesis is therefore to examine the current practices of obesity management in primary care.

II. Identification of high-risk patients

Obesity is a multifactorial condition involving complex interactions between biological, behavioural, social, and environmental factors. Visceral fat, which accumulates around internal organs, is a key factor in the development of obesity-related health risks, particularly cardiovascular diseases. Understanding the complexity of obesity is essential for identifying patients at high risk of obesity-related diseases, enabling early treatment and enhancing prevention of obesity. The second aim of this thesis is therefore to improve the identification of patients with obesity at increased risk of further long-term weight gain or cardiovascular disease.

Figure 1 illustrates the various healthcare providers involved in obesity management and the complexity of the condition. The key areas of the focus in this thesis are marked in different colours, with each colour corresponding to a different chapter of this thesis.

Outline of the thesis

Part I: Current practices

In the first part of this thesis, we examine the current practices of obesity management in Dutch primary care. The findings of part I are described in **Chapters 2** and **3**. **Chapter 2** examines the current recording practices of body mass index, overweight, and obesity in primary care including a sub-analysis of age, sex, and comorbidities. **Chapter 3** explores the barriers and facilitators to addressing obesity in primary care regarding discussing weight, diagnosing, and referring patients with obesity in a qualitative study.

Part II: Identification of high-risk patients

In the second part of this thesis, we identify patients with obesity at increased risk of further long-term weight gain or cardiovascular disease. The findings of part II are described in **Chapters 4** and **5**. **Chapter 4** investigates the association between anxiety, depression, negative life events, and quality of life with weight change over ten years in a middle-aged, population-based cohort with overweight or obesity. **Chapter 5** consists of three parts and uses a mixed-methods approach. The first part examines the current recording practices of general practitioners in measuring waist circumference. The second part explores barriers and facilitators of general practitioners in measuring waist circumference. The last part examines the contribution of measuring waist circumference in identifying patients at increased risk of cardiovascular disease. Finally, **Chapter 6** presents a discussion of the main findings of this thesis, with implications for practice and suggestions for future research.

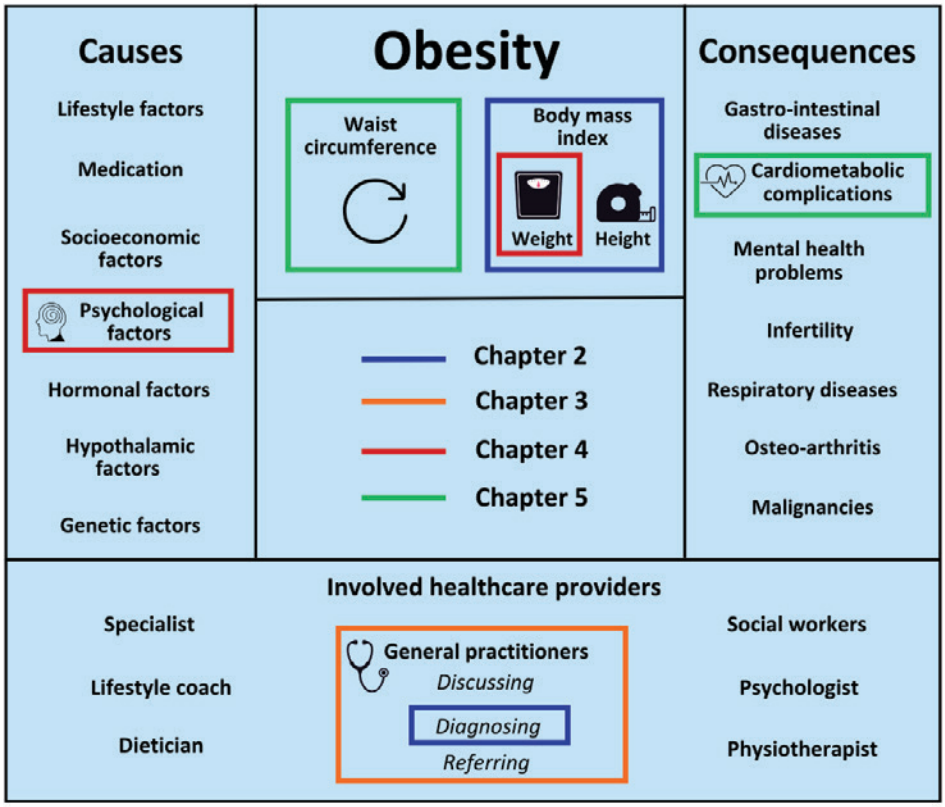

Figure 1 Illustration of the complexity of obesity combined with the outline of the subjects addressed in the different chapters of this thesis highlighted in blue (**Chapter 2**), orange (**Chapter 3**), red (**Chapter 4**), and green (**Chapter 5**)

Overview of the used data sources

Figure 2 shows the data sources used in each chapter of the thesis.

The Extramural LUMC (Leiden University Medical Center) Academic Network (ELAN)

In **Chapters 3** and **5**, we analyse routine healthcare data from ELAN. ELAN is a regional, integrative population-based data infrastructure comprising >1 million individuals. Routinely collected medical, social, and public health data at the patient level from the greater The Hague and Leiden area is linked within ELAN (69, 70). The ELAN data infrastructure has multiple potentials and objectives serving different actors e.g. it provides policymakers and healthcare providers with data and information enhances citizen involvement, and increases knowledge through scientific research. General practitioners enlisted in ELAN can also be recruited for qualitative studies. In this

thesis, we use routine healthcare data from the electronic health records of general practices enlisted in ELAN.

Qualitative data

In **Chapters 2** and **5**, qualitative data is analysed and collected from six focus groups with 21 general practitioners working in primary care in the Netherlands. Focus groups were organised with three to five general practitioners. The general practitioners were recruited from the extramural LUMC academic network (ELAN), an online platform for general practitioners (HAweb), a local network of locums and from the researchers' personal network.

The Netherlands Epidemiology of Obesity (NEO) study

In **Chapters 4** and **5**, we analyse data from the *Netherlands Epidemiology of Obesity* (NEO) study, a population-based cohort study including 6671 men and women aged 45 to 65 years (71). All inhabitants, living in the greater area of Leiden, the Netherlands, with a self-reported body mass index (BMI) of 27 kg/m^2 or higher and were eligible to participate in the NEO study. Additionally, all inhabitants aged between 45 and 65 years from one adjacent municipality (Leiderdorp, the Netherlands) were invited to participate, irrespective of their body mass index, allowing for a reference distribution of body mass index. Prior to the study visit, participants completed questionnaires at home with respect to demographic, lifestyle, and clinical information. Participants visited the NEO study center for an extensive physical examination, including anthropometry.

	ELAN	Qualitative data	NEO
Chapter 2	X		
Chapter 3		X	
Chapter 4			X
Chapter 5	X	X	X

Figure 2 Overview of the used data sources in the thesis
ELAN: Extramural LUMC Academic Network, NEO: The Netherlands epidemiology of obesity study

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Part I

Current practices

Chapter 2

Recording practices of body mass index, overweight and obesity by Dutch general practitioners: an observational study

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BMC Primary care. 2025;26:1. Published January 2, 2025.

Abstract

Background

Routine body mass index (BMI) recording in electronic health records (EHR) could support general practitioners (GPs) in managing patients with obesity. This study aimed to evaluate recording practices of BMI, overweight, and obesity in adults including subgroup analysis of age, sex, and comorbidities in primary care in the Netherlands.

Methods

An observational study of individuals aged ≥ 18 years and registered between 2007 and 2023, using routine healthcare data from the Extramural LUMC Academic Network (ELAN) in the Netherlands. Outcomes were (i) incidence rates of a recorded BMIs per 1000 person-years for sex and ten-year age categories (ii) proportions of recorded BMIs for different comorbidities and (iii) proportions of diagnosis of overweight (BMI between 25 and 30 kg/m^2) and/or obesity (BMI ≥ 30 kg/m^2) for a corresponding recorded BMI.

Results

Approximately 30% of 676,708 individuals had a recorded BMI. Highest incidence rate (186 per 1000 person-years) was at age 71 to 80 years. At least one BMI was recorded in 68.5% of individuals with chronic obstructive pulmonary disease, 70.6% with hypertension, 86.3% with type II diabetes, 42.4% with eating disorders, 36% with depression and 64.2% with osteoarthritis. Diagnoses of overweight and/or obesity were found in 11.5% of individuals with a BMI between 25 and 30 kg/m^2 and in 36.4% with a BMI of ≥ 30 kg/m^2.

Conclusion

In the Netherlands, GPs recorded BMIs in nearly one third of all adults, mainly in adults with chronic diseases. Routinely recording BMI is not currently standard practice. With the increasing prevalence of obesity and its related comorbidities, it may be beneficial to start routinely recording BMI in primary care.

Introduction

Obesity is associated with a high risk of developing various diseases, including type II diabetes (DM2), cardiovascular disease, osteoarthritis and cancer, contributing to an increased morbidity and mortality in patients with obesity (1, 2). Early diagnosis of overweight and obesity in primary care might mitigate these negative effects and has been shown to be an important step towards weight loss (3, 4). Since general practitioners (GPs) often underestimate patients' weight when solely relying on visual assessment, an important first step might be to record an adequate body mass index (BMI) in the electronic health record (EHR) (5). This also yields benefits for the GPs as evidence shows that a recorded BMI in the EHR makes it easier for them to discuss weight (3, 6). Additionally, GPs find it useful to have a recorded BMI in the EHR when prescribing medications, writing referral letters, collaborating with colleagues (e.g., emergency services), and interpreting laboratory results (6).

Dutch GPs consultations are different from some other countries in that patients are not typically seen by a practice nurse for physical assessment beforehand. Additionally, the GP consultations only last 10–15 min and BMI is not routinely measured by the GP, unless it is relevant to the reason for consultation. Patients with comorbidities such as chronic obstructive pulmonary disease (COPD) and diabetes are however regularly (e.g., quarterly, or annually) seen by the practice nurse. The practice nurse is a specially trained healthcare professional who supports the GP in the management of chronic diseases and preventive care. In practice nurse consultations, it is expected that BMI is more frequently recorded in the EHR.

The aim of this study is to evaluate current recording practices of BMIs in primary care in the Netherlands, concerning age, sex, comorbidities, as well as recording practices concerning the diagnosis made of overweight (BMI between 25 and 30 kg/m^2) and obesity (BMI ≥30 kg/m^2) for a corresponding recorded BMI.

Methods

Study design and study population

This is an observational study from a population-based cohort in the Netherlands using routine healthcare data approached from the Extramural LUMC Academic Network (ELAN). ELAN is a regional integrative population-based data infrastructure in which medical, social, and public health data is linked at the patient level from the greater The Hague and Leiden area (7, 8). Individuals were included if they were registered between 1st of January 2007 and 30th of June 2023 at an ELAN-participating general

practice and were at least 18 years old or became 18 years old during the study period. Individuals with a follow-up duration in a general practice of less than a month were excluded, as these patients were likely registered for a very short period, such as vacationers, for whom routine recording BMI was generally irrelevant.

Data collection

Outcome

In this study we used height, weight and BMI that was coded during the study period (2007–2023) within the structured EHR as a laboratory result. The recorded BMIs were derived from an already available BMI (automatically calculated by the GPs information system), or BMI was calculated using a recorded height and weight on the same date or a recorded weight and a previous recorded height. All recorded BMIs were divided into a measurement of <25 kg/m^2 (normal weight), 25–30 kg/m^2 (overweight) and ≥30 kg/m^2 (obesity). For a diagnosis of overweight or obesity, we used the first recorded diagnosis of overweight (International Classification of Primary Care (ICPC) T83) or obesity (ICPC T82). A first recorded diagnosis prior to the study period (before 2007) was also included. The diagnoses are based on an episode and a thereto linked ICPC-code. An episode is defined as the context within which a diagnosis is established and managed, including all events and activities throughout the patients care pathway (9).

Covariates

Age, year of birth and sex were derived at cohort entry. Age was divided into seven age categories: 18–30, 31–40, 41–50, 51–60, 61–70, 71–80, and ≥ 81 years. Five diagnosed comorbidities were selected which are related to weight change, overweight or obesity (1, 10-13): COPD (ICPC R91-R91.01-R91.02-R95), hypertension (ICPC K85-K86-K87), DM2 (T90.02), eating disorders (ICPC T06-T06.01-T06.02), depression (ICPC P03-P76-P76.01-P76.02) and osteoarthritis (ICPC L89-L90-L91). These comorbidities were based on a registered episode and a thereto linked ICPC. For each comorbidity every first recorded diagnosis was included. A first recorded diagnosis prior to the study period (before 2007) was also included. Due to the non-chronic nature of depression and eating disorders, we also included a first recorded diagnosis during the study period (2007–2023) for these two diseases, to be able to additionally examine whether a BMI was recorded within one year before and after these diagnoses were made. In individuals with multiple diagnoses of depression or eating disorders during the study period only the first diagnosis was included.

Statistical analysis

Baseline characteristics of the study population were summarized median (25th, 75th percentiles) or as percentage. Follow-up time in person-years was calculated from cohort entry (at least 18 years and registered in a general practice from the 1st of January 2007) until deregistration with a participating general practice, death, or end of the study period (30th of June 2023).

First, we calculated the incidence rates of a recorded BMI within each year (from 2007 to 2023) per 1000 person-years. If multiple recorded BMIs for an individual were recorded within one year, only the first recorded BMI within that year was included. Individuals were censored after a first recorded BMI in that year. Second, using this same technique, we calculated the incidence rates of a recorded BMI in each age category per 1000 person-years, followed by a sub-analysis for men and women. Cox regression was used to examine differences in incidence rates between men and women across age categories and to examine differences in incidence rates among age categories (reference category 18–30 year), adjusted for the calendar year in which the BMI was recorded. We reported hazard ratios (HR) with 95% confidence intervals. Third, proportions were calculated of at least one recorded BMI for COPD, hypertension, DM2, eating disorders, depression and osteoarthritis. A sub-analysis was performed for eating disorders and depression, examining the proportions of BMI recordings within one year before or after these diagnoses were made. Fourth, proportions were calculated for a coded diagnosis of overweight and/or obesity based on a corresponding BMI. Overweight was defined as a BMI between 25 and 30 kg/m^2 and obesity as a BMI of 30 kg/m^2 or higher. The data was pre-processed using R Statistical Computing (version 4.3.1) and SPSS statistical software (version 29, IB Corporation, Armonk, NY). All statistical analyses were performed using SPSS statistical software.

Results

Characteristics of the study population

Our analysis included 676,708 individuals (Figure 1), with a total of 1,553,555 BMIs and 5,717,777 person-years. Baseline characteristics of this population are presented in Table 1. Almost 30% had at least one recorded BMI.

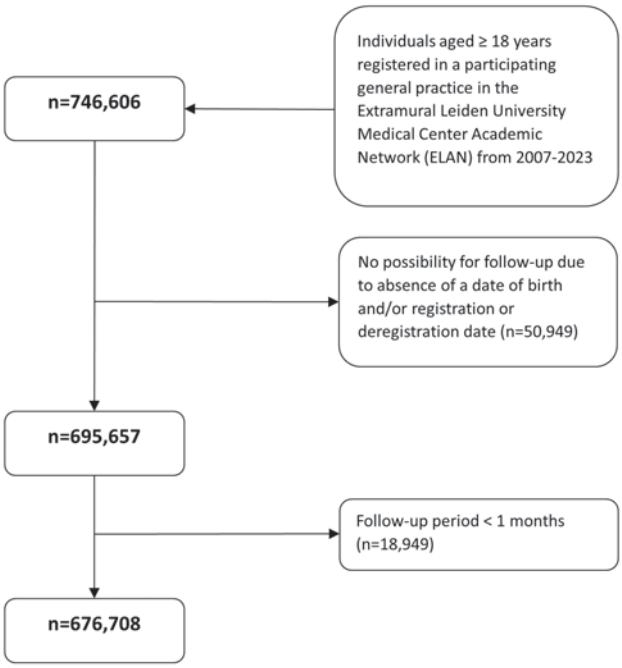

Figure 1 Flowchart with exclusion criteria

Table 1 Baseline characteristics routine healthcare cohort of ELAN, 2007-2023 from 18 years and older

	Total population n=676,708
Sex (% men)	48.0
Year of birth (year, median, IQR)	1971 (1954-1987)
Age at entry cohort (years, median, IQR)	40.0 (26.0 -56.0)
Follow-up in general practice (person-years, median, IQR)	7.5 (2.8 – 15.5)
Recorded BMI (%) - First recorded BMI <25kg/m^2 (%) - First recorded BMI 25-30kg/m^2 (%) - First recorded BMI ≥30kg/m^2 (%)	28.8 9.0 11.2 8.6
Overweight* (%)	3.4
Obesity* (%)	3.5
COPD* (%)	3.6
Hypertension* (%)	20.4
Type II diabetes* (%)	7.3
Eating disorders* (%)	0.3
Depression* (%)	11.9
Osteoarthritis* (%)	9.8

IQR: interquartile range, BMI: body mass index.
*Based on the international classification of primary care (ICPC) codes

Recorded BMIs from 2007 to 2023

The incidence rates of at least one recorded BMI increased with 61 to 215 per 1000 person-years from 2007 to 2019. During the COVID-19 pandemic (2020, 2021, 2022), the incidence rates decreased to 173, 200 and 203 per 1000 person-years respectively. The highest incidence rate was observed in 2023 with an incidence rate of 263 person-years (Figure 2).

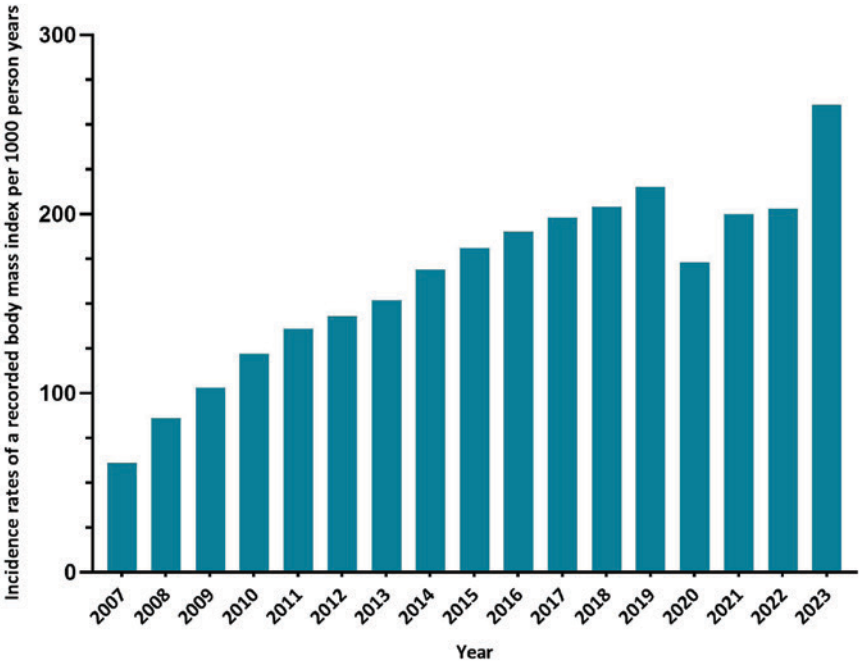

Figure 2 Incidence rates of a recorded body mass index per year 2007–2023

Recorded BMIs per age category and sex

The incidence rate of a recorded BMI per 1000 person-years was highest in the age category 71–80 years (186 per 1000 person-years; HR: 10.38; 95% CI 10.20-10.57) compared with the age category 18–30 years old. In the oldest age category (≥ 81 years), the incidence rate decreased to 154 per 1000 person-years (HR: 8.86 95% CI: 8.69–9.04). Adjusting for the calendar year in which the BMI was recorded, the hazard ratio (reference category 18–30 year), continued to increase, even in the oldest age category (Supplemental table 1).

At younger ages, a recorded BMI was more frequent in women than in men (age category 18–30 years: HR 1.63; 95% CI 1.58–1.68). This equalled for men and women in the age category 51–60 years (HR 1.01; 95% CI 0.99– 1.02). In the age categories above 60, recorded BMIs were always more frequent in men than in women. The largest difference was found in the oldest age category (≥ 81 years) with an incidence rate of a recorded BMI of 174 for men and 142 for women per 1000 person-years (HR 0.86; 95% CI 0.84–0.88) (Figure 3).

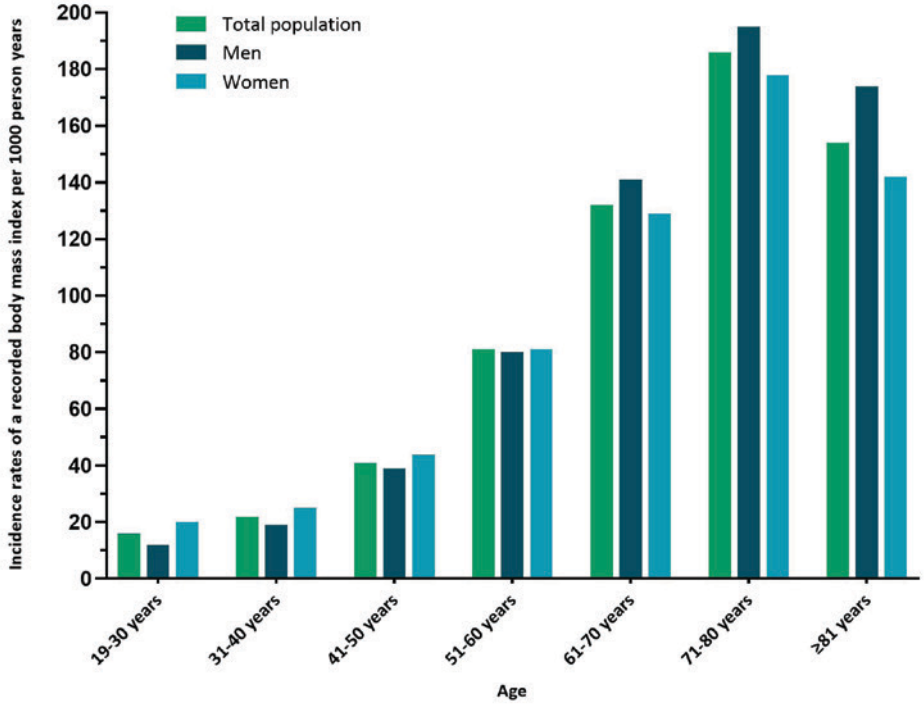

Figure 3 Incidence rates of a recorded body mass index per 1000 person years within age categories (n = 676,708)

Diagnosis of overweight and/or obesity

In 15.0% (n = 101,517) of the study population, a BMI between 25 and 30 kg/m^2 was recorded. Of these individuals, 11.5% showed a coded diagnosis of overweight and/or obesity. In 10.7% (n = 72,280) of the study population, a BMI of more than 30 kg/m^2 was recorded. Of these individuals, 36.4% showed a coded diagnosis of overweight and/or obesity (Figure 4).

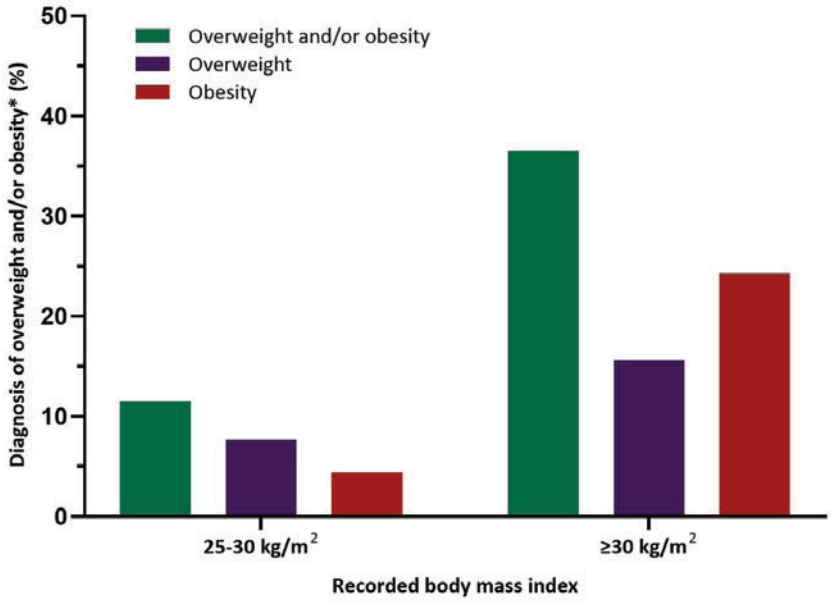

Figure 4 Diagnosis of overweight and/or obesity* within a recorded body mass index
*based on the International Classification of Primary Care (ICPC) codes
Recorded body mass index between 25-30 kg/m^2 n=101,517, recorded body mass index ≥30 kg/m^2 n=72,280

Recorded BMIs per comorbidity

Proportions of at least one recorded BMI were 68.5% in individuals with COPD, 70.6% for hypertension, 86.3% for DM2 and 64.2% for osteoarthritis. For eating disorders and depression, the proportions were 42.4% and 36% respectively (Figure 5). In the sub-analyses in which we included only individuals with an eating disorder (n = 957) or depression (n = 46,973) between 2007 and 2023 and a recorded BMI before and after the year of the coded diagnosis, the proportions were 20.3% and 29.5% respectively.

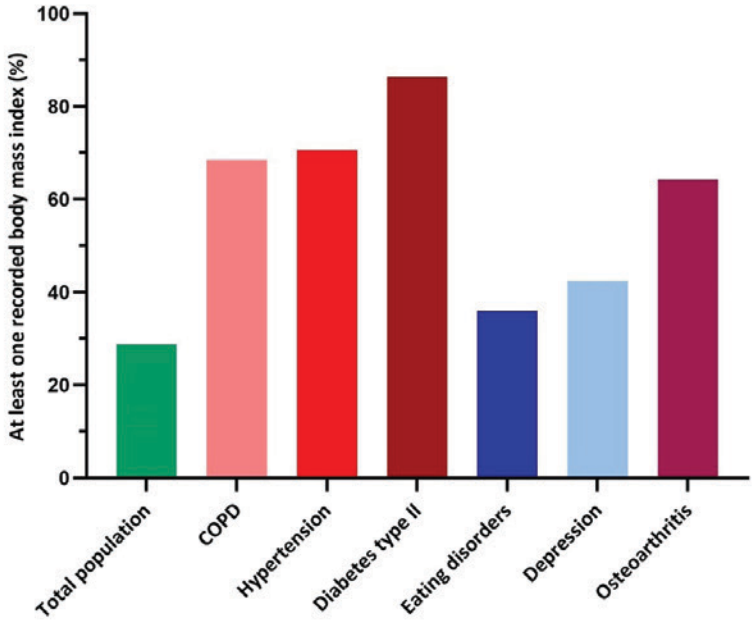

Figure 5 At least one recorded body mass index in patients with different co-morbidities*. COPD: chronic obstructive pulmonary disease, *based on the International Classification of Primary Care (ICPC) codes. Total population n = 676,708, COPD n = 24,150, hypertension n = 137,776, diabetes type II n = 49,652, eating disorders n = 2,172, depression n = 80,531, osteoarthritis n = 66,531

Discussion

In this observational study of 676,708 individuals using routine healthcare data from a Dutch cohort, almost 30% of the individuals had a recorded BMI in primary care. Incidence rates have been increasing consistently from 2007 to 2023 (except during the COVID-19 pandemic). The incidence rate of a recorded BMI per 1000 person-years increased with age, with the highest incidence rate in the age category of 71 to 80 years old. At younger age, more women than men had a recorded BMI while at older age more men than women. GPs recorded BMIs more often in individuals on indication, mainly in chronic diseases like COPD, hypertension, DM2 and osteoarthritis. In psychiatric disorders (depression and eating disorders) affecting weight changes, BMI was frequently recorded. A coded diagnosis of overweight (25-30 kg/m^2) or obesity (≥30 kg/m^2) was recorded in only a small fraction of those who had a BMI recording indicative for these conditions.

The increase in recorded BMIs over the years was also observed in previous studies (14, 15). In this study, a notable decrease in BMI recordings occurred in the years 2020 to 2022. This decrease can be explained by the COVID-outbreak during these years and

the restrictions taken at that time resulting in fewer visits to the GP and practice nurse (16-18). A positive development is that BMI recordings increased again in 2023. These findings suggest a growing awareness of the importance of recording BMI in the EHR in primary care but also show the value of in practice encounters. It is remarkable that the proportion of a recorded BMI in the Netherlands is considerably lower compared with data from other countries such as the United States, the United Kingdom and Australia (14, 19-21). In the Netherlands, according to the guidelines, recording BMI is standard practice for specific comorbidities such as COPD and DM2, as well as during cardiovascular risk assessment (22-24). However, it is not standard practice for the general population, whereas in some other countries, recording BMI might be standard practice for all patients visiting the general practice. Besides, comparing the studies from the different countries is difficult due to methodological differences, such as variability in follow-up duration and differences in inclusion criteria for patients with a minimal number of consultations with their GP. Our study included the entire population, including individuals who did not visit their GP. Interestingly, mortality rates for obesity-related diseases between the United Kingdom and the Netherlands are similar (25, 26), while proportions of recorded BMIs are different between these countries. Nonetheless, it remains unclear whether GPs are already more aware through routine recording BMI or if their awareness increases as a result of a recorded BMI. However, recording the BMI can change GPs behaviour, for example by making it easier to discuss weight during follow-up visits (3, 6). Further research should focus on factors influencing BMI recording practices within different healthcare systems across countries and the subsequent consequences of these practices.

Regarding the sex differences, more women than men had a recorded BMI at younger ages, while at older ages, more men than women had their BMI recorded. This might be related to the difference in consultation rates between men and women. About 80% of the women between the ages 16 and 54 years visit the GP at least once yearly, versus about 60% of men of the same age. At older ages, however, the consultation rates between men and women are nearly equal (27).

In line with previous studies, BMI is more often recorded in older patients with obesity-related comorbidities such as COPD, hypertension, and diabetes (19, 20, 28). This could be explained by these patients being routinely seen by the practice nurse due to the introduction of an integrated and structured care system since 2007 for patients with COPD, DM2 and cardiovascular risk management in the Netherlands (29-31). In this integrated care system, unlike in the United Kingdom where pay for performance exists (14, 32), there is no financial incentive for BMI recordings in the Netherlands (33).

It is noteworthy that individuals with eating disorders and depression less frequently have a recorded BMI than patients with COPD, hypertension, DM2 and osteoarthritis. This discrepancy could be explained by the higher prevalence of these psychiatric disorders among younger individuals, of whom a BMI is already less frequently recorded (Figure 3). Additionally, GPs might be more hesitant with these individuals, as measuring BMI can sometimes be very triggering. Certain psychiatric disorders are associated with obesity and weight change (12, 34-37), with depression for example sharing the same biological mechanisms as obesity (11, 38, 39). Recording BMI more frequently in this population might help prevent further weight gain or weight loss, as long as it is provided in a careful and empathetic manner, ensuring no discomfort to the patient or triggering feelings of shame.

In this study, a coded diagnosis of overweight and/ or obesity for a corresponding BMI was not commonly found in the EHR, which is consistent with the literature (40-42). Both diagnosing overweight and obesity and recording BMI are crucial: it results in prevention and early identification of overweight and obesity and can lead to weight loss (4, 42). Besides, it enables GPs when prescribing medication, writing referral letters, collaborating with colleagues (e.g., emergency services), discussing weight at follow-up, interpreting laboratory results and supports in risk management (6). A real-life example from the Netherlands shows it was clearly important and useful to have a recently accurate BMI recording: during the COVID-19 pandemic, GPs were asked to vaccinate patients with morbid obesity (BMI ≥ 40 kg/m^2) for COVID-19. GPs were unable to identify those patients, since BMIs were not recorded in the EHR.

To our knowledge, this is the largest population-based study from the Netherlands about recording practices of overweight, obesity, and recorded BMIs by Dutch GPs. This study, however, also has some limitations. First, our dataset is limited to a recorded height, weight, and BMI within the structured EHR, because we did not include free text data. It is likely that more BMIs (or weight and height) are recorded in free text in the EHR, as not all GPs translate their medical assessment to accurately coded recordings. So, our results could be an underestimation of available recorded BMIs. Second, it is important to note that routine healthcare data were used, showing limitations. To use this data accurately, we evaluated the data for extreme values and inconsistent records. Only less than 2% of the values were removed due to non-adequate or extreme values of height, weight, and BMI. Third, in this study, we cannot be sure that height and weight were actually measured. Some GPs inquire about height and weight and rely on the measurements provided by the patients themselves. Self-reported weight may be an underestimation, but in the majority of the cases the diagnosis of overweight and obesity is accurately identified (43).

Conclusion

Routinely recording BMI in the Netherlands is not currently standard practice since only one third of the adults in the Netherlands have a recorded BMI in their EHR. Incidence rates of recorded BMIs increased over the years from 2007 to 2023. Contributing factors to recording BMI are older age and chronic diseases such as COPD, DM2, hypertension and osteoarthritis. With the increasing prevalence of obesity and its related comorbidities, it should be considered to routinely record BMI in primary care in the Netherlands since it leads to early identification and treatment of obesity.

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Supplemental table 1 Results of the cox regression of the association between age categories and a recorded body mass index

Age category (years)	HR (95% CI)	HR (95% CI)*
19-30	reference	reference
31-40	1.34 (1.31-1.37)	1.11 (1.08-1.13)
41-50	2.58 (2.54-2.63)	1.10 (1.07-1.11)
51-60	4.90 (4.81-4.98)	1.29 (1.27-1.31)
61-70	7.81 (7.68-7.95)	1.55 (1.53-1.58)
71-80	10.38 (10.20-10.57)	1.96 (1.93-2.00)
81+	8.86 (8.69-9.04)	2.07 (2.03-2.11)

HR: hazard ratio, CI: confidence interval. *Adjusted for the calendar year in which the body mass index was recorded

Chapter 3

Dutch GPs' perspectives on addressing obesity: a qualitative study

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BJGP Open. 2024;8. Published April 25, 2024.

Abstract

Background

Early diagnosis and treatment of obesity in primary care may help to tackle the obesity pandemic. Nonetheless, GPs frequently fail to address obesity and demonstrate limited adherence to guidelines.

Aim

To explore Dutch GPs' perspectives on addressing obesity regarding the following three target behaviours: discussing weight; diagnosing; and referring patients with obesity.

Design and setting

A qualitative focus group study with Dutch GPs.

Method

Six focus groups were conducted with a purposive sample of 21 GPs. Thematic analysis was performed using deductive coding, according to the Theoretical Domains Framework (TDF).

Results

For discussing weight, the main barriers identified were a presented complaint unrelated to obesity (environmental context and resources), concerns about a negative response from the patient (beliefs about consequences), and worries about obesity being a sensitive subject to discuss (emotions). A long-term trustworthy relationship (social influences) facilitated discussing weight. For diagnosing patients with obesity, the main barriers were related to resources; for example, lack of (appropriate) measuring equipment and time (environmental context and resources). For referring patients with obesity, the main barriers were no referral options nearby (environmental context and resources), and doubts about the positive effects of the referral on weight change (beliefs about consequences).

Conclusion

Different barriers for discussing weight, diagnosing, and referring patients with obesity were identified, underscoring the importance for tailored interventions to these specific behaviours. Improving knowledge and skills of GPs seems insufficient as this study showed that particular attention should be paid to establishing long-term relationships, addressing GPs' beliefs about consequences, and creating a supportive environment with sufficient time and resources.

Introduction

The prevalence of patients with obesity is increasing worldwide (1, 2). In the Netherlands, currently almost half of the population is overweight or obese (2). Patients with obesity visit their GP more often than those of a healthy weight (3, 4), and have an increased risk of morbidity and mortality (5, 6). This is not only hazardous for patients, but also a burden for primary care, and by extension for the entire healthcare system (7). In primary care, it causes a higher workload for the GP and more prescribed medication in this population (8). Early identification and explicit diagnosis and targeted treatment approaches for obesity in primary care may help to counteract these negative effects.

Nonetheless, in daily practice GPs often fail to address obesity and experience difficulties adhering to the practice guidelines (9, 10). This is unfortunate, since GPs are in a crucial position in the healthcare system to signal, diagnose, and treat patients with obesity. The national guideline for obesity of the Dutch College of General Practitioners (NHG) describes when diagnostics, treatment, and referral are indicated (11). Understanding why there is limited adherence to these guidelines regarding obesity care requires insight into the determinants of the GP's behaviour regarding addressing obesity.

A successful approach to addressing obesity in primary care requires the GP to perform different behaviours; for example, discussing weight, diagnosing, and referring patients with obesity for treatment of their obesity. Different barriers may exist for each of these behaviours. In order to understand determinants of behaviour and to facilitate behaviour change, there is a need for the behaviour for change to be specified and clearly selected (12). Previous research on perspectives of GPs for addressing obesity and adherence to obesity guidelines did not specify the assessed behaviours upfront (13-15). In the present study, we address this limitation by focusing on three specific behaviours separately using the Theoretical Domains Framework (TDF) as a framework, specifically designed to understand determinants of healthcare professional behaviour.

The TDF consists of 14 theory-based domains that represent varying determinants for behaviour change; for example, knowledge, environmental context and resources, social influences, and beliefs about consequences (16, 17). This evidence-based approach was developed to assess implementation problems and health professional behaviours as a basis for intervention development (17). Each domain of the TDF relates to a component in the overarching Capability, Opportunity, Motivation, and Behaviour (COM-B) model. This model identifies the following three key factors that need to be present for any behaviour to occur: capability; opportunity; and motivation.

To our knowledge only one study used the TDF to explore barriers and facilitators of healthcare professionals in addressing obesity (18). However, this study focused only on discussing weight, whereas effective management of obesity in primary care also requires essential behaviours such as diagnosing and referring patients with obesity. With the present study, we thus aimed to extend these findings by applying the TDF to explore the barriers and facilitators of GPs for three specific target behaviours that are crucial to adhere to the guidelines: discussing weight; diagnosing patients with obesity; and referring patients with obesity.

Method

Design and study

This study is a qualitative study using the outcome of tightly guided focus group discussions. Focus groups were chosen as it has been shown that focus groups allow for participant interaction and group dynamics, which may provide a broader range or scope of perspectives and information (19). Focus groups were organised with GPs working in primary care in the Netherlands.

Participant selection and recruitment

We used purposive sampling to recruit a heterogenous sample of GPs in terms of age, sex, working experience, GP practice setting, and patient populations. We recruited GPs from the extramural Leiden University Medical Centre (LUMC) academic network (ELAN), an online platform for GPs (HAweb), a local network of locums, and from the personal network of the researchers. Potential participants received written information regarding study purposes and provided written informed consent before participation. Focus groups were organised with three to five participants, and new groups were added until data saturation was reached (that is, until no new themes were brought forward).

Data collection

In each focus group the following three specific target behaviours were discussed: discussing weight; diagnosing; and referring patients with obesity. Discussing weight referred to raising the topic of weight during consultation. Diagnosing patients with obesity referred to measuring height, weight, and preferably also waist circumference, followed by structured recording the measurements in the electronic health record (EHR). Referring patients with obesity for treatment included various options; for example, a dietician, a lifestyle coach, a combined lifestyle intervention (CLI; combining healthy diet, physical activity, sleep and stress management), the general practice nurse, and bariatric surgery. A semi-structured topic guide for each target behaviour

was developed based on the 14 domains of the TDF (Supplemental table S1). For each target behaviour, participants were asked questions related to all 14 domains of the TDF to gain insight into the barriers and facilitators.

Before the start of each target behaviour, we showed participants one of the three vignettes of an encounter with a specific patient with obesity, as an example to prompt GPs with a variety of real-life practice situations. The vignettes included the following:

- for discussing weight, a patient with obesity with a reason of encounter unrelated to obesity;
- for diagnosing patients with obesity, a patient with obesity asking for help to lose weight;
- and for referring patients with obesity, a patient with obesity with cardiovascular risk factors (Supplemental file S1).

The focus groups lasted 2 hours and were all moderated by an experienced moderator (PP) assisted by two observers (WH, LB) who made fieldnotes. The first and second focus groups took place in the LUMC. The next four focus groups were conducted online as COVID-19 restrictions hindered coming together in person. Data collection took place between September 2021 and February 2022. The focus groups were audio recorded, and transcribed verbatim by two researchers (WH, LB).

Data analysis

The transcripts were analysed using a thematic analysis approach using Atlas ti (version 22). The 14 theoretical domains of the refined TDF were used for deductive coding (16, 20). Barriers and facilitators were identified within each domain. If content did not fit in one of the pre-specified TDF domains, an additional (inductive) code was added. To structure the result section of the report, the COM-B system was used (12). Two researchers (WH, LB) independently coded the focus group discussion to increase reliability. To resolve any inconsistencies and coding problems and to refine generated themes, the research team (including a behavioural scientist; MA) frequently discussed allocation of the codes and themes to TDF domains until agreement was reached.

Results

Sample characteristics

We reached data saturation after six focus groups with three to five GPs (n = 21). Table 1 presents the characteristics of the study population. The participants had a mean age of 49 years (range 33– 66 years) and the majority were women (76.2%). For each

target behaviour, the main barriers and facilitators structured into the three COM-B components with the related TDF domain in brackets are described below. Figure 1 summarises these barriers and facilitators. Supplemental table S2 summarises all reported barriers and facilitators for each domain of the TDF.

Table 1 Sample characteristics reported by the participants (n=21)

Characteristic	**n**
30-39	6
40-49	6
50-59	6
60-69	3
Gender	
Women	16
Men	5
Experience as general practitioner (years)	
0-9	8
10-19	5
20-29	6
30-39	2
Type of employment	
Practice owner	10
Salaried service	2
Locum	9
Practice location	
Urban	12
(Semi)rural	8
Both	1
Type of practice	
Solo practice	8
Duo practice	5
Group practice	5
Mixed	2
Unknown	1
Number of patients in practice	
≤3000 patients	9
>3000 patients	9
Unknown	3
Type of patient population	
Average population (reflection of the Dutch population)	10
Other	11
Specific areas of interest	
GP trainer	7
Obesity	1
Lifestyle coach	1
Other	6
None	6

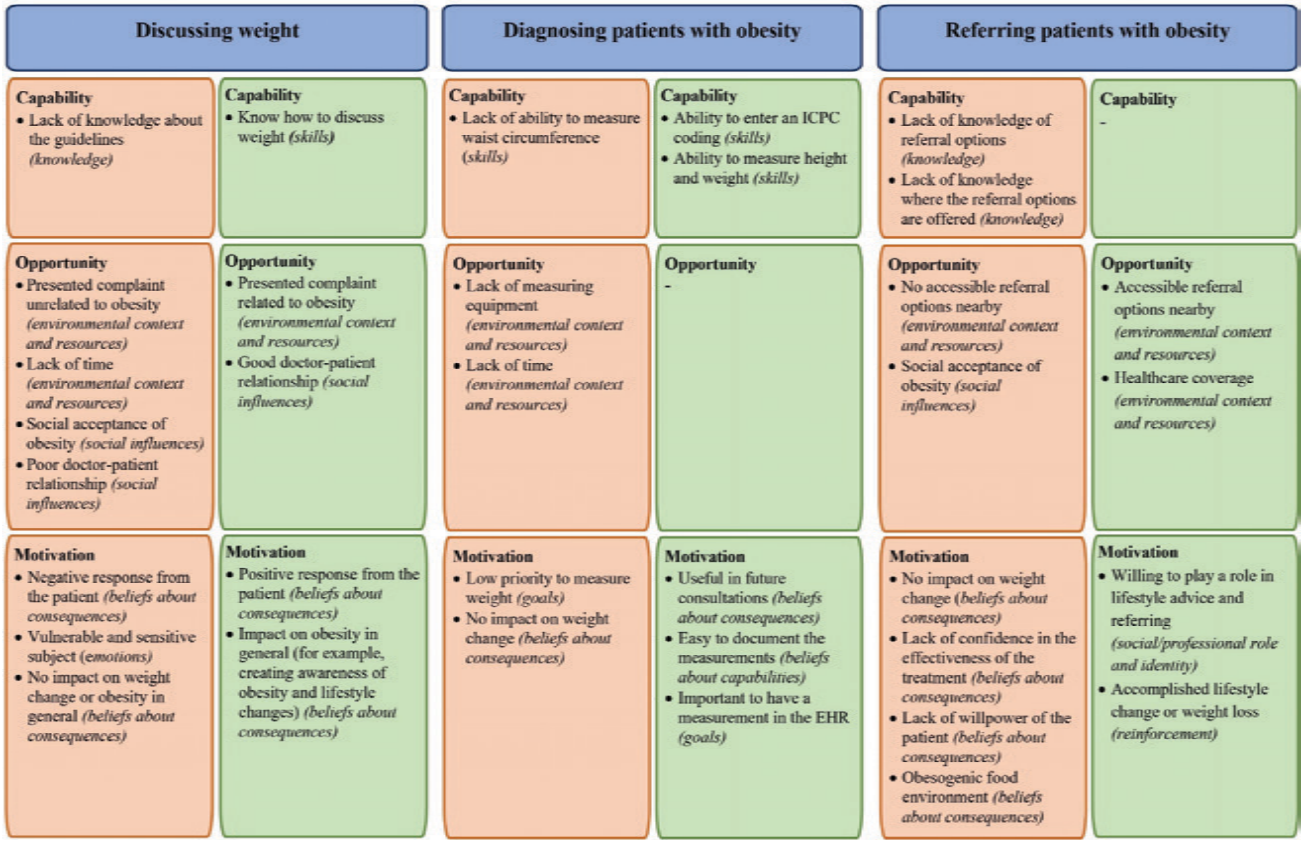

Figure 1 Main barriers and facilitators regarding the three target behaviours structured into the Theoretical Domains Framework (TDF) and Capability Opportunity Motivation Behaviour (COM-B) model
ICPC: International Classification of Primary Care, EHR: Electronic Health Record

Discussing weight

Capability

In the domain of capability, knowledge was the only barrier mentioned related to capability. Several GPs indicated that they had insufficient knowledge regarding guidelines for addressing obesity. Several facilitators were mentioned related to capability. Some GPs mentioned feeling competent in discussing weight. They emphasised they possessed the skills to discuss weight by fact-focused communication and by using the correct vocabulary (skills). Another facilitator was a documented body mass index (BMI) measurement in the EHR as some participants indicated this functioned as a reminder for discussing weight at follow-up (memory, attention, and decision processes).

Opportunity

An important barrier for discussing weight mentioned in all focus groups, was the difficulty to discuss weight when the presented complaint was unrelated to obesity (environmental context and resources). When complaints were related to obesity (for example, joint complaints, cardiovascular risk factors, infertility, or diabetes) a conversation about weight was said to be easier to start:

> *'If the complaint they come up with is unrelated to obesity, I find it to be almost inappropriate to start a conversation about obesity (…) I really must have a clear relationship with obesity, for example, cardiometabolic diseases, fatigue or anything else I can comment on …' (GP 16)*

Within this domain (environmental context and resources), lack of time was mentioned as a barrier to discuss weight, particularly when the GP was inexperienced, was unfamiliar with the patient, or worked as a locum. Social influences were mentioned both as an important barrier and facilitator for discussing weight. Specifically, the absence of a pre-existing good doctor–patient relationship was mentioned as a barrier especially by locums. On the other hand, having a good doctor–patient relationship facilitated discussing weight. This good relationship could arise from a positive atmosphere during consultation, from building a relationship of trust, from experience or from being familiar with the patient.

Motivation

Beliefs about consequences was another important barrier for discussing weight and was mentioned in all focus groups. GPs were hesitant to discuss weight owing to fear of negative responses, which might harm their doctor–patient relationship. However, other GPs mentioned never having negative responses from patients, which facilitated discussing weight:

'People never respond, "mind your own business", but I must say I know these people for a long time (…) they know my intentions.' (GP 10)

Albeit less frequently discussed, GPs were unconvinced about their influence on weight change or the problem of obesity in general by discussing weight (beliefs about consequences). As a facilitator, a few GPs pointed out that they felt they could influence obesity by creating awareness, promoting lifestyle changes, or preventing comorbidities. Anticipated emotions were also a mentioned barrier for discussing weight. GPs expressed feeling reluctant to discuss weight, as they considered it a sensitive subject (emotions):

' … people may be embarrassed about it or find it a sensitive subject, which makes it difficult for me to bring it up.' (GP 18)

Finally, a new theme that did not fit the existing TDF framework emerged and was therefore inductively added as a new theme in our analysis: characteristics of the patient. Characteristics of the patient (for example, age) were said to function either as a barrier or a facilitator for discussing weight. Almost all GPs had examples of patient characteristics (age, sex, BMI, motivation, comorbidities and socioeconomic status of the patient) that they felt made it easier or more difficult to discuss weight. Some characteristics were mentioned as a facilitator by some but as a barrier by others. GPs who mentioned a specific characteristic explained why it was easier or more difficult to discuss weight with a patient with this characteristic. For example:

'I am more reluctant with men because they do not like me nagging.' (GP 2)

' … the younger the patient is, the more likely you are to achieve health benefits …' (GP 8)

'Healthy food is expensive, for example if a patient has financial problems, it is not that easy to eat healthily. For this reason, I will not discuss weight.' (GP 2)

Diagnosing patients with obesity

Capability

Domains related to capability were not frequently mentioned for diagnosing patients with obesity. As a barrier, some did indicate a lack of skill in measuring waist circumference. As facilitator, GPs knew how to enter an International Classification of Primary Care (ICPC)-coding and document the measurements in the EHR (skills).

Opportunity

Almost all barriers mentioned in diagnosing patients with obesity were in the domain of environmental context and resources. Specifically, lack of (appropriate) materials in consultation rooms (for example, scales and measuring tape) was mentioned as a barrier, especially by some locum GPs without their own consultation room. Lack of time was also sometimes mentioned.

Motivation

The most important facilitator for diagnosing patients with obesity, mentioned in all focus groups was that GPs measure and document obesity since it helps themselves in future consultations. For example, when discussing weight at follow-up, assessing cardiovascular disease at follow-up, writing a referral, prescribing medication, it was useful to have an adequate weight in the EHR. Another reason to document obesity was to facilitate easier collaboration with colleagues (beliefs about consequences):

> *'It is good to document weight because it also affects other conditions. I sometimes see patients of a colleague and have to interpret laboratory results. To be able to do this, you need to know if someone is overweight, just as when prescribing. So, it is good to document.' (GP 21)*

> *' … if I document obesity then I can later bring up the subject more easily.' (GP 18)*

Another barrier mentioned by GPs was that documenting obesity was not their priority in daily practice, but as a facilitator they considered it was important to document it in the EHR (goals).

Referring patients with obesity

Capability

For capability, mainly topics belonging to the domain of knowledge were discussed. As a barrier, GPs mentioned a lack of knowledge about referral options, or where the referral options are offered in their municipality, particularly for lifestyle coaches and CLIs. Some GPs also had insufficient knowledge about criteria for certain referral options. Most GPs were able to find a dietician (knowledge).

Opportunity

The first most important barrier mentioned for referring patients with obesity involved the domain environmental context and resources. Specifically, lack of availability of accessible referral options nearby was mentioned as a barrier:

'We do not use the combined lifestyle intervention because there are no healthcare providers who offer this in our city …' (GP 11)

In contrast, having accessible referral options nearby (for example, through personal contact with the healthcare providers or offered treatment on-site) was mentioned as a facilitator by some GPs. Also, healthcare coverage for treatment of obesity was mentioned as a facilitator (environmental context and resources). Lastly, a less frequently mentioned barrier was that GPs failed to refer since obesity has become socially accepted (social influences).

Motivation

The other most important barrier for referring patients with obesity concerned beliefs about consequences. In all focus groups, GPs doubted the impact the referral could have on obesity or weight change. This doubt had several reasons: first, GPs mentioned that they had little confidence in the healthcare providers they could refer to, especially dieticians. They mentioned disappointing results and patient dropouts owing to lack of motivation:

' I have not always been enthusiastic about the dietician in our village (…) although they are not doing too bad, it does not always yield a lot in terms of losing weight.' (GP 6)

'… that dietician from whom I received the third letter from, stating that someone dropped out. At that moment I think I should not do this anymore.' (GP 11)

Second, confidence in the effectiveness of the CLI differed between GPs. Some were convinced of its effects while others mentioned a lack of evidence, long-term results, and lack of willpower of the patient:

'… I am glad I have got the option of a combined lifestyle intervention, as this allows me to refer the patient, but that does not mean I am sure about its effects yet.' (GP 8)

Third, some GPs were hesitant to refer for bariatric surgery, as they had encountered the disadvantages after surgery, and they doubted the long-term effectiveness. Lastly, GPs doubted the impact their referral could have owing to the obesogenic food environment with unhealthy cheap foods being omnipresent (beliefs about consequences). Within this domain (beliefs about consequences) a facilitator was

that GPs found it easier to refer patients with obesity for reasons such as preventing comorbidities, achieving health benefits, or maintaining a stable weight.

GPs were in doubt about their professional role in obesity. They were all sure they should create awareness of obesity and should discuss weight, and the problems associated with it, but uncertain about their exact role in the follow-up. Some GPs were eager to treat patients with obesity themselves, while other GPs felt they would rather refer. Many GPs also acknowledged a role for the community and government; for example, tax on sugar and regulations regarding obesity at school (social or professional role and identity):

> *'… our society is so sickening, when you walk into a supermarket, you first pass the cookies, chocolate, and sweet drinks. It is not something for just the GP to address, it is also a societal task.' (GP 14)*

Finally, a new theme for referring patients with obesity was once again the characteristics of the patient (inductively added). For this target behaviour, this was mainly mentioned as a barrier. In all focus groups, GPs found it difficult to refer their patient if they noticed a lack of motivation during consultation. In addition to this barrier, a low socioeconomic status (for example, patient is unable to afford the treatment or healthy food) was also mentioned as a barrier.

Discussion

Summary

This focus group study explored GPs' barriers and facilitators in discussing weight, diagnosing, and referring patients with obesity related to the TDF. For discussing weight, the main barriers identified were related to environmental context and resources, beliefs about consequences, and emotions. GPs failed to discuss weight when the presenting complaint was unrelated to obesity, when they were concerned about a negative response from the patient, and when they worried about obesity being a sensitive subject. For diagnosing patients with obesity, the most important barrier was related to environmental context and resources; for example, lack of (appropriate) measuring equipment and time. For referring patients with obesity, the main barriers were related to beliefs about consequences, knowledge, and environmental context and resources. GPs doubted about the positive effects of the referral on weight change, had insufficient knowledge of referral options, and had a lack of accessible referral options nearby. In summary, different barriers and facilitators

existed for discussing weight, diagnosing, and referring patients with obesity, which has indicated the necessity to tailor future interventions to each specific behaviour. Moreover, our findings have suggested that limited knowledge and skills are not major barriers to any of the behaviours. Interventions should rather pay particular attention to barriers such as addressing beliefs about consequences and creating a supportive environment with sufficient time and resources.

Strengths and limitations

Strengths of this study included the systematic way in which the problem was approached and defined. First, in line with step two (select the target behaviour) and step three (specify the target behaviour) of the behaviour change wheel (12), three specific target behaviours were specified and addressed in the focus groups. Second, we used the TDF, which is the most widely used, integrated theoretical framework for understanding healthcare professional behaviour, and which allows for identifying a broad range of facilitators and barriers in a structured manner. Results revealed that for the specific target behaviours, the barriers and facilitators were on different domains within the TDF, which implied that different behaviour change techniques will be required to support GPs for the different behaviours. Some limitations should be taken into account. First, focus groups could yield more socially acceptable answers. Second, the participating GPs might have had a special interest in obesity and may have been more motivated to optimise the care for patients with obesity. However, it is to be noted that participants were asked about their special interests in general practice and only two GPs expressed having a special interest in obesity care or lifestyle medicine (Table 1). Lastly, the risk of bias resulting from the use of the vignettes in the focus groups must be mentioned. We aimed to start the broad discussions about each target behaviour with a realistic and representative vignette to enliven their memories of real-life practice situations, but the perspectives of the GPs may have been influenced by the examples we used, which were different for the three behaviours.

Comparison with existing literature

For discussing weight, this study confirmed the difficulty in discussing weight when the presented complaint is unrelated to obesity (18, 21-24). Additionally, in our study many GPs agreed that their knowledge of obesity, its risks, and the skill on how to start a conversation were sufficient, this was in contrast with two previous studies that mentioned the uncertainties on the level of knowledge about obesity being a medical condition (18, 25). Concerning diagnosing patients with obesity, it has been shown that GPs often fail to document obesity in the EHR (26, 27), especially for patients with obesity who are younger and without comorbidities (27, 28). To our knowledge, the reasons behind this underrecording have not been investigated before. Regarding

referring patients with obesity, GPs were in doubt about the effectiveness of the referrals on weight changes. This is underpinned by studies showing only modest weight reduction of dietary interventions (29-31). Also, the long-term effectiveness of the CLI is still uncertain and has not been proven yet (32-36). In addition, GPs admitted their limited knowledge of CLIs, as confirmed by van der Heiden et al (37).

Some challenges were experienced when mapping the data onto the TDF. Therefore, we added a new code in our analysis: characteristics of the patient (for example, age, sex, socioeconomic status). Almost all GPs had examples of a type of patient they felt easier or more difficult to discuss weight with. This is in line with a study showing differences in addressing obesity in patients with specific characteristics in clinical practice (38). They found an association between addressing obesity and the female sex, socioeconomic deprivation, non-White ethnic group, comorbidities, and the heaviest BMI group. These findings and our findings indicated that addressing obesity is a complex problem and requires a patient-centred approach, which involves personalised care for each specific patient characteristic.

Implication for practice

To address these different barriers and facilitators within each target behaviour, it is important to acknowledge the need for tailored intervention management for each specific behaviour.

For discussing weight, establishing strategies for discussing sensitive topics and training in communication techniques might facilitate the GP to discuss weight even when the complaints are unrelated to obesity or when the GP is worried about a negative response from the patient. Also, long-term trustworthy doctor–patient relationships and patient–provider continuity are important to this end. This is a challenge since the number of locum GPs has been increasing over the past years in the Netherlands; this aspect needs specific attention in primary care (39-41).

For diagnosing patients with obesity, it is important to acknowledge the lack of environmental resources and time during consultation. Routinely measuring and weighing patients with obesity and recording the results by the practice nurse before entering the consultation room might be helpful. Also, supplying scales and measuring tapes in each consultation room should be considered.

For referring patients with obesity, awareness of available referral options, easy access to nearby options, and confidence in the expected outcomes are essential. Studies showed that awareness and knowledge among GPs regarding content and

effectiveness of healthcare innovations, such as CLIs, are crucial for developing a positive attitude towards these innovations (37, 42-44). Therefore, providing education and involvement of the GP could contribute to increased referrals to CLIs. A positive development is that healthcare insurances have started to reimburse CLIs in January 2019 in the Netherlands (45). GPs in our study agreed that healthcare coverage for such treatments facilitates referral.

Finally, since GPs mentioned that they felt the problem of addressing obesity goes beyond the scope of the GP's profession, it is of utmost importance that obesity is also addressed by politicians at a societal level (13, 46, 47). In conclusion, based on our results, investment in long-term trustworthy doctor–patient relationships (discussing weight), optimising resources and time management in the consultation room (diagnosing patients with obesity), improving accessible referral options, and addressing beliefs about outcome expectancies (referring patient with obesity) are likely to facilitate addressing obesity in primary care. Future intervention management should be tailored to each different behaviour for change (discussing weight, diagnosing, and referring patients with obesity) rather than addressing obesity in general. Additionally, since most barriers and facilitators concerned beliefs about consequences and environmental context and resources, these should be taken into account when developing future interventions. Adjusting guidelines and improving knowledge among GPs is part of the solution, but by itself insufficient to address obesity in primary care.

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Supplemental table S1 Topic guide with questions based on the Theoretical Domains Framework (TDF) with the example of the target behaviour discussing weight

Knowledge	• Do you know the importance of discussing weight? • Are you familiar with any protocols or guidelines on how and whether you should discuss weight?
Skills	• Are you able to discuss weight?
Memory, attention, and decision process	• Do you remember to discuss weight in the consultation room? • Is there anything that reminds you to discuss weight?
Behavioural regulation	• Are there any guidelines or protocols that help you discuss weight? • Do you have any routines or ways that help you discuss weight? • Is there a system that monitors whether you discuss weight?
Social/professional role and identity	• Do you feel that discussing weight is part of your role as a GP?
Beliefs about capabilities	• How confident are you in your ability to discuss weight? • How confident do you feel about discussing weight? • How comfortable do you feel about discussing weight? • How easy or difficult do you find it to discuss weight?
Optimism	• Do you think it is feasible to discuss weight during consultation? • How likely are you that you will be able to discuss weight more often?
Beliefs about consequences	• What do you think will happen if you discuss? • What do you think are the benefits of discussing weight? • What will happen if you do not discuss weight? • What do you think are the disadvantages of discussing weight? • How likely are you that discussing weight will solve the problem of obesity? • How much impact do you believe that discussing weight can have on the problem of obesity?
Intentions	• Do you intend to discuss weight? • Have you decided not to discuss weight?
Goals	• How important do you think it is to discuss weight in the consultation room? • Is discussing weight a priority during consultations? • Are there any conflicting activities/goals that prevent you from discussing weight?
Reinforcement	• Are you rewarded in any way if you discuss weight?
Emotions	• What emotions have you experienced when discussing weight? • To what extent do the patient's emotions influence your decision to discuss weight? • Are there any emotional reactions from patients that concern you when discussing weight?
Social influences	• How do the opinions of patients or colleagues influence you when discussing weight? • Do you believe many of your colleagues discuss weight in general practice?
Environmental context and resources	• Are there aspects in your work environment that make it easier or more difficult to discuss weight?

Supplemental file S1 Vignettes for each target behaviour

Vignette 1: discussing weight

A 44-year-old patient is visiting your practice. She is visiting you for a headache. She would like to have painkillers for her headache. In the consultation room, you notice that she has obesity. The patient file shows a recently measured BMI of 32 kg/m^2.

Vignette 2: diagnosing patients with obesity

A 38-year-old patient is visiting your practice. She knows that she is obese, and says she wants to lose weight. She has read that her BMI should be below 25 kg/m^2. Currently, her BMI is 32 kg/m^2. She asks you for help and advice.

Vignette 3: referring patients with obesity

A 50-year-old patient is visiting your practice. He wants to have his blood pressure measured and does not take any medication. You measure a blood pressure of 190/100 mmHg and a BMI of 32 kg/m^2. Recent laboratory results show increased cholesterol: LDL: 4.8 mmol/L; HDL: 0.9 mmol/L; Total cholesterol: 5.7 mmol/L; Cholesterol ratio: 6.3 mmol/L. There were no further abnormalities in the laboratory test. You start antihypertensive drugs.

Supplemental table S2 All mentioned barriers and facilitators for discussing weight, diagnosing, and referring patients with obesity structured into the Theoretical Domains Framework (TDF) and Capability Opportunity Motivation Behaviour (COM-B) model

COM-B	TDF	Discussing weight		Diagnosing patients with obesity *(e.g., measuring height, weight, and waist circumference, and documenting the measurements)*		Referring patients with obesity *(e.g., combined lifestyle intervention, dietician, lifestyle coach, general practice nurse, bariatric surgery)*	
		BARRIERS	**FACILITATORS**	**BARRIERS**	**FACILITATORS**	**BARRIERS**	**FACILITATORS**
Capability	*Knowledge*	• Lack of knowledge about the guidelines	• Sufficient knowledge about obesity (for example, obesity is a disease or a risk factor) • Familiar with the guidelines	-	• Sufficient knowledge about obesity (for example, obesity is a disease or a risk factor)	• Lack of knowledge about different referral options (especially the combined lifestyle intervention) • Lack of knowledge where the referral options are offered • Lack of knowledge about criteria for certain referral options	-
	Memory attention and decision processes	-	• A BMI measurement in the EHR	• Failure to think of documenting or measuring • Absence of reminders in the consultation room	-	-	-
	Skills	-	• Know how to discuss weight (for example, by fact-focused communication or by using the correct vocabulary)	• Lack of ability to measure waist circumference	• Ability to enter an ICPC coding • Ability to measure height and weight	• Lack of skills to effectively give lifestyle advice	-
	Behavioural regulation	-	-	-	-	• No monitoring system available for compliance with the referral	-

COM-B	TDF	Discussing weight		Diagnosing patients with obesity *(e.g., measuring height, weight, and waist circumference, and documenting the measurements)*		Referring patients with obesity *(e.g., combined lifestyle intervention, dietician, lifestyle coach, general practice nurse, bariatric surgery)*	
		BARRIERS	**FACILITATORS**	**BARRIERS**	**FACILITATORS**	**BARRIERS**	**FACILITATORS**
Opportunity	*Environmental context and resources*	• Presented complaint unrelated to obesity • Lack of time	• Presented complaint related to obesity	• Lack of time • Lack of (appropriate) measuring equipment in the consultation room	• User-friendly EHR	• No accessible referral options nearby • Lack of time for follow-up and lifestyle advice	• Accessible referral options nearby (for example, personal contact with the healthcare providers) • Healthcare coverage
	Social influences	• Social acceptance of obesity • Poor doctor-patient relationship arises from unfamiliarity with the patient	• Good doctor-patient relationship arises from a relationship of trust, familiarity with the patient, experience, and a good atmosphere during the consultation • No social pressure from colleagues to discuss weight	-	-	• Social acceptance of obesity	-

COM-B	TDF	Discussing weight		Diagnosing patients with obesity *(e.g., measuring height, weight, and waist circumference, and documenting the measurements)*		Referring patients with obesity *(e.g., combined lifestyle intervention, dietician, lifestyle coach, general practice nurse, bariatric surgery)*	
		BARRIERS	**FACILITATORS**	**BARRIERS**	**FACILITATORS**	**BARRIERS**	**FACILITATORS**
Motivation	*Social/ professional role and identity*	• Government and society play a role in obesity care (for example, tax on sugar and regulations at school)	• Willing to play a role in discussing weight	-	• Willing to play a role in diagnosing obesity	• Government and society play a role in obesity care (for example tax on sugar and regulations at school)	• Willing to play a role in lifestyle advice and referring
	Beliefs about capabilities	-	• Confidence in their ability to discuss weight	-	• Easy to document the measurements	-	• Easy to make a referral
	Optimism	-	-	-	-	• Pessimism about the large population of patients with obesity	-
	Beliefs about consequences	• Negative response from the patient • No impact on weight change or obesity in general • Obesogenic food environment	• Positive response from the patient • Impact on obesity in general (for example creating awareness of obesity and lifestyle changes) • Prevention of comorbidities • Achieving health benefits	• No impact on weight change	• Useful for future consultations (for writing a referral letter, for medication prescription, for colleagues, and for discussing weight at follow-up) • No worries about a negative response from the patient	• No impact on weight change • Lack of confidence in the effectiveness of the treatment or healthcare providers • Lack of willpower of the patient to complete the treatment • After a referral, the patient is out of sight (for example absence of feedback from the healthcare provider) • Obesogenic food environment	• Prevention of comorbidities • Achieving health benefits • Maintaining a stable weight
	Intentions	• No intention to discuss weight (especially locums)	• GPs with a special interest in obesity	-	-	-	-

COM-B	TDF	Discussing weight		Diagnosing patients with obesity *(e.g., measuring height, weight, and waist circumference, and documenting the measurements)*		Referring patients with obesity *(e.g., combined lifestyle intervention, dietician, lifestyle coach, general practice nurse, bariatric surgery)*	
		BARRIERS	**FACILITATORS**	**BARRIERS**	**FACILITATORS**	**BARRIERS**	**FACILITATORS**
Motivation	*Goals*	• Discussing weight is low priority	• Obesity and prevention of obesity is an important subject	• Measuring height and weight is low priority	• Important to have a measurement in EHR	• The follow-up of patients with obesity is low priority	-
	Reinforcement	-	• Accomplished lifestyle change or weight loss	-	• Helpful to monitor accomplished weight loss	-	• Accomplished lifestyle change or weight loss
	Emotions	• Vulnerable and sensitive subject • It gets personal (about the appearance or embarrassment of the patient)	-	-	-	-	-
Characteristics of the patient		• Unmotivated patient • Low socio-economic status	• Children • Severely obese • Women	-	-	• Unmotivated patient • Low socio-economic status	-

COM-B: Capability Opportunity Motivation Behaviour model, TDF: Theoretical Domains Framework, ICPC: International Classification of Primary Care, BMI: Body Mass Index, EHR: Electronic Health Record, GP: General Practitioner

Part II

Identification of high-risk patients

Chapter 4

Association of mental health and negative life events with weight change in patients with overweight: A cohort study

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Journal of affective disorders. 2023;334:325-331. Published August 1, 2023.

Abstract

Background

It is unclear to what extent mental health and negative life events (NLEs) contribute to weight change in patients with overweight. This study aimed to evaluate the association of anxiety, depression, NLEs and quality of life (QoL) with weight change over ten years in middle-aged individuals with overweight.

Methods

Population-based cohort study of 2889 middle-aged men and women with a body mass index ≥27 kg/m^2. Relative weight change over ten years was defined as weight loss (≤5%), stable weight (between >5% and <5%) or weight gain (≥ 5%). At baseline, participants reported anxiety symptoms, depressive symptoms, recent (last year) and distant (lifetime) NLEs, and a mental component summary of QoL. With multinomial logistic regression adjusting for potential confounding, we examined the association of mental health and NLEs with weight change after a median (25^{th}, 75^{th} percentiles) follow-up of 9.7 (9.0–10.5) years.

Results

In 51 % participants weight was stable, 33 % participants lost weight and 17 % gained weight. Mild (odds ratio 1.36; 95 % confidence interval 1.05–1.75), and moderate to very severe depressive symptoms (1.43; 0.97–2.12) and four or more distant NLEs (1.35; 1.10–1.67) were associated with weight gain. Anxiety symptoms, the mental component summary of QoL were not associated with either weight gain or weight loss.

Limitations

Due to the observational design residual confounding cannot be excluded.

Conclusion

Our study suggests that depressive symptoms or having experienced distant NLEs are associated with weight gain over time in middle-aged individuals with overweight. These subgroups might benefit from pro-active attention from their health care providers.

Introduction

Obesity has become a worldwide and rapidly growing public health problem. In 2016 worldwide, >1.9 billion adults were overweight. Of these over 650 million were obese (1). In 2022, 50.2 % of the Dutch adult population were overweight or obese (2). Care for patients with obesity should be optimized to control this pandemic more effectively. Weight loss, or maintaining a stable weight, in patients with obesity contributes to achieving health benefits (3). In contrast, weight gain yields an increased risk of the development of co-morbidities and mortality (4-7). To reduce the burden of obesity on society, it is important to know which potentially modifiable factors (e.g., psychological and sociological factors) contribute to weight change in patients with obesity.

Studies have suggested that weight change might partly be attributed to mental health problems as many studies showed associations between, for example, depression and anxiety, and obesity (8-12). It is also known that negative life events (NLEs) (e.g., death of first degree relative, major financial crisis) and deterioration of quality of life (QoL) are associated with obesity (13, 14). It is unclear to what extent these factors play a role in weight change in people who already have overweight or obesity. Studies that examined the association between anxiety, depression, experiencing NLEs and the mental domain of QoL and change in body weight, have shown diverse findings (15-19). For anxiety, one study with a follow-up of 11 years showed an association with weight gain, while another study over 5 years follow-up did not find this association (15, 18). Regarding depression, different longitudinal studies have observed a positive association between depression and weight gain, including Brumpton et al. with a follow-up of 11 years (15), a meta-analysis of 15 studies with varying follow-up durations (16), and Sahle et al. with a follow-up of 5 years (18). Evidence concerning experiencing negative life events and weight gain is limited. Only one longitudinal study with a follow-up of 13 years investigated specifically the association between life events and weight gain, they found a positive association with weight gain (17). Finally, it is unclear if a deterioration in QoL is associated with weight gain. Literature shows different results for the physical, mental and social health domains of QoL and weight change. When focusing on the mental health domain of QoL and weight gain, mainly no association was found over a follow-up of 11 years (19).

Patients with mental health problems constitute a heterogeneous population. In order to identify high-risk patients for weight gain, especially in those with obesity it is important to know to what extent mental health problems are related to weight change in this population.

Therefore, the aim of this study was to investigate the associations of mental health problems (anxiety, depression, mental health domain in quality of life) and negative life events (recent and distant), with weight change over 10-year follow-up in middle-aged individuals with overweight.

Methods

Study design and study population

The Netherlands Epidemiology of Obesity (NEO) study is a population-based cohort study of 6671 individuals. Inclusion criteria for participating the NEO study were men and women aged between 45 and 65 years with a self-reported body mass index (BMI) of 27 kg/m^2 higher, living in the greater area of Leiden (in the West of the Netherlands). In addition, all inhabitants aged between 45 and 65 years from one municipality (Leiderdorp) were invited, irrespective of their BMI.

Participants were invited to a baseline visit between September 2008 and September 2012 at the NEO study center of the Leiden University Medical Center (LUMC) after an overnight fast. Prior to the study visit, participants completed several questionnaires at home to report demographic, lifestyle and clinical information, in addition to questions on mental health and NLEs. Participants came to the research site in the morning to undergo several baseline measurements including anthropometric measurements and blood sampling. The study design and population have been described in detail elsewhere (20). The Medical Ethical Committee of the LUMC approved the design of the study. All participants gave their written informed consent.

During the COVID-19 outbreak a questionnaire was sent in June and July 2020 to 6356 participants of the baseline participants to report COVID-19 related symptoms. In this 2020-questionnaire, demographic, lifestyle and clinical information including body weight were reported. Due to unavailability of an email/home address in the Netherlands, death, or no permission for follow-up research, the questionnaire was not sent to the other 315 of the total 6671 participants. The response rate of the 2020-questionnaire was 62 % (n = 3942).

Data collection

Assessment of mental health and negative life events at baseline

Mental health and NLEs were assessed by self-reported questionnaires at baseline. For analysis purposes and better interpretation side-by-side we dichotomized each questionnaire, except for depression which was divided into three categories.

Anxiety symptoms

The Beck Anxiety Inventory (BAI) questionnaire measures clinical anxiety (range 0–63) (21). A score of 0–21 represents low anxiety (reference category), a score of 22–35 represents moderate anxiety and a score of ≥36 represents potentially concerning levels of anxiety. For analysis purposes and due to the relatively small sample size in the moderate and high subcategories, we merged them into "moderate to high". Cronbach's alpha in the present study was 0.88.

Depressive symptoms

The Inventory of Depressive Symptomatology – Self Rated (IDS-SR30) is a 30-item self-reported questionnaire, that represents the severity of depressive complaints and symptoms (range 0–84) over a period of the past seven days. Scores are rated as follows: 0–13 "no depressive mood" (reference category), 14–25 "mild depressive mood", 26–38 "moderate depressive mood", 39–48 "severe depressive mood" and 49–84 "very severe depressive mood" (22). For analysis purposes and due to the relatively small sample size in moderate, severe and very severe sub-categories, were merged into "moderate to very severe depressive mood" (scores 39–84). Cronbach's alpha in the present study was 0.84.

Negative life events

The list of threatening experiences questionnaire is an instrument to score negative life events developed by Brugha (23-25). This questionnaire consists of 12 categories of common life events with considerable long-term contextual threat. The list of threatening experiences questionnaire has shown good test-retest reliability and high interrater agreement (24). Every question addresses a particular life-threatening event and when answered positively, results in one point. The total score ranges from 0 to 12. A score of 0 means no life event has been reported. We calculated the score for recent NLEs defined as any event experienced in the last year before baseline and distant NLEs defined as any event experienced more than one year ago before baseline. Both time frames can have a score from 0 to 12. We categorized the recent and distant NLEs in two groups based on the median of each variable (the median for recent NLEs was zero events, the median for distant NLEs was three events). Concerning recent NLEs, a score of 0 represents "no recent NLEs" (reference category) and a score of 1–12 represents "one or more recent NLEs". For distant NLEs, a score of 0–3 represents "fewer than four NLEs" (reference category) and a score of 4–12 represents "four or more distant NLEs".

Quality of life

The Short Form Health Survey (SF-36) measures the QoL (Dutch translation) (26, 27). The questionnaire contains 36 items on the domains: physical, mental and social health: divided over 8 subcategories: vitality, physical functioning, bodily pain, general health perceptions, physical role functioning, emotional role functioning, social role functioning and mental health. In addition to this score, a sub score can be calculated for every subcategory, but also a physical component summary and a mental component summary can be calculated (27). In this study we will focus on the mental component summary, as this study focuses on mental health. This score ranges between 0 and 100. A higher score represents a better mental health experience. The score is categorized in two groups with cut off value of 50: a "low mental component summary" (reference category) ranges from 0 to 50.0 and a "high mental component summary" ranges from 50.01 to 100. Cronbach's alpha in the present study for the mental component summary (14 items from the SF-36 included) was 0.90.

Assessment of weight change during follow-up

Body weight at baseline was measured by the Tanita impedance balance (TBF-310, Tanita International Division, UK) without shoes and 1 kg was subtracted to correct for weight of clothing. Body weight was self-reported in the 2020-questionnaire. Relative weight change (%) was calculated by subtracting measured baseline weight from the self-reported weight in the 2020-questionnaire divided by measured baseline weight and multiplied by 100.

Covariates at baseline

At baseline, participants reported their date of birth, ethnicity, educational level (as a proxy for the socioeconomic status), tobacco smoking status and alcohol consumption. Also, participants reported the frequency and duration of their usual physical activity during leisure time in the short questionnaire to assess health-enhancing physical activity (SQUASH), which was expressed in hours per week of metabolic equivalents (28, 29). Energy intake (kJ/day) and alcohol consumption (g/day) were estimated by a food frequency questionnaire (30). The presence of cardiovascular disease was based on self-reported pre-existing cardiovascular disease such as myocardial infarction, angina, congestive heart failure, stroke, or peripheral vascular disease. The presence of diabetes mellitus type I or diabetes mellitus type II was based on the use of anti-diabetic drugs or self-report. For the use of medication (including psychotropic drugs: N05A (antipsychotics), N05B (anxiolytics), N05CD (benzodiazepine derivates), N05CF (benzodiazepine related drugs), N06A (antidepressant use including use of tricyclic antidepressants and selective serotonin reuptake inhibitors)), participants were asked to bring all medications that they have been using for the last month to the NEO study

center. Research nurses recorded prescribed, and self-medication based on Anatomical Therapeutic Chemical Classification System (ATC). Finally, anthropometric measurements were assessed at baseline. Body height was measured with a vertically fixed, calibrated tape measure. Total body fat was estimated by Tanita bioelectrical impedance balance (TBF-310, Tanita International Division, UK). BMI was calculated by dividing the weight by the height squared (kg/m^2). Waist circumference was measured with a measuring tape placed midway horizontally between the lower costal margin and the iliac crest.

Statistical analysis

Baseline characteristics of the study population were summarized as mean (SD), median (25th, 75th percentiles) or as percentage (Table 1). First, we categorized relative weight change during 10 years into 3 categories: weight loss (≤- 5 %), stable weight (between >- 5 % and <5 %) based on the influence of normal fluctuations on body weight and weight gain (≥5 %) (31). We performed multinominal logistic regression to examine the associations of anxiety symptoms, depressive symptoms, NLEs and mental component summary of QoL with weight change over 10 years of follow-up. The first model was adjusted for age and sex (model 1); the second model for age, sex, use of psychotropic drugs, BMI at baseline, educational level, ethnicity, tobacco smoking status, alcohol consumption, physical activity, energy intake and pre-existing diabetes and cardiovascular disease (model 2). Lastly, we repeated all analyses stratified by sex. All statistical analyses were performed with SPSS statistical software (version 25, IB Corporation, Armonk, NY).

Results

Characteristics of the study population

For the present analysis we included the subset of participants who completed the 2020-questionnaire (n = 3942) and of those we excluded participants who had a BMI <27 kg/m^2 at baseline (n = 1020). Data on self-reported weight in 2020 were missing in 33 participants, resulting in a total study population for the present study of n = 2889 (Figure 1). Median (25th, 75th percentiles) time from baseline to follow-up was 9.7 (9.0–10.5) years. Responders to the 2020-questionnaire included in our analysis (n = 2889) used fewer psychotropic drugs (9.6 % vs. 14.7 %), had fewer depressive symptoms (no depressive symptoms 72.3 % vs. 63.8 %) and had fewer anxiety symptoms (low anxiety 97.7 % vs. 95.8 %) than non-responders to the 2020-questionnaire (n = 2729) (Supplemental table 1). Baseline characteristics of the 2889 participants are shown in Table 1. More participants lost weight (32.5 %) than gained weight (16.8 %). Half of the participants (50.7 %) had a stable weight (Figure 2). Weight gain was more often seen in women (20.5 %) than in men (13.5 %).

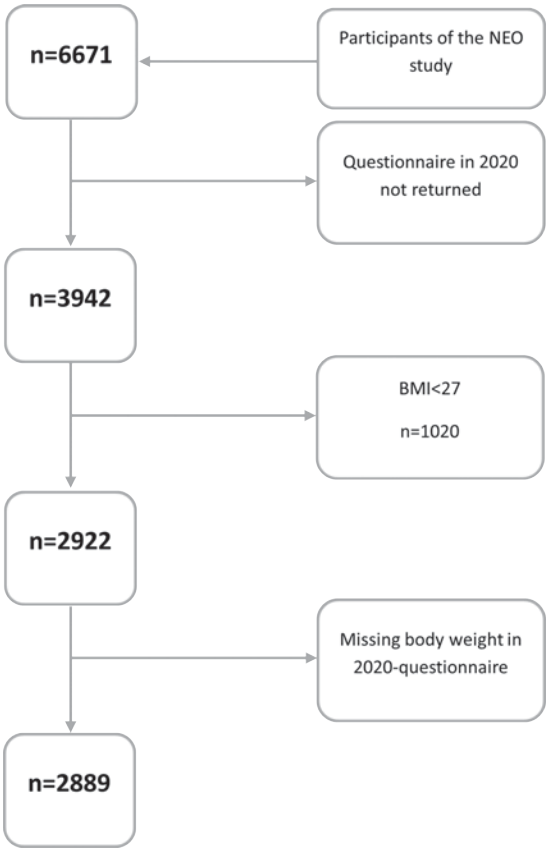

Figure 1 Flowchart of participants with exclusion criteria

Table 2 Baseline characteristics

Characteristics	Total population	Men (53.0%)	Women (47.0%)
Participants, n	2889	1530	1359
Age (years)	56.0 (5.9)	56.3 (6.0)	55.7 (5.8)
Baseline BMI (kg/m^2)	30.3 (28.6-32.9)	29.9 (28.4-32.1)	30.9 (28.9-33.7)
Baseline waist circumference (cm)	105.5 (10.2)	108.6 (9.0)	102.0 (10.3)
Total body fat (%)	37.8 (29.3-44.0)	29.6 (26.8-32.9)	44.1 (41.7-46.7)
Tobacco smoking (%)			
Never	33.2	30.0	36.8
Former	52.9	52.6	53.3
Current	13.9	17.5	9.9
Alcohol consumption (g/day)	10.4 (2.1-22.8)	16.8 (5.2-30.4)	4.9 (1.0-15.0)
Educational level (% high)	40.5	43.8	36.6
Ethnicity (% Caucasian)	96.7	97.1	96.2
Physical activity (metabolic equivalent of task hours per week)	27.0 (14.0-47.0)	28.0 (13.9-49.5)	26.0 (14.0-45.0)
Energy intake (kJ/day)	9680 (3276)	10581 (3361)	8665 (2857)
Use of psychotropic drugs (%)	9.6	6.6	12.9
Co-morbidity			
Diabetes (%)	7.0	7.8	6.0
Cardiovascular disease (%)	6.9	9.2	4.4
Median BAI score range 0-63	3 (1 – 7)	2 (0 – 5)	4 (2 – 9)
Low (%)	97.9	98.2	97.4
Moderate and high (%)	2.1	1.8	2.6
Median IDS-SR 30 range 0-84	8 (5 – 14)	7 (4 – 12)	11 (7 – 17)
None (%)	72.3	81.0	62.6
Mild (%)	20.9	13.5	29.1
Moderate to very severe (%)	6.8	5.4	8.3
Median score recent NLEs range 0-12	0 (0 – 1)	0 (0 – 1)	0 (0 – 1)
<1 recent NLE (%)	54.1	56.6	51.3
≥1 recent NLEs (%)	45.9	43.4	48.7
Median score distant NLEs range 0-12	3 (2 – 5)	3 (2 – 4)	4 (2 – 5)
<4 distant NLEs (%)	53.1	58.2	47.4
≥4 distant NLEs (%)	46.9	41.8	52.6
Median MCS of the SF-36 range 0-100	54.2 (49.1 – 57.3)	54.8 (50.5 – 57.6)	53.7 (46.7 – 57.0)
Low (%)	28.0	23.3	33.3
High (%)	72.0	76.7	66.7

Normally distributed data shown as mean and standard deviation (SD), skewed distributed data shown as median (25th, 75th percentiles) and categorical data are shown as percentage BMI: body mass index, BAI: Beck Anxiety Inventory, IDS-SR30: Inventory of Depressive Symptomatology, NLEs: Negative Life Events, MCS: Mental Component Summary, SF-36: Short Form Health Survey-36

Missing values: total body fat n=13, educational level n=19, ethnicity n=2, physical activity n=40, tobacco smoking n=1, diabetes n=28, cardiovascular disease n=9, BAI n=3, IDS-SR n=3, recent NLEs n=6, distant NLEs n=6, MCS n=24

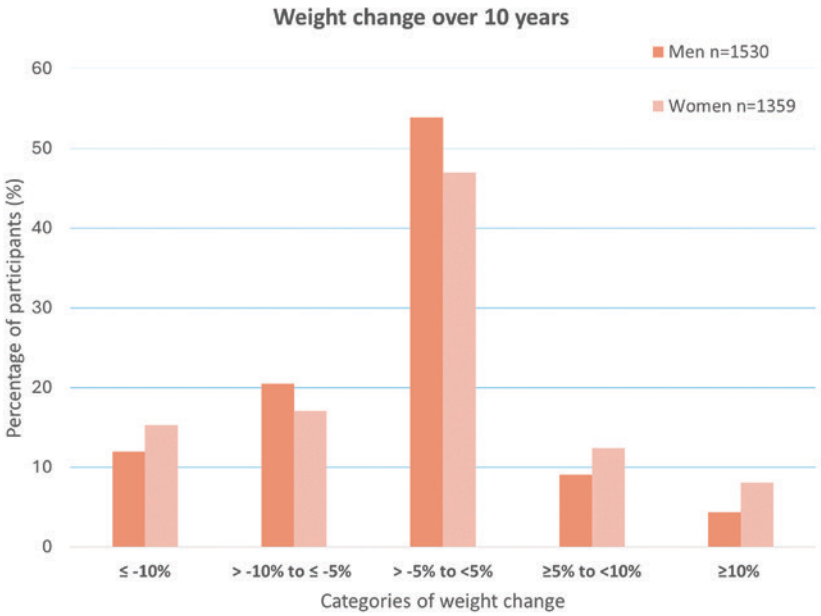

Figure 2 Distribution of weight change over 10 years in 1530 men and 1359 women of middle age with overweight

Mental health, negative life events and weight change at middle age

Regarding anxiety symptoms, there was no association between a moderate or high score on the BAI and weight loss and weight gain (Figure 3). For the depressive symptoms, a mild or moderate to very severe score on the IDS-SR30 was associated with weight gain over 10 years at middle age. After adjustment for potential confounding including the use of psychotropic drugs and BMI at baseline (model 2), participants with a mild score (odds ratio (OR) 1.34; 95 % confidence interval (CI) = 1.03–1.74) showed an increased risk of weight gain compared with participants with a low IDS-SR30. Participants with a moderate to very severe score (OR 1.36; 95 % CI = 0.89–2.07) also showed an increased risk of weight gain compared with participants with a low IDS-SR30, though this association was not significant. Regarding NLEs, participants who had experienced four or more distant NLEs had a higher risk of weight gain than participants who experienced fewer than four distant NLEs (OR 1.33; 95 % CI = 1.07–1.66), after adjustment for potential confounding (model 2). Furthermore, having experienced four or more distant NLEs was also associated with weight loss compared with experiencing fewer than four distant NLEs (OR 1.24; 95 % CI = 1.05–1.46), which association attenuated after adjustment for potential confounders (OR 1.13; 95 % CI = 0.95–1.35). Having experienced recent NLEs was not associated with either weight loss or weight gain over time. Regarding QoL, there was no association between a high score of the mental component summary of QoL and both weight loss and weight gain.

In the sex-stratified analysis of the association between mental health and NLEs with weight loss and weight gain, direction and strength of the effect sizes were similar for men and women, except for the association of anxiety: compared with a low score on the BAI the OR of weight gain was 1.73 (95 CI% = 0.60–4.97) for men with a moderate or high score on the BAI, and 0.77 (95 CI% = 0.29–2.04) for women (model 2, Supplemental figure 1).

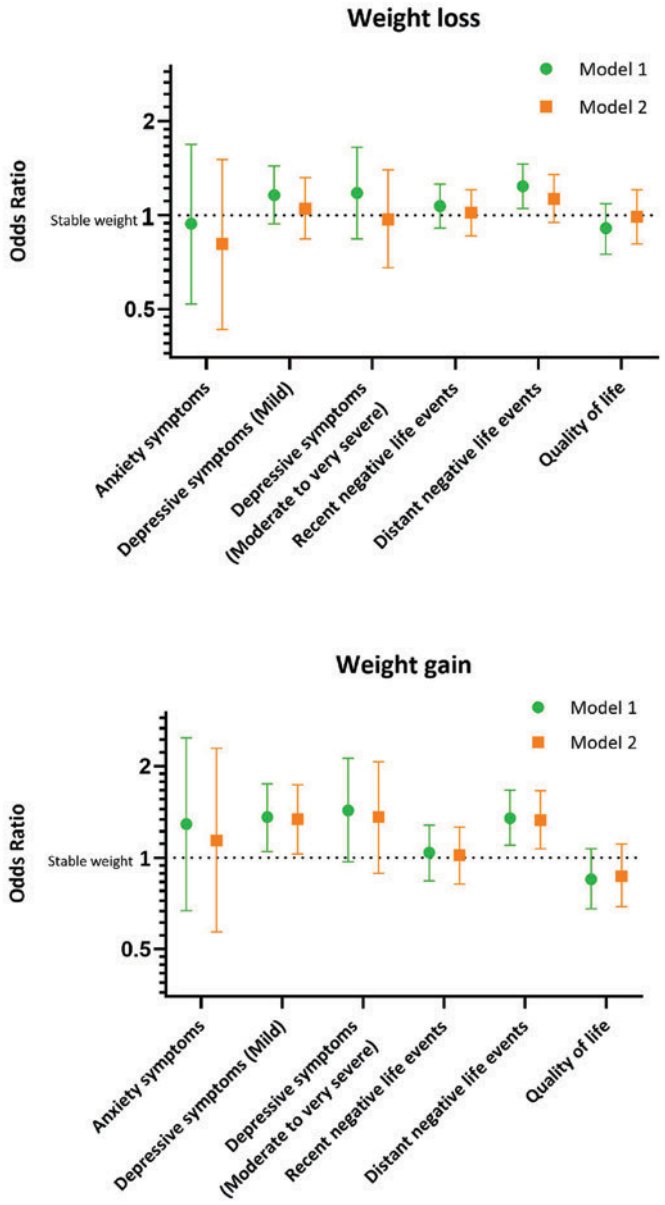

Figure 3 Results of multinomial logistic regression analysis of the association between mental health, negative life events and weight change after 10 years (n=2889)
The categories "low anxiety", "no depressive mood", "no recent negative life events", "fewer than four distant negative life events", and "low mental component summary" of quality of life were set as the reference categories
Model 1 adjusted for age and sex
Model 2 adjusted for age, sex, the use of psychotropic drugs, BMI at baseline, educational level, tobacco smoking, alcohol consumption, physical activity, energy intake, ethnicity, diabetes and cardiovascular disease

Discussion

In this population-based cohort study of 2889 middle-aged overweight individuals with ten years follow-up, about half of the participants maintained a stable weight, almost a third of the participants lost weight, and less than a quarter gained weight. Depressive symptoms at baseline were associated with weight gain. In addition, the association between distant NLEs and weight change was U-shaped, with both an increased risk of weight gain and weight loss. Anxiety symptoms, recent NLEs, and the mental component summary of QoL were not associated with weight changes.

Results from previous studies on anxiety symptoms and weight gain are inconsistent. Several studies with varying follow-up durations of 11, 19 and 40 years have shown, in contrast to our results, a positive association between anxiety and weight gain (15, 32, 33). However, other studies with a shorter follow-up duration of 2 respectively 5 years showed no association (18, 34). This inconsistency can be explained by the heterogeneity among these studies such as variation in duration of follow-up, participants characteristics (e.g. age), affective disorders in broad sense (depression and anxiety were merged), and the severity of anxiety symptoms. Patients with anxiety symptoms are also heterogenous population according to severity, subtype, age of onset, and chronicity. Mechanisms of anxiety pathways and weight change might differ between patients. The results of the present study can also possibly be explained by the small sample size, since only 2 % of the participants experienced anxiety symptoms.

Concerning depressive symptoms, in line with our results, other longitudinal studies with varying follow-up durations have also observed a positive association between depression and weight gain over time (15, 16, 18, 34, 35). Alterations in systems involved in homeostatic adjustments (hypothalamic-pituitary-axis activation, immune-inflammatory activation, neuroendocrine regulators of energy metabolism including leptin and insulin and microbiome) which are directly associated with adiposity levels in the body might explain this association (36). Behavioural mechanisms (low motivation, low energy level, physical inactivity and overconsumption of energy-dense food) have also been suggested (37). Especially vegetative depressive symptoms (such as pain, change in appetite and weight, gastrointestinal symptoms and arousal related symptoms), and not mood and cognitive symptoms of depression, lead to a higher BMI (8, 9).

NLEs have been shown to be associated with obesity over a follow-up time of 13 years (17). This might be explained by the fact that experiencing NLEs increases stress levels (38). Stress might cause weight gain due to metabolic (hypothalamic pituitary-axis activation) and behavioural changes (eating behaviour) (14, 38). The most remarkable finding in our study is the association between distant NLEs with both weight gain

and weight loss. This might be due to the fact that distant NLEs are heterogeneous and experienced in different ways, giving rise to different reactions and stress levels, which may then in turn be associated with either weight gain or weight loss.

Regarding QoL, in line with our study, one study also observed that the mental domain of QoL was not associated with weight change over a 11-year period (19). In contrast, another study with a follow-up duration of 5 years, that did not account for a wide range of lifestyle factors as confounders, did show a relationship between the mental domain of QoL and weight gain (39). Since our study and Sahle et al. (19) are both longitudinal studies with a longer period of follow-up, a clear association of the mental domain of QoL with weight change seems unlikely.

Some methodological issues should be considered. The most important strengths of the present study include the large sample size, the prospective study design, the long follow-up period and the avail- ability of the different aspects of mental health. However, this study also has some limitations. First, we calculated weight change using self-reported weight in the 2020-questionnaire. Previous studies have shown that self-reported weight often is lower than objectively measured body weight (40), which may have led to an underestimation of weight gain and an overestimation of weight loss. This would have resulted in an underestimation of the associations with weight gain, and an overestimation of relations with weight loss. Second, although we adjusted for a large number of confounding factors in the models, due to the observational nature of the study residual confounding may still be present. Third, the non-responders to the follow-up questionnaire slightly differed from our study population. Non-responders more often used psychotropic drugs, and more often reported anxiety and depressive symptoms when entering the study. If these non-responders would have had different weight change patterns this may have influenced our results. Lastly, it must be noted that the majority of this population-based study is white, and that in this study we selected middle-aged participants with overweight. Therefore, our findings apply to a middle-aged white population with overweight and should be confirmed in other groups.

In conclusion, depressive symptoms and distant NLEs were associated with weight gain over time in middle-aged men and women with overweight. Since most mental health professionals and primary care physicians will learn about this kind of symptoms and events from their patients, it might be worthwhile to pay proactive attention to this subgroup of patients. In many countries, somatic and psychological health care is still separated. Optimized cooperation between psychosocial and somatic health care providers might be beneficial for patients with overweight and mental health problems.

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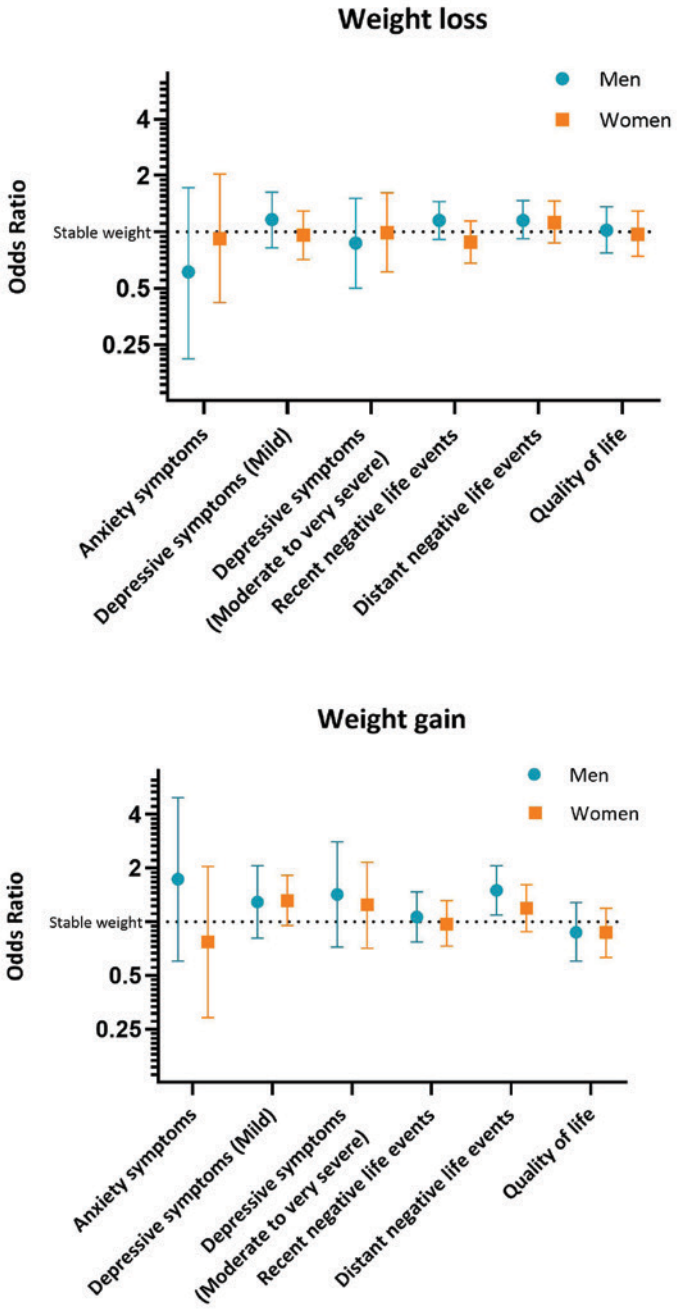
Supplemental table 1 Baseline characteristics of non-responders of the 2020-questionnaire and the study population

Characteristics	Non-responders	Study population
Participants, n	2729	2889
Men (%)	43.4	53.0
Age (years)	55.6 (6.1)	56.0 (5.9)
Baseline BMI (kg/m^2)	30.2 (28.0 – 33.4)	30.3 (28.6-32.9)
Baseline waist circumference (cm, M/W)	107.7 (11.7)/100.6 (13.5)	108.6 (9.0)/102.0 (10.3)
Total body fat (%, M/W)	29.1 (25.8 – 33.2) /43.5 (40.2 – 46.9)	29.6 (26.8-32.9) /44.1 (41.7-46.7)
Tobacco smoking (%)		
Never	33.8	33.2
Former	46.5	52.9
Current	19.7	13.9
Alcohol consumption (g/day)	7.9 (1.0 – 20.9)	10.4 (2.1-22.8)
Educational level (% high)	28.8	40.5
Ethnicity (% Caucasian)	92.5	96.7
Physical activity (metabolic equivalent of task hours per week)	25.8 (11.7 – 45.5)	27.0 (14.0-47.0)
Energy intake (kJ/day)	9394 (3362)	9680 (3276)
Use of psychotropic drugs (%)	14.7	9.6
Co-morbidity		
Diabetes (%)	9.1	7.0
Cardiovascular disease (%)	8.0	6.9
Median BAI score range 0-63	4 (1 – 9)	3 (1 – 7)
Low (%)	95.8	97.9
Moderate and high (%)	4.2	2.1
Median IDS-SR 30 range 0-84	10 (6 – 17)	8 (5 – 14)
None (%)	63.8	72.3
Mild (%)	25.3	20.9
Moderate to very severe (%)	11.0	6.8
Median score recent NLEs range 0-12	0 (0 – 1)	0 (0 – 1)
<1 recent NLE (%)	54.4	54.1
≥1 recent NLEs (%)	45.6	45.9
Median score distant NLEs range 0-12	3 (2 – 5)	3 (2 – 5)
<4 distant NLEs (%)	54.8	53.1
≥4 distant NLEs (%)	45.2	46.9
Median MCS from the SF-36 range 0-100	52.7 (45.6 – 56.7)	54.2 (49.1 – 57.3)
Low (%)	38.3	28.0
High (%)	61.7	72.0

Normally distributed data shown as mean and standard deviation (SD), skewed distributed data shown as median (25th, 75th percentiles) and categorical data are shown as percentage BMI: body mass index, M: men, W: women, BAI: Beck Anxiety Inventory, IDS-SR30: Inventory of Depressive Symptomatology, NLEs: Negative Life Events, MCS: Mental Component Summary, SF-36: Short Form Health Survey-36

Missing values non-responders: baseline waist circumference n=6, total body fat n=14, tobacco smoking n=7, alcohol consumption n=4, educational level n=44, ethnicity n=11, physical activity n=57, energy intake n=4, diabetes n=31, cardiovascular disease n=16, BAI n=17, IDS-SR30 n=13, recent NLEs n=17, distant NLEs n=17, MCS n=66

Missing values study population: total body fat n=13, educational level n=19, ethnicity n=2, physical activity n=40, tobacco smoking n=1, diabetes n=28, cardiovascular disease n=9, BAI n=3, IDS-SR n=3, recent NLEs n=6, distant NLEs n=6, MCS n=24



Supplemental figure 1 Results of multinomial logistic regression analysis of the association between mental health, negative life events and weight change after 10 years (n=2889) stratified by sex
Adjusted for age, the use of psychotropic drugs, BMI at baseline, educational level, tobacco smoking, alcohol consumption, physical activity, energy intake, ethnicity, diabetes and cardiovascular disease

Chapter 5

The value of measuring waist circumference in primary care: a mixed-methods study

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Submitted

Abstract

Background

It remains a challenge for GPs to identify and treat all patients at increased risk of cardiovascular disease (CVD), because cardiovascular risk assessment in all patients is not feasible.

Aim

To investigate the value of measuring waist circumference in primary care by investigating: current recording practices of GPs; barriers and facilitators; its contribution to the identification of patients at increased risk of CVD.

Design and setting

A mixed-methods study in Dutch primary care

Methods

We investigated three datasets**:** routine data from general practices (n=676,708 health records of adults); qualitative data from 6 focus groups (n=21 GPs); data from the Netherlands Epidemiology of Obesity (NEO) study (n=6,671 middle-aged individuals).

Results

Between 2012 and 2023, incidence rates of recorded waist circumference by GPs decreased from 47 to 3 per 1000 person-years. Barriers of GPs to measure waist circumference included discomfort, inability to measure it accurately, lack of measuring tape, and perceived uselessness. Facilitators included knowledge that increased waist circumference is a cardiovascular risk factor. In the NEO study population, after excluding patients already treated for the prevention of CVD (n=2407), 1731 patients were at increased risk of CVD (n=1113 intermediate risk, n=618 high risk). Measuring waist circumference would identify 89% of those at intermediate and 93% of those at high predicted cardiovascular risk.

Conclusion

Measuring waist circumference may be a valuable tool to identify patients at increased risk of CVD in primary care. Since GPs currently rarely measure waist circumference, inclusion in guidelines and addressing identified barriers and facilitators is warranted.

Introduction

In the current Dutch guideline for cardiovascular risk management in primary care (1), which is based on European guidelines (2), obesity (defined by Body Mass Index (BMI)≥30 kg/m^2), but not increased waist circumference is included in the criteria for the selection of patients eligible for a cardiovascular risk assessment (1). Only in individuals who are eligible for cardiovascular risk assessment, a predicted cardiovascular risk is calculated using the Systematic Coronary Risk Evaluation-2 (SCORE2) to estimate the 10-year fatal and non-fatal cardiovascular risk, and treatment options are considered (1, 3). However, BMI alone is an insufficient marker of abdominal adiposity and offers insufficient information to identify and manage all patients at increased risk of obesity-related health problems (4, 5).

Whereas it is previously shown that adding waist circumference to current risk scores does not improve the prediction of cardiovascular disease (CVD) in the total population, it clearly improves risk stratification of individuals without obesity, showing increased risks in those with a BMI below 30 kg/m^2, but with increased waist circumference (6, 7). Therefore, measuring waist circumference alone, but also addition of waist circumference in the criteria for the selection of patients eligible for cardiovascular risk assessment, may help to identify patients at increased cardiovascular risk, and subsequent CVD prevention.

Body height and weight are frequently measured, and BMI (height/(weight*weight)) is recorded in electronic health records in some countries, while in others it is not (8-12). In contrast, waist circumference is rarely assessed in primary care (13-16). To address this issue, it is crucial to understand the barriers and facilitators of healthcare providers concerning measuring waist circumference, as this could enhance patient care and health outcomes (5). Few studies have explored these barriers and facilitators. Identified barriers in these studies include lack of time and feeling discomfort by the physician (13, 17).

The aim of this study was therefore to investigate the potential value of measuring waist circumference in primary care, focusing on first, current recording practices of general practitioners (GPs) regarding waist circumference measurements, secondly current barriers and facilitators of GPs for measuring waist circumference, and thirdly the contribution of measuring waist circumference in the identification of patients at increased risk of CVD.

Methods

A mixed-method approach was used based on data from three different datasets (Figure 1).

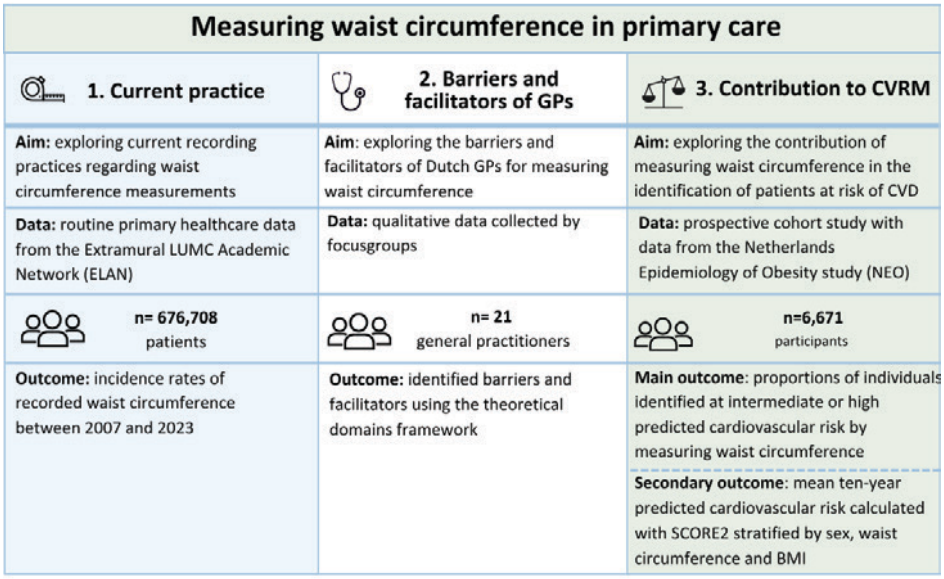


Figure 1 An illustration of the study methods using a mixed-method approach with three different datasets
GP: general practitioner, CVRM: cardiovascular risk management, CVD: cardiovascular disease, SCORE2: Systematic Coronary Risk Evaluation 2, BMI: body mass index

Current recording practices

Study design and study population

For our first aim, we used routine collected healthcare analyses from 676,708 individuals of 152 general practices from the Extramural LUMC Academic Network (ELAN). ELAN is a regional integrative population-based data infrastructure in which medical, social and public health data are linked at the patient level from the greater The Hague and Leiden area (18, 19). The study population used for our first aim, was also included in a previous study by van den Hout et al. (12) (Chapter 2 of this thesis). However, measuring waist circumference had not been investigated and reported previously. Individuals were included in the analyses when they were registered between 1 January 2007 and 30 June 2023 at a general practice participating in the ELAN database and over 18 years. The study design and exclusion criteria are described elsewhere (12, 19).

Data collection

For waist circumference as outcome, we used the values coded within the structured electronic health records as a laboratory result.

Age, year of birth and sex were derived at cohort entry. For BMI, we used height, weight and BMI coded within the structured electronic health records as a laboratory result. BMIs were derived from an already available BMI (automatically calculated by the GPs information system), or BMI was calculated using a recorded height and weight on the same date or a recorded weight and a previously recorded height. BMI was calculated by dividing weight in kilograms by the square of height in metres. BMI measurements between 17 and 50 kg/m^2 were included in our analysis. We assessed the data for extreme values and inconsistencies, removing less than 2% of records due to inadequate or extreme values for height, weight, and BMI.

Statistical analysis

Baseline characteristics were expressed as median (25^{th}, 75^{th} percentiles) or as percentage. Follow-up time in person-years was calculated from cohort entry (at least 18 years and registered in a general practice from 1^{st} of January 2007) until deregistration with a participating general practice, death, or end of the study period (30^{th} of June 2023).

We estimated the incidence rates of a recorded waist circumference within each calendar year (from 2007 to 2023) per 1000 person-years. If multiple recorded waist circumferences for an individual were recorded within one year, only the first recorded waist circumference within that year was included. Individuals were censored after their first recorded waist circumference for that calendar year but were included again in subsequent years. Furthermore, in the electronic health records of the n=676,708 individuals, all BMI recordings between 17 and 50 kg/m^2 were selected. For each of these BMI values, we assessed the frequency of waist circumference measurements taken on the same day. This aimed to determine the frequency of waist circumference recordings for each recorded BMI value within 17-50 kg/m^2, to identify at which BMI values, waist circumference is most frequently recorded.

Barriers and facilitators of GPs

Study design and study population

For our second aim, we conducted a qualitative focus group study with 21 Dutch GPs to explore the barriers and facilitators to diagnosing obesity in primary care, including the use of a waist circumference measurement.

Data collection

The qualitative data used for the second aim were derived from van den Hout et al. (20) (Chapter 3 of this thesis). In this previous study, barriers and facilitators to diagnosing obesity were explored. At the start of the focus group sessions, we explained that diagnosing obesity referred to measuring height and weight (for BMI calculation), and preferably also waist circumference, and recording these values in the electronic health records. Participants were reminded of this throughout the discussions. Although waist circumference was not addressed through a dedicated question, participants frequently raised it when discussing the barriers and facilitators to diagnosing obesity. In the present study, we conducted a more in-depth analysis focusing specifically on the barriers and facilitators mentioned by GPs regarding measuring waist circumference. This analysis is presented in greater detail here.

We used purposive sampling to recruit a heterogenous sample of GPs in terms of age, sex, working experience, GP practice setting, and patient populations. Focus groups were organized with three to five GPs, and new groups were added until data saturation was reached (that is, until no new themes were brought forward). Details of the data collection process are described elsewhere (20).

Analysis

Details of the analysis process are described elsewhere (20). In short, the transcripts were analysed using a thematic analysis approach using Atlas ti (version 22). All fourteen theoretical domains of the refined theoretical domains framework (TDF) were used for deductive coding. The TDF is a framework specifically designed to understand determinants of healthcare professional behaviour (21-23). Each domain of the TDF relates to a component in the overarching "Capability, Opportunity, Motivation and Behaviour" (COM-B) model. This model identifies three key factors that need to be present for any behaviour to occur: capability, opportunity, and motivation. Barriers and facilitators using the TDF, and the overarching COM-B model were identified for measuring and recording waist circumference.

Contribution of measuring waist circumference to cardiovascular risk management

Study design and study population

For our third aim, data from the Netherlands Epidemiology of Obesity (NEO) study, a population-based cohort study of 6671 individuals were used. Inclusion criteria for participating in the NEO study were men and women aged between 45 and 65 years with a self-reported BMI of 27 kg/m^2 or higher, living in the greater area of Leiden (in the West of the Netherlands). In addition, all inhabitants aged between 45 and 65 years

from one municipality (Leiderdorp) were invited, irrespective of their BMI. Participants were invited to a baseline visit between September 2008 and September 2012 at the NEO study center of the Leiden University Medical Center (LUMC). At baseline, participants completed several questionnaires to report demographic and clinical information and underwent anthropometric measurements and blood sampling. Participants were followed for the occurrence of CVD through GP records. The study design and population have been described in detail elsewhere (24).

Definitions of the populations

For the present analysis, we first excluded individuals who were already treated by their GP to prevent CVD: those using lipid-lowering or antihypertensive treatment (n=2407). Then, we excluded those with missing data for the SCORE2 (n=32). In the remaining population we calculated the predicted cardiovascular risk using SCORE2, to identify those at intermediate or high risk of CVD. In this study we refer to this population as the risk assessment population (n=4232) (Figure 5).

From this risk assessment population, we selected two populations by two different approaches: (1) based on guideline-defined risk factors (i.e. individuals with pre-existing CVD, diabetes mellitus, rheumatoid arthritis, chronic obstructive pulmonary disease, obesity, chronic kidney disease, a suspected hereditary dyslipidemia, elevated blood pressure, elevated cholesterol concentrations, an active smoking status and a burdened family history of premature CVD); and (2) based on an increased waist circumference (men >94cm, women >80cm). The definitions of each risk factor are explained in Supplemental file 1.

Data collection

Outcomes

Main outcome was predicted 10-year fatal and non-fatal cardiovascular risk and categorized into low, intermediate and high risk. Individuals were categorized into these risk categories either based on an priori high-risk factor or a calculated predicted risk score with SCORE2 (3). Individuals classified as high risk a priori were those with pre-existing CVD, diabetes mellitus, chronic kidney disease, severely increased systolic blood pressure, or diagnosed hereditary dyslipidemia, regardless of their SCORE2 result (1). For others, the predicted cardiovascular risk score was calculated with SCORE2. For individuals with rheumatoid arthritis, risk scores were multiplied by 1.5. The calculated predicted cardiovascular risks were categorized into low, intermediate, and high based on age and predicted cardiovascular risks, in accordance with the Dutch guideline for cardiovascular risk management (Supplemental file 2) (1).

Secondary outcomes were incidence rates of incident CVD events. The GP records were searched for information on incident myocardial infarction, stroke (ischemic and non-ischemic) and transient ischemic attacks coded according to the International Classification of Primary Care (Supplemental file 3). Time of follow-up was defined as the number of days between the baseline visit and the date of a first CVD event, or censoring due to death, loss to follow-up, or the end of follow-up (extraction date at the GP), whichever came first.

Covariates

The variables used in the SCORE2 were collected at baseline: age, sex, systolic blood pressure, total cholesterol/high-density lipoprotein (HDL) cholesterol ratio and smoking status. BMI was calculated by dividing the weight by the height squared (kg/m^2) categorized into normal ($<25kg/m^2$), overweight ($25\text{-}30kg/m^2$) and obesity ($\geq 30kg/m^2$). Waist circumference was measured with a measuring tape placed midway horizontally between the lower costal margin and the iliac crest and categorized into normal (men ≤ 94 cm, women ≤ 80 cm), increased (men > 94 - 102 cm, women > 80 - 88 cm) and substantially increased (men > 102 cm, women > 88 cm) (25).

Statistical analysis

Baseline characteristics of the risk assessment population were expressed as mean (SD), median (25^{th}, 75^{th} percentiles), or percentages. Mean predicted risk scores with 95% confidence intervals (CI) were calculated, stratified by BMI, waist circumference, and sex. A Venn diagram was created to identify the overlap between the two populations: the population based on guideline-defined risk factors and the population based on an increased waist circumference. To evaluate the proportion of individuals identified at increased risk of CVD in each population, proportions of individuals at low, intermediate, and high predicted risk were calculated in each population and compared with the total risk assessment population. Finally, in each population, we calculated the incidence rates of observed incident CVD events per 1000 person-years.

Results

Current recording practices

This analysis included 676,708 individuals (Supplemental table 1) with median of 7.5 person years (i.q.r. 2.8 – 15.5 person-years) of follow-up in a general practice, and a total of 131,487 waist circumferences recorded. Of the total population, 6.7% had at least one recorded waist circumference. From 2007 to 2012 the incidence rate of a recorded waist circumference increased with 17 to 47 per 1000 person-years. Between 2012 and

2023, the incidence rate of a recorded waist circumference decreased to 3 per 1000 person years (Figure 2). For n=128,623 (97.8%) recorded waist circumferences, a BMI was also recorded at the same date. Waist circumference was most often recorded in individuals with BMIs between 25-33 kg/m^2 (Supplemental figure 1).

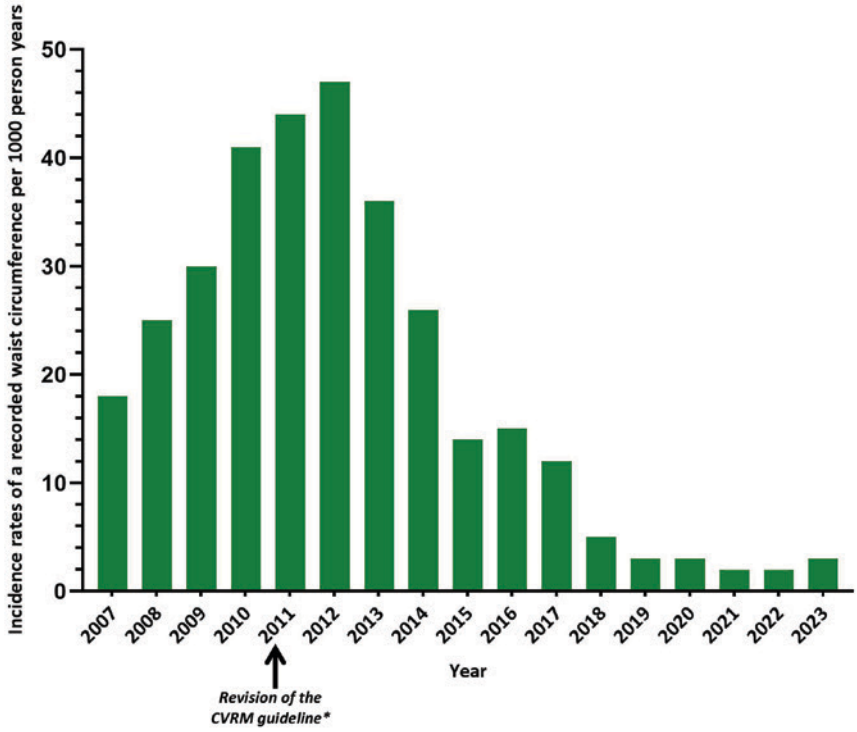


Figure 2 Incidence rates of a recorded waist circumference of n=676,708 electronic health records of Dutch general practitioners between 2007 and 2023
*The national guideline of the Dutch College of General Practitioners: cardiovascular risk management

Barriers and facilitators of GPs

We reached data saturation after six focus groups with three to five GPs (*n* = 21). The GPs had a mean age of 49 years (range 33–66 years) and the majority were women (76%) (Supplemental table 2). Barriers and facilitators for measuring waist circumference structured into the three COM-B components with the related domain of the theoretical domains framework in brackets are described below (Figure 3).

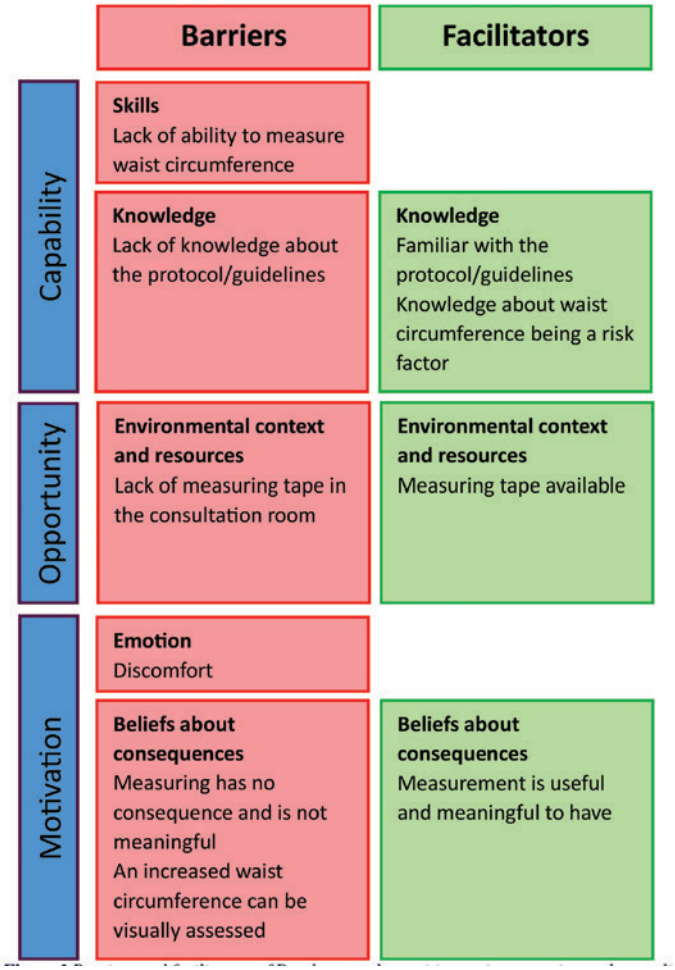


Figure 3 Barriers and facilitators of Dutch general practitioners in measuring and recording waist circumference

Capability

For capability, mainly topics belonging the domain *knowledge* were mentioned. A facilitator for measuring waist circumference was GPs knowledge that an increased waist circumference is a risk factor for developing CVD *(knowledge).* Additionally, as facilitator some GPs had familiarity with the guidelines for measuring waist circumference, while others did not, which acted as a barrier *(knowledge).*

As barrier, some GPs did indicate a lack of skill in measuring waist circumference. On the other hand, as facilitator, some GPs expressed they were able to measure waist circumference. However, their explanations on how to measure it did not always align with the guideline how to measure waist circumference *(skills).*

Opportunity

As a barrier, GPs mentioned the absence of measuring tape in their consultation room for measuring waist circumference *(environmental context and resources).*

Motivation

Some GPs mentioned that measuring waist circumference felt uncomfortable *(emotion).* The most important barrier, however, was related to the domain *beliefs about consequences*. Many GPs considered not to measure waist circumference since they felt it had no consequence for further management. They also considered it as an unreliable measurement. Additionally, in the domain *beliefs about consequences*, some GPs mentioned that they could visually assess if someone had an increased waist circumference thus deeming the measurement unnecessary.

Contribution of measuring waist circumference to cardiovascular risk management

From the 6671 participants in the NEO study population, we observed that 2407 patients were already treated for the prevention of CVD. After exclusion of missing values for the SCORE2 (n=32), 4232 patients were eligible for cardiovascular risk assessment (Figure 4). Baseline characteristics of this risk assessment population are presented in Supplemental table 3. Mean age was 55 years (SD 6), and 46% were men. Within this population, 87% had increased waist circumference and 85% had overweight or obesity. In the risk assessment population (n=4232), 559 patients were considered a priori at high risk of CVD due to a specific risk factor. For the remaining 3673 patients, risk scores were calculated with SCORE2, resulting in 1113 at intermediate predicted risk and 59 at high predicted risk. This results in a total of 1731 patients at increased risk of CVD (1113 at intermediate predicted risk and 618 at high predicted risk) (Figure 4).

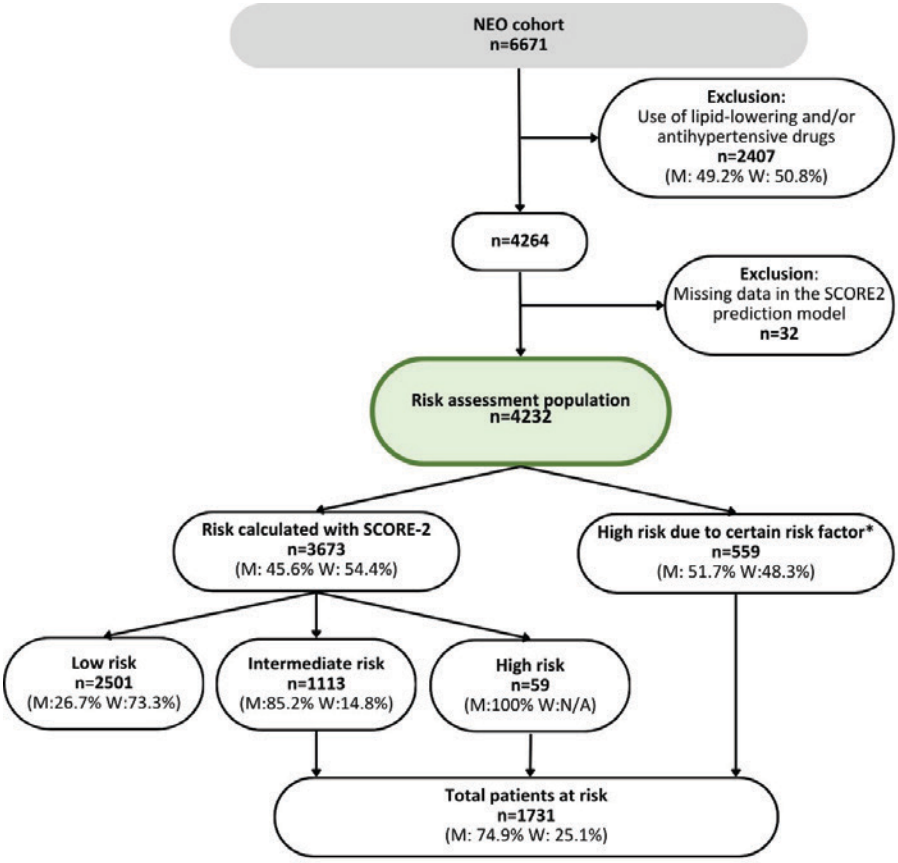


Figure 4 Flowchart of the risk assessment population and the number of individuals at low, intermediate, and high risk of cardiovascular disease in this population
*Individuals with pre-existing CVD n=48, diabetes mellitus n=97, moderate and severe chronic kidney disease n=15, severely elevated blood pressure (systolic>180mmHg) n=23, diagnosed hereditary dyslipidemia (LDL cholesterol>5 or total cholesterol>8) n=403
SCORE2: systematic coronary risk evaluation 2, M: men, W: women

Figure 5.A. illustrates the overlap between the risk assessment population (dark green, n=4232) and the two populations: the population based on guideline-defined risk factors (dark orange, n=3287), and the population based on an increased waist circumference (dark blue, n=3659). Patients with guideline-defined risk factors but without an increased waist circumference are shown in light orange (n=315), while those with an increased waist circumference but without guideline-defined risk factors are shown in light blue (n=687). Figure 5.B. shows the proportions of patients at low, intermediate and high predicted risk within each population. When in the risk assessment population (n=4232), the population with guideline-defined risk factors would be selected, 91% (n=1013/1113) of the total patients at intermediate predicted risk and 100% (n=618/618) of the total of patients at high predicted risk would be identified (Figure 5.C.2. and 5.C.3. dark orange population). When in the risk assessment population (n=4232), the population with increased waist circumference would be selected, 89% (n=993/1113) of the total patients at intermediate predicted risk and 93% (n=575/618) of the total patients at high predicted risk would be identified (Figure 5.C.2 and 5.C.3. dark blue population). Adding the population with an increased waist circumference to the population with current guideline-defined risk factors would identify an additional 6.4% (n=71/1113) of the total patients at intermediate predicted risk (Figure 5.C.2. light blue population).

In the population in which the risk of CVD could be calculated with SCORE2 (n=3673), the mean predicted cardiovascular risk was higher for those with increasing waist circumference in both normal weight and overweight categories (Figure 6). In men with substantially increased waist circumference and overweight, the mean predicted cardiovascular risk was 5.3% (95% CI 5.1-5.5%) compared with 4.4% (95% CI 4.0-4.7%) in those with normal weight and normal waist circumference. In women with overweight and substantially increased waist circumference this was 2.7% (95% CI 2.6-2.9%), compared with 2.1% (95% CI 2.0-2.3%) in women with normal weight and normal waist circumference (Figure 6).

Incidence rates of 10-year incident CVD per 1000 person years are similar in the two populations: 6.2 in the population based on guideline-defined risk factors versus 5.9 in the population based on an increased waist circumference per 1000 person years.

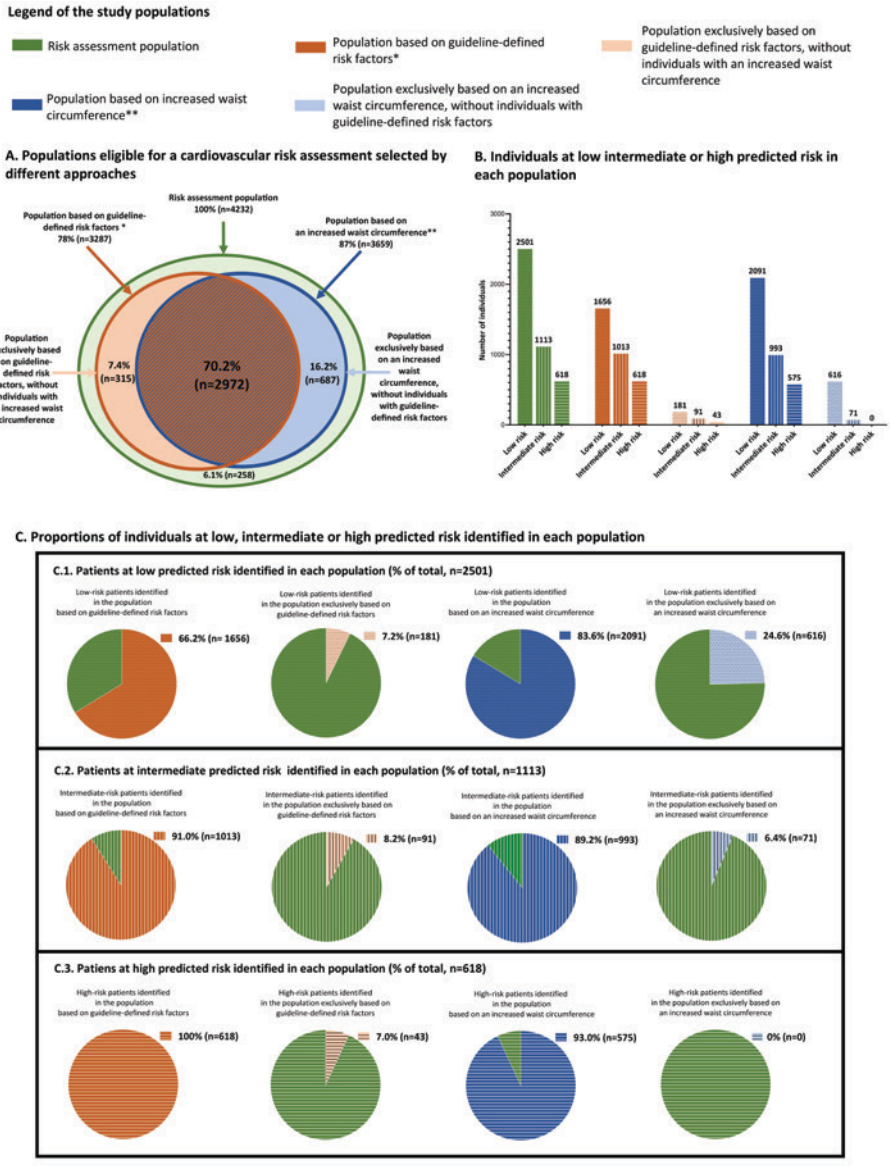
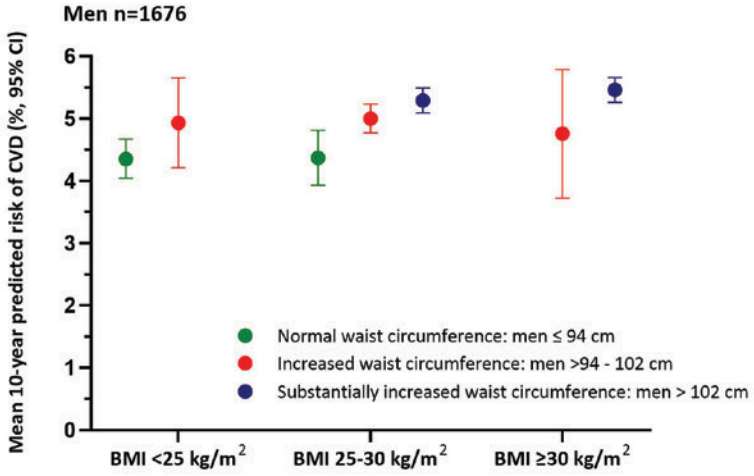


Figure 5 Individuals at low, intermediate, and high predicted cardiovascular risk (calculated with SCORE2°) identified by two different approaches 1. guideline-defined risk factors and 2. an increased waist circumference

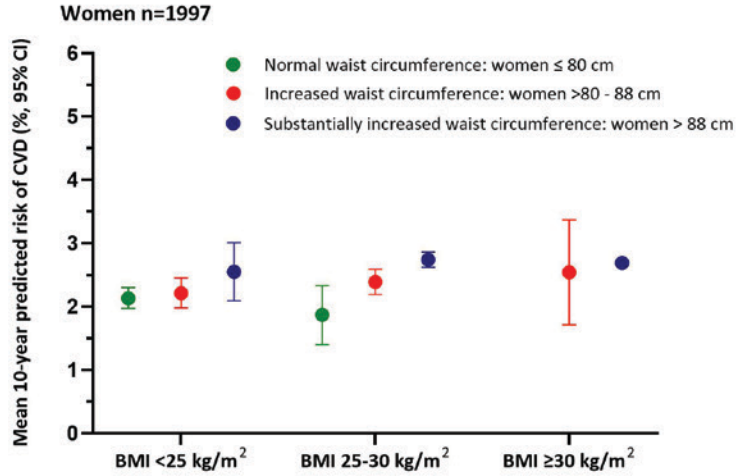
SCORE2: Systematic Coronary Risk Evaluation 2

*Population based on guideline-defined factors: individuals with a family history of premature cardiovascular disease, pre-existing CVD, diabetes mellitus, an active smoking status, obesity (BMI≥30kg/m^2), elevated blood pressure (systolic blood pressure 140>mmHg), suspected hereditary dyslipidemia, elevated cholesterol concentrations (total cholesterol/hdl ratio >5), chronic obstructive pulmonary disease, rheumatoid arthritis, chronic kidney disease.

**Population based on an increased waist circumference: men >94 cm, women >80 cm.



BMI <25 kg/m^2 and normal WC n=158; BMI <25 kg/m^2 and increased WC n=34; BMI <25 kg/m^2 and substantially increased WC n=0; BMI 25-30 kg/m^2 and normal WC n= 99; BMI 25-30 kg/m^2 and increased WC n=356; BMI 25-30 kg/m^2 and substantially increased WC n=481; BMI ≥30kg/m^2 and normal WC n=0, BMI ≥30kg /m^2 and increased WC n=20; BMI ≥30kg/m^2 and substantially increased WC n=528



BMI <25 kg/m^2 and normal WC n = 252; BMI <25 kg/m^2 and increased WC n=106; BMI <25 kg/m^2 and substantially increased WC n=38; BMI 25-30 kg/m^2 and normal WC n= 24; BMI 25-30 kg/m^2 and increased WC n=143; BMI 25-30 kg/m^2 and substantially increased WC n=595; BMI ≥30kg/m^2 and normal WC n=0; BMI ≥30kg /m^2 and increased WC n=12, BMI ≥30kg/m^2 and substantially increased WC n=827

Figure 6 Mean 10-year predicted cardiovascular risk of fatal and non-fatal cardiovascular disease calculated with the SCORE2 stratified by waist circumference, BMI, and sex n=3673
CVD: cardiovascular disease, BMI: body mass index, WC: waist circumference, SCORE2: Systematic Coronary Risk Evaluation 2

Discussion

Summary

In this mixed-methods study we investigated the value of measuring waist circumference in primary care. Currently, this is not standard practice in primary care in the Netherlands. Only in 6.7% of the GP records of patients aged 18 years and older, a waist circumference measurement was recorded. Incidence rates of recorded waist circumference decreased from 2012 to 2023 from 47 to 3 per 1000 person-years. Barriers of GPs to measure waist circumference were feeling discomfort, the inability to measure it accurately, lack of measuring tape and perceived uselessness. Facilitators included the availability of measuring tape and the comprehension that increased waist circumference is a cardiovascular risk factor. We showed that measuring waist circumference is a valuable measurement in the identification of patients at increased risk of CVD. Selecting patients with an increased waist circumference for cardiovascular risk assessment identified 89% of those at intermediate and 93% of those at high predicted cardiovascular risk. This approach is particularly relevant for practices that lack access to comprehensive tools e.g., blood pressure and blood tests, or in situations where time is too limited to conduct a broad range of measurements.

Strengths and limitations

Strengths of this study are the mixed-methods approach, which ensures that both quantitative and qualitative data were collected. This allows for a broad interpretation of the research results and ultimately, well-tailored interventions that lead to improvements and a more efficient approach in cardiovascular risk management in current practice. Other strengths of this study are the access to a large population (n=676,708) with routine healthcare data. We also identified barriers and facilitators using a well-established theoretical framework (Theoretical Domains Framework) (21). Additionally, we had access to extensive and uniform measurements of all information needed for calculating the 10-year cardiovascular risk with SCORE2. Several limitations should be taken into account though. In the routine heath care data, measured waist circumference could have been missed because analysis was limited within the structured electronic health records, as we did not include free text data. It is likely that more waist circumferences have been recorded in free text in the electronic health records, as not all GPs translate their medical assessment to accurately coded recordings. This would have led to an underestimation of available recorded waist circumference. It is important to note that routine healthcare data were used. To use these data accurately, we evaluated the data for extreme values and inconsistent records. Only less than one percent of the values was removed due to non-adequate or extreme values of waist circumference. For the qualitative study,

focus groups could have yielded socially acceptable answers. Additionally, GPs who attended the focus groups might have had a special interest in obesity and may have been more motivated to optimize the care for patients with obesity. However, only two GPs expressed having a special interest in obesity or lifestyle medicine (Supplemental table 1). The first limitation in the NEO study may be the oversampling of individuals with a BMI ≥ 27 kg/m^2. This may have led to overestimation of the number of patients with an intermediate or high risk of CVD that can be identified by an increased waist circumference. However, patients with overweight are more likely to visit their GP for other complaints than patients without overweight, (26, 27) and therefore the NEO study population might be viewed as a typical population visiting general practice. Second limitation in the NEO study is that some individuals in our risk assessment population may already be identified by their GP and monitored accordingly, e.g., those with self-reported diabetes, pre-existing CVD, or chronic obstructive pulmonary disease. We included these individuals in our analysis since we were uncertain whether the baseline diagnosis in the NEO study fully aligns with real-life medical records of GPs, leaving it unclear whether these individuals have been identified by their GP. For individuals not yet identified by their GP, measuring waist circumference could be a valuable tool to identify those at increased risk in general practice.

Comparison with existing literature

The decrease in recorded waist circumference from 2012 to 2023 may be explained by revisions in the Dutch cardiovascular risk management guidelines. Until 2011, both BMI and waist circumference were recommended as part of the physical examination (28). After 2011, the guidelines shifted focus to BMI, with waist circumference listed as an optional additional measurement (29, 30). The in 2024 updated guideline reintroduced waist circumference alongside the BMI as part of the physical examination but did not include it as a criteria for cardiovascular risk assessment eligibility (1). The low measurement rates are consistent with findings from other countries (Canada, United Kingdom, United States), where waist circumference is also rarely recorded (13-16). These trends contradict the increasing awareness that knowledge of waist circumference has added value for risk assessment. So, the barriers for measuring waist circumference should be overcome to ease implementation in practice and support guideline adherence.

Previous studies investigated the barriers and facilitators for measuring waist circumference (13, 17). We confirmed some of the barriers reported by these studies: the discomfort felt by GPs (13, 17), the perceived usefulness of a measurement (17) and the lack of measuring tapes (13). In our qualitative study, the most important barriers mentioned were that GPs felt measuring waist circumference had no consequence for

further management and that they believed they could visually assess an increased waist circumference. We, however, showed that measuring and adding increased waist circumference to the current guidelines would lead to the identification of an additional 6.4% of patients at intermediate cardiovascular risk, who would need follow-up in cardiovascular risk management but would otherwise be missed. The identification of these patients is particularly important, because these are patients with a BMI below 30, in whom a large waist may be less visible but who are at increased risk of CVD.

Our results are in line with findings from two other studies that investigated the role of waist circumference in identifying patients at increased risk of CVD (31, 32), and showed that waist circumference (with cut-offs of 80 cm for women and 94 cm for men) can effectively identify individuals at increased risk, highlighting its value in general practice. Comparing these studies however requires careful consideration, as they used different endpoints, such individual risk factors (e.g., hypertension, cholesterol), or other prediction models than the SCORE2 model used in our study, which is currently widely adopted in Europe. Furthermore, our findings suggest that the population with an increased waist circumference, in addition to the high number of patients identified at high predicted risk, also showed a high observed risk, deeming this population suitable for cardiovascular risk assessment eligibility. The high number of patients identified at high predicted/observed cardiovascular risk by measuring waist circumference can be explained by the strong association between waist circumference and visceral fat, which is associated with CVD (5, 33-36).

Waist circumference is a simple method to assess abdominal adiposity that is easy to perform in a clinical setting (5, 33, 35). Besides, it is a low-cost, low-risk tool, especially useful in countries where other assessments, e.g., cholesterol concentrations or blood pressure measurements, are not or less easily available. This makes it a practical option in settings where a more comprehensive screening is not feasible or in general practice where time and money is too limited to conduct a broad range of measurements in all patients. We previously showed that selecting patients with overweight or obesity for cardiovascular risk assessment by the GP may help to identify 70% of patients with a treatment indication who were not yet receiving treatment to prevent CVD (37). Our present findings may further help to identify patients at increased risk of CVD by measuring waist circumference in those patients who have overweight but no apparent obesity, enabling further treatment. Additionally, waist circumference is a measurement that can aid patients to recognize their own condition as it may lead to active attempts and successful weight loss (38). Furthermore, it could be used to know which patients should seek and be offered weight management and it enables monitoring the effects of weight management and healthy behaviors (5, 39).

Implications for practice and conclusion

Our findings show that measuring waist circumference may be a valuable addition in general practice as it identifies patients at increased risk of CVD, and particularly useful in patients with a BMI <30kg/m^2. Since GPs currently do not measure waist circumference frequently, it is not only important to include waist circumference in existing guidelines but also to address the barriers. This can be achieved by providing GPs with training, ensuring access to measuring tapes and enhancing their understanding of the clinical value of measuring waist circumference, but also in other practice workaround procedures like creating routine measurement opportunities. Future interventions should focus on tailored interventions to overcome these barriers, ultimately leading to the identification of intermediate and high-risk patients and the prevention of CVD.

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39. Lean ME, Han TS, Morrison CE. Waist circumference as a measure for indicating need for weight management. Bmj. 1995;311:158-61.

Supplemental table 1 Baseline characteristics routine healthcare cohort of ELAN, 2007-2023 from 18 years and older

	Total population n=676,708
Sex (% men)	48.0
Year of birth (calendar year)	1971 (1954-1987)
Age at entry cohort (years)	40.0 (26.0 -56.0)
Follow-up in general practice (years)	7.5 (2.8 – 15.5)
Recorded BMI (%)	28.8
Recorded waist circumference (%)	6.7
- First recorded waist circumference (normal)[1] (%)	0.3
- First recorded waist circumference (increased)[2] (%)	0.7
- First recorded waist circumference (substantially)[3] (%)	5.6

Skewed distributed data are shown as median (25^{th}, 75^{th} percentiles) and categorical data are shown as percentage

1 Normal waist circumference, waist circumference: men ≤ 94 cm, women ≤ 80 cm

2 Increased waist circumference, waist circumference: men >94 - 102 cm, women >80 - 88 cm

3 Substantially increased waist circumference, waist circumference: men > 102 cm, women > 88 cm

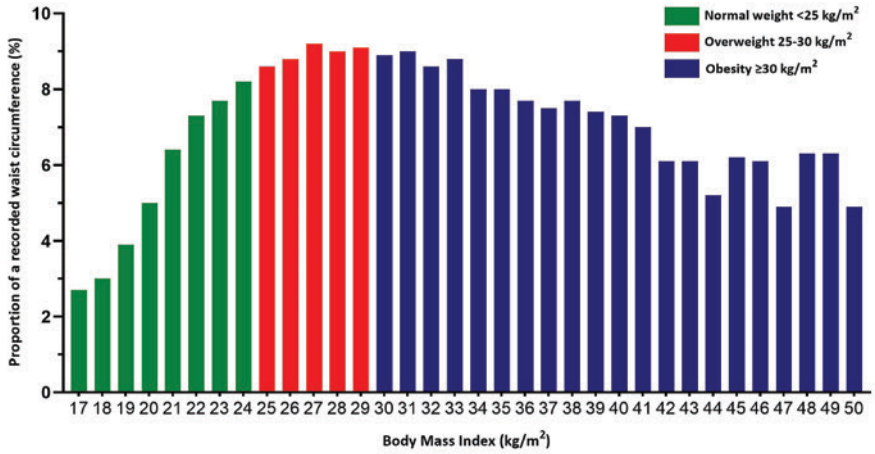
Supplemental table 2 Sample characteristics of the qualitative study reported by the general practitioners (n=21)

Characteristic	n
30-39	6
40-49	6
50-59	6
60-69	3
Sex	
Women	16
Men	5
Experience as general practitioner (years)	
0-9	8
10-19	5
20-29	6
30-39	2
Type of employment	
Practice owner	10
Salaried service	2
Locum	9
Practice location	
Urban	12
(Semi)rural	8
Both	1
Type of practice	
Solo practice	8
Duo practice	5
Group practice	5
Mixed	2
Unknown	1
Number of patients in practice	
≤3000 patients	9
>3000 patients	9
Unknown	3
Type of patient population	
Average population (reflection of the Dutch population)	10
Other	11
Specific areas of interest	
GP trainer	7
Obesity	1
Lifestyle coach	1
Other	6
None	6

Supplemental table 3 Baseline characteristics of the risk assessment population

	Risk assessment population
Participants, n	4232
Men (%)	46.4
Age (years)	54.8 (6.0)
Ethnicity (Caucasian, %)	94.7
Educational level (high, %)	40.7
Follow-up (years)	6.7 (6.0-7.9)
BMI (kg/m^2)	29.3 (4.6)
• Normal (BMI<25kg/m^2) (%)	15.0
• Overweight (BMI 25-30 kg/m^2) (%)	46.5
• Obesity (BMI ≥30kg/m^2) (%)	38.5
Waist circumference (cm)	99.7 (12.9)
• Normal waist circumference (%)*	13.5
• Increased waist circumference (%)*	18.2
• Substantially increased waist circumference (%)*	68.3
Guideline-defined risk factors for cardiovascular risk management	
- Pre-existing CVD (%)	1.1
- Family history of premature CVD (%)	25.3
- Suspected hereditary dyslipidaemia (%)	9.5
- Elevated blood pressure (systolic>140mmHg) (%)	26.3
- Elevated cholesterol concentrations (%)	24.2
- Smoking status (current, %)	17.0
- Obesity (≥30kg/m^2 %)	38.5
- COPD (%)	5.2
- Diabetes mellitus (%)	2.3
- Rheumatoid arthritis (%)	1.6
- Chronic kidney disease	
• Mild (%)	3.9
• Moderate (%)	0.4
• Severe (%)	0

Normally distributed data are shown as mean and standard deviation (SD), skewed distributed data are shown as median (25th and 75th percentiles) and categorical data shown as percentage
BMI: body mass index, CVD: cardiovascular disease, COPD: chronic obstructive pulmonary disease
*Normal waist circumference: men ≤ 94 cm, women ≤ 80 cm, increased waist circumference: men >94 - 102 cm, women >80 - 88 cm, substantially increased waist circumference: men > 102 cm, women > 88 cm
Missing values: ethnicity n=5, educational level n=34, follow-up n=59, pre-existing CVD=6, family history of premature CVD n=506, suspected hereditary dyslipidaemia n=2, elevated blood pressure n=1, elevated cholesterol concentrations n=1, smoking status n=2, COPD n=3, diabetes mellitus n=59, rheumatoid arthritis n=1, chronic kidney disease n=29



Supplemental figure 1 Proportion of recorded waist circumferences within a recorded body mass index value of n=676,708 electronic health records of Dutch general practitioners between 2007 and 2023*
* n=1,546,777 body mass index between 17 and 50 kg/m^2 were recorded and n=128,623 waist circumferences were recorded on the same date as a recorded body mass index

Supplemental file 1 Definitions of the different risk factors in the NEO study, collected at baseline

Obesity: body mass index 30 ≥ kg/m^2
Increased blood pressure: systolic blood pressure >140mmHg
Severely increased blood pressure: systolic blood pressure >180mmHg
Increased cholesterol levels: total cholesterol/HDL cholesterol ratio >5 mmol/L
Chronic kidney disease: estimated glomerular filtration rate (eGFR) <60 ml/min/1,73 m^2 and/or albumin-creatinine ratio (ACR) ≥ 3 mg/mmol divided into:

- Mild chronic kidney disease: eGFR ≥60ml/min/1,73 m^2 with ACR 3-30 mg/mmol, or eGFR 45-59 ml/min/1.73 m^2 with ACR
- Moderate chronic kidney diseases: eGFR 30-44 ml/min/1.73 m^2 with ACR <3 mg/mmol, or eGFR 45-59 ml/min/1.73 m^2 with ACR 3-30 mg/mmol, or eGFR ≥60 ml/min/1.73 m^2 with ACR >30 mg/mmol
- Severe chronic kidney disease: eGFR <29 ml/min/1.73 m^2, or eGFR 30-44 mL/min/1.73 m^2 with ACR 3-30 mg/mmol, or eGFR 45-59 mL/min/1.73 m^2 with ACR >30 mg/mmol

Plasma creatinine was used to calculate the estimated glomerular filtration rate using Modification of Diet in Renal Disease and was given in ml/min/1,73m^2 (1).
Suspected hereditary dyslipidemia: total cholesterol>8 mmol/L or low-density lipoprotein (LDL) cholesterol>5mmol/L (2). LDL cholesterol was calculated using Friedewald formula using triglyceride, total cholesterol and high-density lipoprotein concentrations (3).
Diagnosed hereditary dyslipidemia: Not reported at baseline, therefore we defined individuals with diagnosed hereditary dyslipidemia as suspected hereditary dyslipidemia.
Family history of premature cardiovascular disease (CVD): self-reported. Siblings and parents were reported as first-degree family members. The age of CVD of the family members was divided into age-groups defined as: < 50 years, 50-60 years, 60-70 years and > 70 years. For selecting the population eligible for cardiovascular risk assessment, the number of first-degree relatives with a history of CVD under 55 years for men and under 65 years for women was needed. We assumed Individuals had a first-degree male relative under 55 years if they reported at least one first-degree male relative under 60 years and a first-degree female relative under 65 years if they reported at least one first-degree female relative under 70 years.
Type I diabetes mellitus or type II diabetes mellitus: based on the use of anti-diabetic drugs or self-reported diabetes.
Active smoking status: self-reported current smoker.
Rheumatoid arthritis: self-reported rheumatoid arthritis.
Chronic obstructive pulmonary disease: self-reported lung emphysema or chronic bronchitis.

Pre-existing CVD: self-reported myocardial infarction, angina, congestive heart failure, stroke, or peripheral vascular disease.

1. Levey AS, Coresh J, Greene T, Stevens LA, Zhang YL, Hendriksen S, et al. Using standardized serum creatinine values in the modification of diet in renal disease study equation for estimating glomerular filtration rate. Ann Intern Med. 2006;145:247-54.

2. Walma EP, Wiersma T. NHG-Standpunt Diagnostiek en behandeling van familiaire hypercholesterolemie. In: Wiersma T, Boukes FS, Geijer RMM, Goudswaard AN, editors. NHG-Standaarden 2009. Houten: Bohn Stafleu van Loghum; 2009. p. 153-9.

3. Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clin Chem. 1972;18:499-502.

Supplemental file 2 Categorization of predicted cardiovascular risks according to the guideline cardiovascular risk management of the Dutch College of General Practitioners (NHG)

Low Risk:

Age <50 years: predicted cardiovascular risk score <2.5%

Age 50–69 years: predicted cardiovascular risk score <5%

Intermediate Risk:

Age <50 years: predicted cardiovascular risk score 2.5–7.5%

Age 50–69 years: predicted cardiovascular risk score 5–10%

Age ≥70 years: predicted cardiovascular risk score <15%

High Risk:

Age <50 years: predicted cardiovascular risk score ≥7.5%

Age 50–69 years: predicted cardiovascular risk score ≥10%

Age ≥70 years: predicted cardiovascular risk score ≥15%

Supplemental file 3 Ascertainment of cardiovascular diseases in the NEO study

New diagnoses of cardiovascular disease (CVD) were extracted between October 2017 and July 2018 from the electronic medical records of the general practitioner (GP) of the participants. These records cover all medical information of the patients regarding GP consultations, prescriptions, and reports from laboratories and specialist visits available at the GP office.

Data extraction was performed based on three criteria: (1) the diagnostic coding by the GPs to indicate the health problems or type of care, based on the International Classification of Primary Care (ICPC) (1), (2) finding of predefined CVD-related keywords, and (3) prescription of specific medication, registered according to the Anatomical Therapeutic Chemical (ATC) codes or by screening medication names (2). The date of diagnosis was defined as the date of an ICPC-coded diagnosis, a strong indication for the diagnosis based on keywords in the medical records, or prescription of relevant medication.

In case only a keyword was found without a confirmed ICPC code, laboratory results and the free text in the medical records were checked. These findings were discussed by the NEO study adjudication committee to decide on a diagnosis. If the diagnosis remained uncertain, the GP of the participants was contacted to confirm the date and diagnosis. A diagnosis was considered incident when the first date of diagnosis occurred after the baseline visit date.

In the present analysis, CVD was defined as a diagnosis of myocardial infarction (ICPC Code: K75 or K76.02), transient ischemic attack (K89), and stroke/cerebrovascular accident (K90 or its subtypes: K90.01, subarachnoid haemorrhage; K90.02, intracerebellar haemorrhage; or K90.03, cerebral infarction). Keywords included synonyms of myocardial infarction, chest pain, cardiovascular surgery procedures such as coronary artery bypass grafting (CABG) or angioplasty, and synonyms of cerebrovascular accident or haemorrhage. The medication list of participants was checked for the use of specific anticoagulants.

1. Dutch College of General Practitioners. ICPC. https://www.nhg.org/themas/artikelen/icpc.

2. World Health Organization. Anatomical Therapeutic Chemical (ATC) Classification https://www.who.int/tools/atc-ddd-toolkit/atc-classification.

Chapter 6

General discussion

General discussion

Obesity is a major global health problem, leading to chronic disease and increased mortality (1, 2). The rise in obesity-related diseases results in increased healthcare costs due to the need for treatment and frequent medical visits (3, 4). Obesity is also a complex disease, influenced by behavioural, environmental, social, and genetic factors (5). Because of the increased prevalence of obesity, effective prevention and early identification of patients at risk are crucial. Primary care plays a key role in this, as general practitioners are often the first point of contact for these patients. Therefore, this thesis aims to provide a contribution to the improvement of obesity management in primary care. In this final chapter, main findings and overall perspectives of obesity are discussed, covering the following topics: the definition of obesity, developments in treatment, and the role of primary care in the management of obesity. Subsequently, the implications for clinical practice are examined, followed by future perspectives and recommendations for future research.

Main findings

Part I: Current practices

The first aim was to examine the current practices of obesity management in primary care. **Chapter 2** examined current recording practices of body mass index, overweight, and obesity in primary care. In this chapter we analysed routine healthcare data from 676,708 electronic health records and found that the incidence rates of recorded body mass index increased from 2007 to 2023. During the COVID-19 pandemic (2020-2022), the incidence rates temporarily decreased, before increasing again. Recording body mass index is not currently standard practice. General practitioners recorded body mass index for about one-third of all adults, and mainly for those with chronic diseases (chronic obstructive pulmonary disease, type II diabetes, hypertension, and osteoarthritis). Those with mental health conditions (depression and eating disorders) were less likely to have their body mass index recorded. In **Chapter 3,** a qualitative study using focus group discussions with general practitioners was conducted. In this study we explored the barriers and facilitators to three target behaviours of general practitioners in addressing obesity: discussing weight, diagnosing, and referring patients with obesity. For discussing weight, the main barriers identified were a presented complaint unrelated to obesity, concerns about a negative response from the patient, and worries about obesity being a sensitive subject to discuss. The general practitioners mentioned that a long-term trustworthy relationship facilitated in discussing weight. Barriers related to diagnosing patients with obesity were more related to resources, e.g., lack of (appropriate) equipment and time. For referring

patients with obesity, barriers were lack of accessible referral options nearby and doubts about the positive effects of the referral. In conclusion, different barriers for discussing weight, diagnosing, and referring patients with obesity were identified, underscoring the importance for tailored interventions to these three behaviours rather than addressing obesity in general. Attention should be paid to establishing long-term relationships, addressing general practitioners' beliefs about consequences, and creating a supportive environment with sufficient time and resources.

Part II: Identification of high-risk patients

The second aim was to improve the identification of patients with obesity at increased risk of further long-term weight gain or cardiovascular disease. In **Chapter 4**, we investigate the association between anxiety, depression, negative life events and quality of life with weight change over ten years in a middle-aged population-based cohort with overweight or obesity using data from the NEO study. We concluded that depressive symptoms and distant negative life events were associated with weight gain over ten years. Anxiety symptoms and quality of life were not associated with either weight gain or weight loss. **Chapter 5** examines the value of measuring waist circumference in primary care in a mixed-methods study consisting of three parts: first, current recording practices of general practitioners in measuring waist circumference; second, barriers and facilitators of general practitioners in measuring waist circumference; and third, the contribution of measuring waist circumference in identifying patients at increased risk of cardiovascular disease. We found that the incidence rates of recorded waist circumference in primary care decreased between 2007-2023. Barriers for general practitioners to measuring waist circumference included discomfort, inability to measure accurately, lack of tape measure, and perceived uselessness. Facilitators for general practitioners included the availability of measuring tape and the comprehension that increased waist circumference is a cardiovascular risk factor. Measuring waist circumference alone would already identify almost 90% of individuals at intermediate predicted cardiovascular risk and 93% at high predicted cardiovascular risk. In addition, adding an increased waist circumference as an eligibility criterion for cardiovascular risk assessment in the guideline *cardiovascular risk management* of the Dutch College of General Practitioner is of added value. It leads to the identification of an additional 6.4% of patients at intermediate predicted cardiovascular risk. In conclusion, measuring waist circumference may be a valuable addition to cardiovascular risk management in primary care, as it identifies patients at risk of cardiovascular disease and is a low-cost, simple assessment. However, the barriers need to be addressed.

All findings considered, this thesis shows that both body mass index and waist circumference were underrecorded in primary healthcare records. Overcoming the barriers for general practitioners to discussing weight, diagnosing and referring patients with obesity requires not only improving knowledge and skills, but also establishing long-term relationships, creating a supportive environment and addressing their beliefs about consequences. Proactive attention is needed for patients with depressive symptoms and those who have experienced negative life events, as they are more likely to gain weight over time. In addition, measuring waist circumference is a cost-effective and accessible tool that identifies patients at increased risk of developing cardiovascular disease.

Overall perspectives

In this paragraph we discuss the views on the definition of obesity, the developments in the treatment of obesity, and the role of primary care in obesity management (preventive, reactive or both).

Views on the definition of obesity

Although the World Health Organization recognises obesity as a chronic disease (6), the idea of obesity as a chronic disease remains highly controversial, with ongoing debate about its definition and diagnostic criteria (7). Traditionally, body mass index, calculated by dividing weight in kilograms by height in metres squared, has been used to assess obesity (8). While the body mass index has guided treatment decisions for decades, it has limitations. Body mass index does not distinguish between fat and muscle, nor does it take into account the body fat distribution, both of which are essential for assessing health risks. These evolving insights in obesity and its health risks highlight the need for a more comprehensive approach to identifying and managing obesity. A study (2025) by Rubino et al., introduced obesity as preclinical obesity (excess body fat without current organ dysfunction but with an increased risk of developing clinical obesity) and clinical obesity (excess body fat with symptoms of organ dysfunction or functional limitation), which can guide clinical decision making. They recommended that excess adiposity should be confirmed through a direct measurement of body fat (e.g. by Dual-energy X-ray absorptiometry (DEXA), bioimpedance, etc), wherever available, or at least one anthropometric measurement (e.g. waist circumference, waist-to-hip ratio, or waist-to-height ratio) in addition to body mass index. This approach greatly reduces, but does not eliminate, both overdiagnosis and underdiagnosis of obesity status (9). Other studies have also confirmed the importance of these additional measurements (10, 11). Among these, waist circumference is particularly useful in identifying patients at increased risk of cardiovascular diseases (**Chapter 5**). In addition, it is a practical

low-cost tool that is easy to perform in a clinical setting, especially compared with for example laboratory tests (12-14).

The under recording of body mass index (**Chapter 2**) and waist circumference (**Chapter 5**) in primary healthcare records suggests that these diagnostic criteria for obesity described above are not yet routinely applied in primary care. Although the incidence rate of body mass index measurements increased in primary care, the decrease in waist circumference measurements may represent a missed opportunity. Figure 1 shows the trends in both measurements over time (**Chapters 2** and **5**), along with relevant guidelines, important Dutch political agreements, international literature, and the prevalence of obesity in the Netherlands in previous years. During the 1990s, several studies highlighted the importance of measuring waist circumference (14-16). Nevertheless, in 1997, the World Health Organisation established body mass index ≥30kg/m^2 as the definition of obesity, which led to the standard parameter for defining obesity in guidelines (17). From 2006 to 2011, the guideline *cardiovascular risk management* of the Dutch College of General Practitioners recommended measuring body mass index and waist circumference as part of the physical examination (18). This recommendation was followed by a marked increase in recorded measurements in Dutch primary care (**Chapter 5**). After 2011, the focus of the guidelines shifted to measuring body mass index alone, with waist circumference listed as an optional additional measurement (19, 20). Interest in waist circumference has resurfaced since 2020 (13), with its reintroduction into national guidelines (21, 22), which may improve clinical practice in obesity management in primary care and support a renewed uptake of waist circumference measurements. Despite this renewed attention, body mass index currently remains the primary criterion for reimbursement of bariatric surgery (23). In contrast, both body mass index and waist circumference are included in the eligibility criteria for the combined lifestyle interventions (24). Taken together, the evidence suggests that we are currently in a transitional phase in which waist circumference is gaining recognition as an important clinical measure alongside the body mass index but has not yet been fully integrated into routine practice and policy.

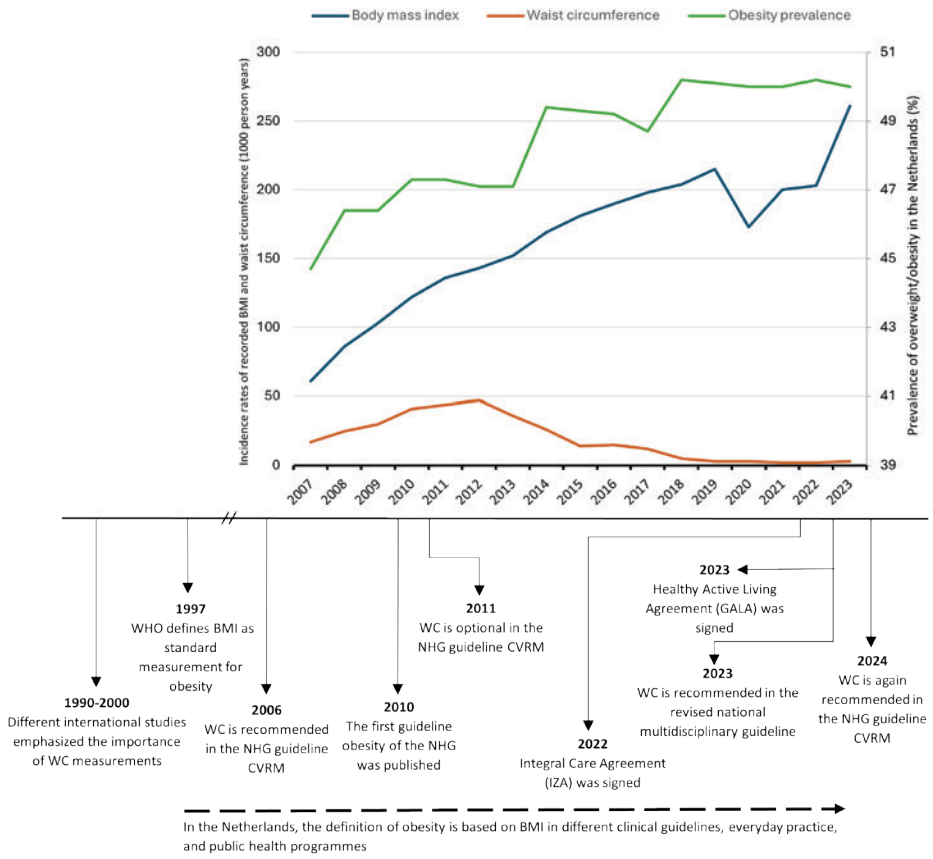


Figure 1 Incidence rates of recorded body max index and waist circumference (results of **Chapters 2** and **5**) in Dutch primary care and prevalence of overweight and obesity in the Netherlands
WC: waist circumference, BMI: body mass index, WHO: World Health Organization, CVRM: cardiovascular risk management, NHG: Dutch College of General Practitioners

Developments in treatment of obesity

Below, two treatment options for obesity that are currently highly relevant in primary care are discussed.

Combined lifestyle interventions

From 2019, health insurances in the Netherlands have started reimbursing lifestyle interventions for patients with a body mass index ≥25 kg/m^2 and related health problems (comorbidity or increased waist circumference), or a body mass index ≥35 kg/m^2 (24).

Studies showed an average weight loss of 2-3 kg in the first year after starting the intervention, although long-term weight effects remain uncertain (25-28). An annual monitoring report (2024) by the National Institute for Public Health and the Environment (RIVM) reported an average weight loss of 5% and an improvement in quality of life after completing the intervention (29). These findings emphasise the importance of managing patients' expectations by presenting improved quality of life as the main goal of the GLI, rather than focusing solely on reducing body mass index and waist circumference. General practitioners should address this during the referral process in order to prevent dropouts and encourage successful completion. New insights into the pathophysiology of obesity underscore the challenges we face when treating obesity. Hinte et al. showed that even after weight loss, adipose tissue retains an epigenetic memory of obesity, maintaining metabolic changes that predispose individuals to weight regain (30). This phenomenon, known as fat memory, complicates long-term weight management and makes sustained weight loss a difficult goal to achieve. Despite the short-term benefits of combined lifestyle interventions, the persistence of fat memory means that individuals face ongoing challenges in maintaining long-term weight loss and improving metabolic health. These findings help to explain why general practitioners in our focus groups expressed limited confidence in the long-term effectiveness of lifestyle interventions and dietitians (**Chapter 3**) and highlight the need for more realistic expectations and broader outcome measures that extend beyond weight loss alone.

Pharmacological treatment

At the time of starting this thesis (2020), advances in obesity management include the introduction and increasing use of new pharmacological treatments for obesity. Drugs such as glucose-dependent insulinotropic polypeptide (GIP) and glucagon-like peptide-1 receptor agonists (GLP-1) such as semaglutide, liraglutide and tirzepatide (31-34), originally developed for type 2 diabetes, are now increasingly prescribed for obesity. A randomised control trial (SURMOUNT trial) published by Jastreboff et al. showed that the use of tirzepatide resulted in an average weight loss of 19% and 20% (at weekly doses of 10 mg and 15 mg, respectively), compared with a one percent weight loss with placebo over more than three years (33). The findings of this thesis (**Chapters 4** and **5**) enable general practitioners to identify patients at high risk who may benefit from these pharmacological treatments. However, ethical and practical challenges arise for general practitioners when considering the prescription of these drugs. For example, questions about long-term effectiveness, accessibility, affordability, side-effects, and their role in primary care. At present, only liraglutide and naltrexone/bupropion are reimbursed for obesity treatment in the Netherlands, provided that the combined lifestyle intervention has proven unsuccessful (35).

Current reimbursement policies ensure that pharmacological treatments are used as a complement to lifestyle changes rather than replace them. At the same time, it poses practical challenges, as patients with greater financial resources may choose to pay for the treatment themselves, potentially leading to inequalities in healthcare. In addition, there may be concerns that these drugs may be seen as substitutes for lifestyle and behavioural changes, resulting in a potential need for lifelong use. The literature supports these concerns, pointing to long-term use and gastrointestinal side-effects (32, 33, 36, 37). Furthermore, continued media attention on these treatments has raised patient expectations, which may put pressure on general practitioners. In the focus group study (**Chapter 3**), general practitioners mentioned a poor doctor-patient relationship as a barrier to discussing weight. Increased demand for these drugs might influence the doctor-patient relationship and might hinder open discussions about all possible treatments for obesity in primary care. In contrast, the availability of these drugs could also address some of the barriers identified in **Chapter 3**, such as doubts about the effect on weight change, the lack of confidence in the effectiveness of treatments, and the lack of treatment options. In conclusion, the introduction of these drugs presents new challenges for general practitioners, but also has the potential to address some of the barriers that general practitioners face in managing obesity.

Primary care: preventive, reactive, or both?

General practitioners play a crucial role in identifying patients at risk of obesity and its related diseases, as discussed in **Chapters 4** and **5**. However, their efforts alone are not enough to tackle obesity. In this section, we further explore three key issues in the management of obesity: the need for a collaborative approach to obesity prevention, the role of general practitioners in identifying obesity-related conditions, and patient perspectives on obesity management.

Obesity prevention: a collaborative approach

The Dutch healthcare system faces growing pressure from an ageing population, workforce shortages, increasing demand for care and escalating costs, alongside the growing obesity epidemic. To ensure sustainability and accessibility, the Integral Care Agreement (IZA) was introduced in 2022 and signed by the national government, health insurers, healthcare providers, and other stakeholders (38). The IZA emphasises the importance of collaboration between healthcare providers, municipalities, and social services. Complementing this, in 2023 the Healthy and Active Living Agreement (Gezond en Actief Leven Akkoord, GALA) was developed to support local governments in promoting health, preventing diseases, and reducing health inequalities (39). Tackling obesity requires a comprehensive strategy that goes beyond the scope of primary care alone. While general practitioners play a central role in identifying individuals

with obesity, the general practitioners in our focus groups discussions mentioned the need for a broader public health approach, including taxes on sugar-sweetened beverages, school-based prevention programmes, and local government initiatives (**Chapter 3**). The priorities of the IZA and GALA, such as accessible primary care, regional collaboration, promoting a healthy lifestyle and environment, and reducing health inequalities, offer important opportunities to prevent and manage obesity through a more coordinated, multidisciplinary approach.

Identifying obesity-related diseases

As we described in our introduction (Figure 2 in the introduction), obesity is associated with various diseases. One of the main challenges in preventing obesity and its related diseases is that primary care in the Netherlands is largely demand-driven. This poses a challenge to early detection of individuals at increased risk of cardiovascular disease. The guideline *cardiovascular risk management* of the Dutch College of General Practitioners recommends programmatic as well as opportunistic screening (21). According to Leemrijse et al, 25% of the Dutch general practitioners use opportunistic screening, 20% use programmatic screening, and almost 20% use both methods. However, almost 37% of general practitioners do not use any form of screening (40). Programmatic screening involves systematically inviting patients at risk for consultations, while opportunistic screening takes place during routine consultations when risk factors, such as obesity or increased waist circumference, are noticed during an encounter for other reasons. Each approach has its limitations. Programmatic screening, while more effective in detecting cases in the short term, has not been shown to have long-term health benefits and is therefore not considered cost-effective (41, 42). Opportunistic screening may miss cases, because some patients rarely visit their general practitioner to discuss their weight, and general practitioners often experience a barrier to raising the issue if the reason for encounter is unrelated to obesity (**Chapter 3**). Despite the early detection potential of both approaches, screening has inherent limitations. The report of the Council for Public Health and Society (RVS) criticised a prevention policy that relies heavily on individual medical interventions such as screening (43). The RVS emphasizes that health problems are largely influenced by social and environmental factors. Effective prevention, therefore, requires structural societal interventions that go beyond the medical domain. According to the RVS, screening should not be the cornerstone of health policy, but rather one of the tools within a broader public health strategy. Although each screening approach currently has its limitations, simple measurements such as body mass index and waist circumference, are valuable low-costs tools for the early identification of patients at increased risk of cardiovascular disease in primary care (**Chapter 5**) (44). Also, raising public awareness of the link between (abdominal) obesity

and its related diseases may encourage patients to present to their general practitioner earlier, making opportunistic screening more feasible and acceptable.

Patient perspectives on obesity management

Although not specifically addressed in this thesis, the patient perspectives on obesity management are an important area for consideration. While policymakers and healthcare providers may express a willingness to tackle obesity, it is crucial to understand what patients expect from their healthcare providers. A systematic review of 21 qualitative studies found that discussions about weight between healthcare providers and patients were less frequently started than patients thought desirable (45). Some patients reported feeling unworthy of medical attention, others felt that doctors did not consider being overweight to be a serious health risk, and some felt stigmatised due to the lack of discussion about weight. Despite these concerns, patients generally responded positively when doctors acknowledged their efforts to lose weight, offered weight loss support, and provided ongoing follow-up (45). As we explored general practitioners' barriers and facilitators in measuring waist circumference in **Chapter 5**, it is important to highlight that another qualitative study conducted in a primary care population found that patients had few concerns about waist circumference measurements being taken by healthcare providers (46). These findings suggest that such measurements are broadly acceptable during routine consultations in general practice. Finally, a randomised controlled trial by Aveyard et al. showed that a very brief behavioural advice from general practitioners, suggesting that weight loss would benefit the patient's health, was acceptable to patients and effective in reducing the mean weight of the population (47).

Taken together, there is a gap in current preventive care practices, with missed opportunities for the early identification of patients at risk of cardiovascular disease. This highlights the key role of primary care in identifying and managing patients with obesity. However, its impact on obesity must be coordinated with broader community and policy efforts. Effectively tackling obesity requires collaboration between public health authorities, policymakers, and primary care, integrating both preventive and reactive strategies. Raising public awareness of the link between obesity and related diseases is also essential. By promoting a collaborative, patient-centered approach, we can better address the obesity epidemic and its associated health risks.

Implications for practice

The results of the studies described in this thesis lead to several implications for obesity management in primary care.

Implications for policymakers

- *Revision of the national guideline obesity of the Dutch College of General Practitioners (NHG).* At the time of writing this thesis (2025), the national guideline *obesity* of the Dutch College of General Practitioners (NHG) dates from 2010 (48). This outdated guideline is concerning, particurlarly given the increase in prevalence of obesity over the past fifteen years, with almost 16% of Dutch adults having a BMI ≥ 30 kg/m² (49). In addition, a growing body of updated European guidelines on obesity management could provide a valuable foundation for updating the Dutch guideline (50, 51). The absence of an up-to-date national guideline for general practitioners means that general practitioners must rely on outdated recommendations to manage a condition that is increasingly recognised as both prevalent and complex. This highlights the urgent need for an updated national guideline for general practitioners that reflects current evidence and supports them in effectively managing obesity. Encouragingly, a revised guideline is currently under development and is expected to be published by the end of 2025. In addition, a new practice guide on overweight and obesity in general practice has recently been published. This guide is based on the recently updated national multidisciplinary obesity guideline (22, 52). This is a practical guide for general practitioners that supports them in addressing obesity.
- *Including waist circumference in guidelines and decision-making processes.* Currently, body mass index is the primary criterion for diagnosis and treatment decisions in obesity management among healthcare providers. However, the findings presented in this thesis show that an increased waist circumference, which is associated with cardiovascular diseases (12-14, 53-55), identifies an additional 6.4% of individuals at increased cardiovascular risk (**Chapter 5**). This suggests that measuring waist circumference is a valuable additional risk factor in determining who is eligible for a cardiovascular risk assessment. Therefore, we recommend adding waist circumference as an eligibility criterion for cardiovascular risk assessment in the current guideline *cardiovascular risk assessment* of the Dutch College of General Practitioners (NHG), alongside existing risk factors (e.g., premature family history of cardiovascular disease, obesity ≥30kg/m²). We also recommend including waist circumference in the decision-making process for both bariatric surgery and the prescription of pharmacological treatments.

Personal experience of the author (general practitioner in training)
Ms Y, 45 years old, came to my consultation with a persistent cough. We discussed her symptoms, and we determined a way of addressing them. Throughout the consultation, I found myself thinking that she likely had a high BMI, yet I could not find any mention of it in her medical record. An internal dialogue started on whether to address the topic of her weight. Why am I hesitating? What is holding me back?

As we were wrapping up the consultation and she was about to stand up, I felt I could not let the moment pass. At the last minute, I asked, *"Would you mind if I ask you something about your weight or would that be uncomfortable?"*

She replied, *"Of course, go ahead,"* and immediately began sharing her story. I could see that it brought her relief. I recorded her self-reported weight in the medical record.

Afterwards, I remembered the focus group discussion I had conducted. Why was it so difficult for me to raise the issue? What would make this easier next time? This moment suddenly made clear how challenging it can be to address obesity in practice – even after spending three years researching the topic.

Implications for general practitioners

The personal experience of the author above is presented to illustrate the challenges general practitioners (in training) face, and the need to support them in initiating conversations about weight and addressing obesity in routine consultations. We present several recommendations based on the findings of this thesis which could support general practitioners in addressing obesity.

- *Continuity of care:* aim to establish long-term trustworthy relationships between doctors and patients, as a trusting relationship facilitates discussing weight (56). The increasing presence of locum general practitioners in Dutch primary care threatens continuity of care (57, 58), which needs to be addressed in order to provide adequate support for obesity in primary care.
- *Equipment in every consultation room:* provide a scale and measuring tape (for both waist circumference and height) in every consultation room.
- *Routine measuring body mass index and waist circumference*: consider routinely measuring BMI and waist circumference.
- *User-friendly electronic health record system:* ensure that BMI and waist circumference can be easily recorded in the electronic health records.

- *Education and up-to date information:* keep abreast of the latest developments in the treatment of obesity. During the focus group discussions (**Chapter 3**) conducted in 2020-2021, some general practitioners were unfamiliar with the combined lifestyle intervention and pharmacological treatments were discussed to a limited extent at that time. This illustrates the rapid advances in obesity management in recent years, particularly the growing emphasis on pharmacological treatments. To ensure that general practitioners can effectively manage obesity, it is important to provide them with ongoing support and education.
- *Collaboration between practice nurses:* ensure close collaboration between the practice nurse for physical health (*Praktijkondersteuner-somatiek)* and the practice nurse for mental health *(Praktijkondersteuner-GGZ)* when treating patients with obesity and depressive symptoms or who have experienced negative life events. This thesis highlights the need for improved collaboration to address both the mental and physical dimensions of obesity in a coordinated and integrated way.

Methodological considerations

This thesis combines several research methods, including analysis of routine primary healthcare records, qualitative focus group discussions with general practitioners, and a cohort study with almost ten years of follow-up, to provide a comprehensive understanding of obesity management in primary care. Together, these different study approaches provide a broad perspective on the challenges and opportunities in obesity management. The implementation of both qualitative and quantitative findings into clinical practice is essential to improve obesity management (59).

The generalisability of the findings should be interpreted with caution for healthcare settings outside of the Netherlands. The data used in this thesis are specifically related to the Dutch primary healthcare system, which has its own unique structure and practice. While the findings are valuable in the Dutch context, their applicability to other healthcare systems may be limited. Additional studies in different healthcare settings and populations are needed to assess the broader relevance of these findings. It is also important to note that the findings of this thesis are not generalizable to children, as the study focused exclusively on adults. This is an important limitation, particularly as children are a key target group for obesity prevention. Addressing obesity early in life is crucial to limiting the long-term health and societal consequences of the condition.

Routine healthcare data

For the routine healthcare data, we used data from the Extramural LUMC Academic Network (ELAN). A key strength of this data was that it allowed us to analyse real-life clinical care over multiple years, without the bias associated with self-reported data. It also comprised >1 million electronical health records. A limitation of using routine healthcare data is that its quality depends on the documentation practices of healthcare professionals. As the data is recorded during regular consultations and not specifically for research purposes, there may be issues with completeness and consistency of the information.

Focus group discussions

Qualitative research aims to reflect diversity rather than achieve generalisability. However, its relevance to clinical practice partly depends on the extent to which findings can be transferred to other contexts (60). In **Chapter 2**, we presented three real-life examples to support readers in assessing the transferability of our findings to their own settings. In the focus group discussions, we examined three specific behaviours of general practitioners when addressing obesity: discussing weight, diagnosing, and referring patients with obesity. Although this structured approach enabled us to generate specific, actionable insights, the wide scope of the discussions limited the opportunity to explore certain topics in depth. For example, the topic of waist circumference might have benefited from more focused attention. Despite these limitations, data saturation was reached after six focus groups, suggesting that no additional barriers or facilitators would have emerged with further discussions.

The Netherlands Epidemiology of Obesity study

In this thesis, we used data from the Netherlands Epidemiology of Obesity (NEO) study, a population-based cohort study. A key strength is the broad range of baseline data available, which allows for comprehensive analyses. A limitation of this study is the oversampling of individuals with a body mass index ≥27 kg/m², which may limit the external validity of the findings to Dutch primary care settings. However, since the time of data collection (2008-2012), the prevalence of overweight and obesity has increased, making the study population increasingly more representative of the general population. Another limitation is that the self-reported data at baseline could not be verified against diagnosis recorded in electronic health records. However, de Boer et al. found that there was 98% agreement between self-reported diabetes and the reference standard, and 99% agreement between an ICPC-coded (International Classification of Primary Care) diabetes diagnosis and the reference standard, suggesting that self-reported data can be reliable for certain conditions (61). Lastly,

the study population consist predominantly of white individuals which may limit the generalizability of the findings to more ethnically diverse populations.

Future perspectives and recommendations for future research

Considering the low recording practices observed in this thesis, measuring body mass index and waist circumference should be more seamlessly integrated into daily workflows, possibly through digital prompts or assessment during an intake consultation or before regular consultations by the medical assistant. Another innovative solution could be the development of a patient self-assessment system in the waiting room, allowing patients to independently measure their body mass index and waist circumference. These anthropometric measurements could then be automatically uploaded to the patient's medical record, reducing the burden on healthcare providers, and ensuring consistent documentation. This approach would streamline the recording process and enable patients to take an active role in monitoring their health. Further research is needed to design, implement and evaluate these interventions in order to support the routine measurement of body mass index with waist circumference in primary care.

An increasing range of pharmacological treatments for obesity is likely to become available in the coming years. Current injectable drugs (e.g. liraglutide, tirzepatide) will increasingly be replaced by oral drugs, and these treatments are becoming increasingly effective (62, 63). Currently, these treatments are relatively expensive. In the future, however, patents will expire, reducing the costs of these treatments. This trend is expected to continue in Europe over the next five to ten years, leading to the potential widespread adoption of these therapies (64). Given these new developments in pharmacological treatments for obesity and the growing interest of patients in pharmacological treatment options, future research should focus on understanding the barriers that general practitioners face in prescribing these newly available drugs for obesity. Addressing the barriers that general practitioners face in prescribing these drugs is essential for the appropriate and increased use of these treatments in primary care.

Another important direction for future research is to unravel the multifactorial nature of obesity and the underlying mechanisms that contribute to obesity-related diseases which are beginning to be elucidated (5, 65). Some not yet identified interactions, mechanisms and processes may prove crucial to a full understanding of the condition and its consequences. For instance, not all individuals with obesity face the same health risks. Some can live with what is known as 'metabolically healthy obesity,' while others are at greater risk of developing obesity-related diseases (66). Future research should

focus on identifying high-risk patients more effectively in order to develop targeted and personalised prevention and treatment strategies. Artificial intelligence (AI) can play a crucial role in this process by analysing complex data patterns to improve patient identification and risk stratification, enabling more precise and personalised care.

Time to tip the scales

Obesity management in primary care needs to be adapt further to the increasing prevalence of obesity: *Time to tip the scales and find balance.* Addressing the key insights of this thesis, which highlight the importance of implementing both quantitative and qualitative findings, can contribute to a more effective approach to obesity management in primary care. Ultimately, obesity management should focus more on prevention rather than treating its effects.

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Chapter 7

Nederlandse samenvatting

List of publications

Dankwoord

Curriculum Vitae

NEDERLANDSE SAMENVATTING

Obesitas is wereldwijd een groot gezondheidsprobleem en wordt geassocieerd met vele ziekten, waaronder hart- en vaatziekten, diabetes mellitus type II, gewrichtsklachten, geestelijke gezondheidsproblemen en bepaalde soorten kanker. De toename van obesitas-gerelateerde ziekten zorgt niet alleen voor een toenemende belasting op de zorg maar heeft ook bredere maatschappelijke gevolgen. De zorgkosten stijgen door een toenemende behoefte aan langdurige behandelingen, medicatie en medische bezoeken. Daarnaast is de maatschappelijke bijdrage van mensen met obesitas vaak beperkter, door lagere arbeidsparticipatie, een groter aantal ongezonde levensjaren, en een verhoogde kans op vroegtijdig overlijden. Dit benadrukt het belang van het aanpassen van het huidige (zorg)systeem aan de toenemende prevalentie van obesitas met als uiteindelijk doel obesitas te voorkomen*: Time to tip the scales on obesity and find balance*.

Door de toegenomen prevalentie van obesitas is effectieve preventie, vroege identificatie en behandeling van risicopatiënten van cruciaal belang. De eerstelijnszorg speelt hierin een belangrijke rol aangezien huisartsen vaak het eerste aanspreekpunt zijn voor deze patiënten. Zij identificeren en begeleiden patiënten met obesitas en obesitas-gerelateerde aandoeningen. Het is belangrijk om de huidige praktijken in de eerstelijnszorg te onderzoeken om huisartsen te ondersteunen in een effectieve aanpak van deze patiënten.

Daarnaast is obesitas een multifactoriële aandoening, waarbij complexe interacties plaatsvinden tussen biologische, gedragsmatige, sociale en omgevingsfactoren. Visceraal vet, dat zich rondom de interne organen ophoopt, speelt bovendien een belangrijke rol in de ontwikkeling van obesitas-gerelateerde gezondheidsrisico's, met name cardiovasculaire aandoeningen. Het meten van de buikomvang is een eenvoudige manier om de hoeveelheid visceraal vet vast te stellen. Het begrijpen van deze complexiteit van obesitas is belangrijk voor het tijdig herkennen van patiënten die een verhoogd risico hebben op obesitas-gerelateerde ziekten, zodat in de eerste lijn vroegtijdige behandeling ingezet kan worden.

Dit proefschrift heeft als doel een bijdrage te leveren aan het verbeteren van de zorg voor patiënten met overgewicht en obesitas in de eerste lijn en zal zich focussen op 1. de huidige aanpak van obesitas in de eerste lijn 2. de identificatie van patiënten met obesitas met een verhoogd risico op gewichtstoename op de lange termijn of cardiovasculaire ziekten.

Deel I. De huidige aanpak

In het eerste deel van dit proefschrift onderzochten we de huidige aanpak van obesitas in de eerste lijn. De bevindingen van deel I staan beschreven in **hoofdstuk 2** en **3**.

In **hoofdstuk 2** hebben we onderzocht wat de huidige aanpak is met betrekking tot het registreren van de body mass index (BMI) en het stellen van de diagnose overgewicht en obesitas in de eerste lijn. Daarnaast hebben we een sub-analyse gedaan naar leeftijd, geslacht en obesitas-gerelateerde aandoeningen. We maakten gebruik van routine huisartsendata van ELAN (Extramuraal LUMC Academisch Netwerk) en analyseerden 676.708 elektronische patiëntendossiers uit de eerste lijn. Tussen 2007 en 2023 namen de incidentiecijfers van geregistreerde BMI-metingen toe. Gedurende de COVID-19 pandemie (2020-2022) was er een tijdelijke daling van de incidentiecijfers, waarna de registratie in 2023 weer toenam. Op dit moment wordt de BMI niet routinematig geregistreerd in de huisartsenpraktijk. Bij slechts één derde van de volwassenen werd een BMI-meting geregistreerd in het patiëntendossier. De BMI werd met name geregistreerd bij volwassenen met chronische ziekten zoals chronische obstructieve longziekte (COPD), diabetes mellitus type II, hypertensie en artrose. De BMI werd minder vaak geregistreerd bij psychische aandoeningen zoals een depressie of eetstoornis. Vanwege de toenemende prevalentie van obesitas bevelen we routinematige registratie van de BMI in de eerste lijn aan.

In **hoofdstuk 3** beschreven we een kwalitatieve studie bestaande uit zes focusgroepen met in totaal 21 huisartsen. In deze studie werden belemmerende en bevorderende factoren voor drie belangrijke taken van de huisarts in de aanpak van obesitas onderzocht: het bespreekbaar maken van het gewicht, het stellen van de diagnose obesitas en het doorverwijzen van patiënten met obesitas. Huisartsen werden belemmerd in het bespreken van het gewicht als de gepresenteerde klacht van de patiënt niet gerelateerd was aan obesitas. Andere barrières voor het bespreken van het gewicht waren de angst voor een negatieve reactie van de patiënt, en de opvatting van huisartsen dat het onderwerp te gevoelig lag. Ze gaven aan dat een langdurige vertrouwensband met de patiënt het bespreken van het gewicht makkelijker maakte. Het diagnosticeren van obesitas werd belemmerd door omgevingsfactoren, waarbij het gebrek aan tijd en (geschikte) materialen als voornaamste redenen werden genoemd. De belangrijkste barrières voor het doorverwijzen van patiënten met obesitas waren het ontbreken van verwijsmogelijkheden in de buurt, maar ook de twijfel of het überhaupt zinvol was om te verwijzen. We concludeerden dat er verschillende belemmeringen zijn voor het bespreken van het gewicht, het stellen van de diagnose obesitas en verwijzen van patiënten met obesitas. Dit benadrukt het belang van op maat gemaakte interventies voor elk van deze drie taken in plaats van één algemene

aanpak van obesitas. Het is belangrijk dat niet alleen kennis en vaardigheden van huisartsen worden aangepakt, maar ook dat de opvattingen van huisartsen over de gevolgen van de aanpak van obesitas veranderen, dat langdurige behandelrelaties worden opgebouwd en dat er voldoende tijd en materialen beschikbaar zijn.

Deel II: Identificatie van hoog-risico patiënten met obesitas

In het tweede deel van dit proefschrift identificeerden we patiënten met obesitas met een verhoogd risico op gewichtstoename op de lange termijn of cardiovasculaire ziekten. De bevindingen van deel II staan beschreven in **hoofdstuk 4** en **5**.

In **hoofdstuk 4** onderzochten we bij personen van middelbare leeftijd met overgewicht of obesitas de associatie van angst, depressie, negatieve levensgebeurtenissen en kwaliteit van leven op gewichtsverandering na tien jaar. We gebruikten data van de NEO-studie (Nederlandse Epidemiologie van Obesitas studie). Bij aanvang van het onderzoek werd het gewicht van de deelnemers gemeten en vulden zij vragenlijsten in over hun psychosociale klachten. Na een gemiddelde follow-up van bijna tien jaar werd opnieuw het gewicht van de deelnemers gemeten (zelf-gerapporteerd). We ontdekten dat zowel depressieve klachten als het meemaken van negatieve levensgebeurtenissen geassocieerd waren met gewichtstoename na tien jaar. Angstklachten en kwaliteit van leven waren niet geassocieerd met gewichtsverlies of gewichtstoename. Wij adviseren in de eerstelijnszorg proactief aandacht te besteden aan patiënten met obesitas en depressieve klachten, evenals aan patiënten met obesitas die negatieve levensgebeurtenissen meemaken. Een goede samenwerking tussen psychosociale en somatische zorgverleners zou de zorg voor patiënten met overgewicht/obesitas en psychische problemen mogelijk ten goede kunnen komen.

Tenslotte onderzochten we in **hoofdstuk 5** de toegevoegde waarde van het meten van de buikomvang in de eerste lijn. We maakten gebruik van een *mixed-methods* benadering. Deze studie bestond uit drie delen waarbij drie datasets werden gebruikt, data van het Extramuraal LUMC Academisch Netwerk (ELAN), kwalitatieve data, en data van de Nederlandse Epidemiologie van Obesitas studie (NEO-studie). In het eerste deel, waarin we gebruikmaakten van routine huisartsendata van ELAN, vonden we dat het aantal geregistreerde buikomvangmetingen tussen 2007 en 2023 afnam. In het tweede deel, waarin we gebruikmaakten van kwalitatieve data, vonden we dat huisartsen werden belemmerd bij het meten van de buikomvang, omdat zij zich er ongemakkelijk bij voelden of geen meetlint beschikbaar hadden. Daarnaast hadden zij de opvatting dat het meten weinig toegevoegde waarde had en beschikten zij niet over voldoende vaardigheid om het nauwkeurig te meten. Bevorderende factoren voor huisartsen bij het meten van de

buikomvang waren de aanwezigheid van een meetlint in de spreekkamer en het besef dat een verhoogde buikomvang een risicofactor voor hart- en vaatziekten is. In het laatste deel, waarin we data van de NEO-studie gebruikten, vonden we dat het meten van de buikomvang bijna 90 procent van de personen met een matig verhoogd risico en ongeveer 93 procent van de personen met een hoog risico op hart- en vaatziekten identificeert. Daarnaast is het toevoegen van een verhoogde buikomvang aan de huidige selectiecriteria voor cardiovasculaire risicobeoordeling in de NHG (Nederlands Huisartsen Genootschap) richtlijn *cardiovasculair risicomanagement* van toegevoegde waarde. Het leidt tot de identificatie van ruim zes procent extra personen met een matig verhoogd risico op hart- en vaatziekten. Samenvattend vonden wij dat het meten van de buikomvang een efficiënte, kosteneffectieve en eenvoudige methode is om patiënten in de eerste lijn te selecteren voor cardiovasculaire risicobeoordeling. Daarnaast is het van belang dat de belemmeringen die huisartsen ervaren bij het meten van de buikomvang worden aangepakt.

Alles overziend, concluderen wij dat de BMI en de buikomvang tot op heden weinig worden geregistreerd in de patiëntendossiers van de huisarts. Het aanpakken van de belemmerende factoren van huisartsen in het bespreken van het gewicht, het diagnosticeren van obesitas en het verwijzen van patiënten met obesitas vergt naast het verbeteren van kennis en vaardigheden van de huisarts, ook het opbouwen van langdurige behandelrelaties, het creëren van een ondersteunende werkomgeving, en verandering in de opvattingen over de gevolgen van de aanpak van obesitas. Proactieve aandacht voor patiënten met depressieve klachten en patiënten die negatieve levensgebeurtenissen meemaken is nodig, omdat zij een grotere kans op gewichtstoename hebben na verloop van tijd. Daarnaast bevelen we aan de buikomvang te meten in de eerste lijn; het is een kosteneffectieve en eenvoudige meting waarmee patiënten met een verhoogd risico op hart- en vaatziekten kunnen worden geïdentificeerd.

Implicaties voor de praktijk en toekomstperspectieven

De bevindingen van dit proefschrift leiden tot verschillende implicaties voor het verbeteren van de zorg voor patiënten met obesitas in de eerste lijn. We doen aanbevelingen voor het aanpassen van richtlijnen en voor praktische ondersteuning van huisartsen bij de aanpak van obesitas.

Allereerst bevelen wij aan om zowel de NHG-richtlijn *Obesitas* als de NHG-richtlijn *Cardiovasculair Risicomanagement* te herzien. Op het moment van het schrijven van dit proefschrift (2025) dateert de NHG-richtlijn *Obesitas* uit 2010. Het ontbreken van een actuele richtlijn betekent dat huisartsen zich moeten baseren op verouderde

aanbevelingen voor de behandeling van een aandoening die in prevalentie toeneemt en waarvan de complexiteit steeds meer wordt erkend. Het is bemoedigend dat de herziene richtlijn in oktober 2025 wordt verwacht. Daarnaast bevelen wij aan om in de NHG-richtlijn *Cardiovasculair Risicomanagement* een verhoogde buikomvang toe te voegen aan de selectiecriteria voor cardiovasculaire risicobeoordeling. Hiermee kunnen nog onbekende patiënten met een verhoogd risico op hart- en vaatziekten worden geïdentificeerd.

Op basis van de bevindingen van dit proefschrift formuleren wij tevens een aantal praktische aanbevelingen om huisartsen te ondersteunen bij de aanpak van obesitas:

- *Continuïteit van zorg*: streef naar langdurige behandelrelaties tussen arts en patiënt omdat een vertrouwensband het bespreken van het gewicht bevordert.
- *Beschikbaarheid van meetlint en weegschaal in iedere spreekkamer***:** zorg dat in elke spreekkamer een weegschaal en een meetlint (voor zowel lengte als buikomvang) beschikbaar is.
- *Routinematig meten van de BMI en buikomvang***:** overweeg om routinematig de BMI en buikomvang te meten.
- *Gebruiksvriendelijk elektronisch patiëntendossier*: zorg voor een eenvoudige manier om de BMI en buikomvang vast te leggen in het elektronische patiëntendossier.
- *Voorlichting en actuele informatie*: blijf op de hoogte van recente ontwikkelingen in de behandeling van obesitas**.**
- *Samenwerking tussen praktijkondersteuners:* zorg voor een nauwe samenwerking tussen de praktijkondersteuner somatiek en de praktijkondersteuner geestelijke gezondheidszorg bij patiënten met obesitas en depressieve klachten of die negatieve levensgebeurtenissen meemaakten om een integrale benadering van obesitas te bevorderen.

Toekomstig onderzoek zou zich kunnen richten op het probleemloos integreren van het meten van de BMI en buikomvang in de huisartsenpraktijk. Denk hierbij aan het implementeren van digitale prompts in het patiëntendossier of het routinematig integreren van de metingen tijdens consulten. Tot slot is het belangrijk inzicht te krijgen in de belemmerende en bevorderende factoren waarmee huisartsen te maken hebben bij het voorschrijven van recent op de markt gebrachte medicatie voor obesitas, zoals de GLP-1 receptoragonisten (e.g. semaglutide, liraglutide). Dit is belangrijk om passende en toegankelijke zorg voor obesitas in de komende jaren te waarborgen.

Time to tip the scales

Het is tijd om de zorg voor patiënten met obesitas in de eerste lijn aan te passen aan de toenemende prevalentie van obesitas: *Time to tip the scales and find balance.* Het aanpakken van de belangrijkste inzichten uit dit proefschrift, waarbij de implementatie van zowel kwantitatieve als kwalitatieve bevindingen belangrijk is, kan bijdragen aan een effectievere aanpak van obesitas in de eerste lijn. Uiteindelijk zal de aanpak van obesitas meer gericht moeten zijn op preventie dan op het behandelen van de gevolgen.

LIST OF PUBLICATIONS

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DANKWOORD

Nu kan ik eindelijk zeggen dat dit proefschrift af is.

Het was een traject met *ups* en *downs*, maar dit proefschrift zou niet tot stand zijn gekomen zonder de steun van velen. Iedereen die direct of indirect heeft bijgedragen aan de totstandkoming van dit proefschrift wil ik graag bedanken, waarvan enkelen in het bijzonder.

Allereerst wil ik mijn promotor prof. dr. Numans danken. Beste Mattijs, dank voor het vertrouwen dat je in mij had om dit traject te starten. Jouw vooruitziende, overstijgende blik en de allesomvattende vraag *'Ben je al bijna klaar?'* hebben ervoor gezorgd dat dit proefschrift er nu ligt. Daarnaast mijn onmisbare tweetal aan copromotoren: dr. Van Peet en dr. Mook-Kanamori. Beste Petra, jouw zorgzaamheid, betrokkenheid en je nuchtere, maar altijd oprechte steun, evenals je vermogen om verder te kijken dan alleen dit proefschrift, waren van onschatbare waarde. Beste Dennis, ik bewonder jouw enthousiasme, positieve blik en het vermogen om altijd door te pakken. Jij verliest je niet in de details, maar houdt de grote lijn in de gaten. Ik heb veel geleerd van jouw kennis van de epidemiologie. Petra en Dennis jullie sloten perfect op elkaar aan in de begeleiding. Dank daarvoor! Daarnaast wil ik dr. Büchner danken. Frederike, we hebben samengewerkt tot begin 2022. Samen met Petra, heb jij mij begeleid met de start van dit proefschrift, dankzij jou had ik me geen betere start van dit traject kunnen wensen.

Ik kijk met veel waardering terug op de samenwerking met de afdeling Epidemiologie van het LUMC, en in het bijzonder met dr. de Mutsert. Beste Renée, dank voor je kennis, betrokkenheid, gedrevenheid en oog voor detail. Jouw blik heeft in belangrijke mate bijgedragen aan de kwaliteit van dit onderzoek.

Mede-Aiotho's, mede-promovendus, p0rrelaars, P0-gangers en HAIO's, dank voor de ondersteuning, gezelligheid, kletspraatjes, borrels en samenwerking, zonder jullie was dit promotie-traject een stuk saaier geweest.

Lieve paranimfen, Laurien Zijlstra en Noortje van den Hout, dank dat jullie me bijstaan op deze bijzondere dag.

Tot slot wil ik mijn familie en vrienden danken, en in het bijzonder mijn ouders en zusjes. Lieve pappa, jouw enthousiasme, trots, en onvoorwaardelijke steun geven mij een blij gevoel en versterken mijn eigen enthousiasme. Lieve mamma, jouw luisterend

vermogen, evenwichtige houding en liefdevolle steun betekenen ontzettend veel voor mij. Dank jullie wel voor een leven lang onvoorwaardelijke steun. Lieve Noor, mijn tweelingzusjes, we kiezen onze eigen weg, maar toch eindigen onze paden hetzelfde, dat had ik nooit gedacht. Dank dat je altijd een luisterend oor hebt, zowel vakinhoudelijk als privé. De illustratie op de omslag is prachtig! Lieve Heleen, jij bent er altijd voor me, ik waardeer je betrouwbaarheid, betrokkenheid en zorgzaamheid.

Lieve Karst, ik denk dat je mij, en mijn pieken en dalen, nog beter hebt leren kennen tijdens dit promotietraject. Je gaat onvoorwaardelijk met me mee in mijn pieken en weet mijn dalen te koesteren. Dank je wel voor je liefde en geduld.

CURRICULUM VITAE

Willemijn Julia van den Hout werd geboren op 3 maart 1992 te Utrecht. In 2010 behaalde zij haar VWO-diploma aan de Bataafse Kamp te Hengelo. Aan de Universiteit Leiden studeerde zij geneeskunde. Zij rondde haar studie in 2018 af met een semi-artsstage in de huisartsgeneeskunde waarna zij startte als ANIOS interne geneeskunde in het Alrijne ziekenhuis te Leiderdorp. In maart 2020 begon zij met promotieonderzoek in combinatie met de huisartsenopleiding aan het Leids Universitair Medisch Centrum. Het promotieonderzoek heeft zij verricht aan de afdeling Public Health en Eerstelijnsgeneeskunde onder supervisie van prof. dr. M.E. Numans, dr. D.O. Mook-Kanamori en dr. P.G. van Peet. De resultaten zijn beschreven in dit proefschrift. Het eerste jaar van de huisartsenopleiding vond plaats in Alphen aan den Rijn bij huisartsenpraktijk Prelude. Sinds maart 2025 is zij werkzaam in huisartsenpraktijk de Linde in Leimuiden voor het laatste jaar van de opleiding. Zij verwacht de opleiding tot huisarts in april 2026 af te ronden.