Management of overweight and obesity in primary healthcare

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Management of overweight and obesity in primary healthcare

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Contents

Chapter 1

General introduction

During the 19th century, both height and body weight increased in populations from developed countries. During the 20th century, the increase in height levelled off, while weight continued to increase [1]. Nowadays, excess weight has become a major public health problem in most countries around the world, and interventions and policies have not yet been able to stop the obesity epidemic [2]. In the Netherlands, about half of the adult population is at increased weight-related health risk, and may benefit from weight management services [3]. This thesis focuses on the health status and management of overweight and obesity in Dutch primary healthcare.

Overweight and obesity

A person's weight status is generally described by the body mass index (BMI). This measure was first introduced in the 19th century by Adolphe Quetelet, who defined it as a person's weight in kilograms divided by the square of the person's height in meters (kg/m^2). In 1972 the American nutritionist Ancel Keys gave Quetelet's calculation its modern name (BMI) along with evidence to support its usage in quantitative studies on health and disease [4].

The BMI is used to classify persons into weight categories, and is a risk indicator for morbidity (Table 1). According to the World Health Organization, overweight is defined as a BMI of 25 or more, including pre-obesity defined as a BMI between 25 and 30, and obesity as defined by a BMI of 30 or more [5]. However, pre-obesity and overweight are often used interchangeably, thus giving overweight a definition of a BMI of between 25 and 30.

Table 1 The classification of weight status and risk of comorbidities, according to body mass index [5]

Body mass index	Weight classification	Risk of comorbidities
< 18.5	Underweight	Low (but risk of other clinical problems)
18.5-24.9	Normal weight	Average
≥ 25.0	Overweight:	
25.0-29.9	Pre-obesity	Increased
30.0-34.9	Obesity class I	Moderate
35.0-39.9	Obesity class II	Severe
≥ 40.0	Obesity class III	Very severe

In 2013, the global prevalence of overweight (BMI ≥ 25) and obesity (BMI ≥ 30) in adults was estimated at approximately 40 % and 10 %, respectively [6]. In the Netherlands, the prevalence of overweight and obesity increased over the last decades; up to approximately 50% of adults being overweight (BMI ≥ 25) (Figure 1) [7].

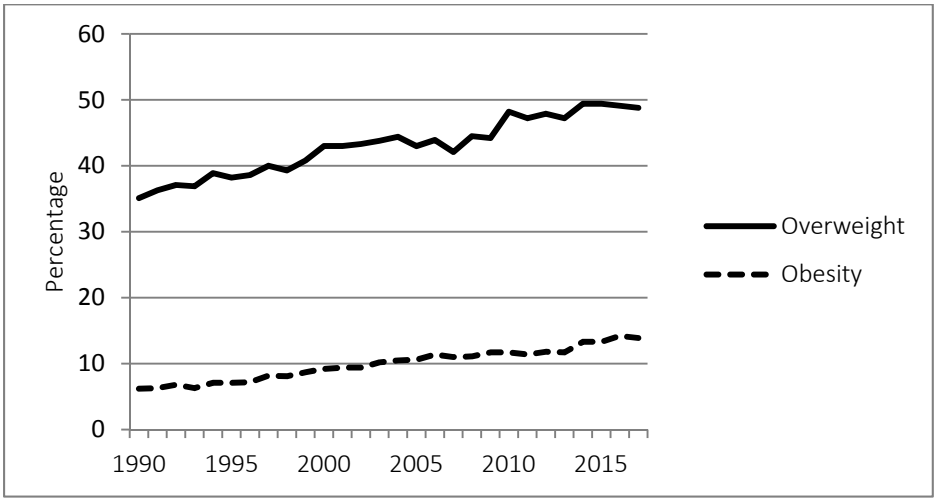

Figure 1 Prevalence of overweight and obesity in Dutch adults, 1990-2017 [7]

The fundamental cause of overweight is a long-term imbalance between energy intake and energy expenditure, and the rise in overweight and obesity prevalence is considered to be a result of the overabundant supply of energy-dense foods and a sedentary lifestyle in many countries around the world [8]. Excess weight lead to adverse effects on blood pressure, cholesterol, triglycerides, and insulin resistance, and is a major risk factor for several diseases: cardiovascular diseases, primarily coronary heart disease and stroke; diabetes mellitus type 2; musculoskeletal disorders, especially osteoarthritis; and some cancers [9-11]. Accordingly, overweight places a high burden on healthcare systems and imposes costs due to morbidity related productivity losses [12-14].

Weight management in primary healthcare

A large part of the care for patients with chronic diseases, such as diabetes mellitus, is provided in primary healthcare, and most primary healthcare systems in Europe provide services for management and treatment of overweight [15]. General practitioners (GPs), practise nurses, and dietitians are the main healthcare professionals to provide these services.

General practitioners are the gatekeepers of healthcare, and have a complete overview of their patients' health status which is recorded in electronic health records [16]. Data from the Netherlands and the UK show that most people consult their GP at least once a year, with an average consultation rate of approximately four to five times a year [17, 18]. With this regular contact frequency and often longstanding relationship with their patients, GPs and their practice nurses are in a unique position to monitor their patients' weight status over time and to play a key role in the diagnostic and management of overweight [19-22]. Weight management tasks by GPs and practise nurses may consist of regular

weight measurements, advisement on nutrition and physical activity, and might include referral to a lifestyle intervention, a dietitian, a physiotherapist, or to secondary care for bariatric surgery [19, 20, 23, 24].

Dietitians are also considered as important healthcare professionals for treatment of overweight persons [20, 21]. The primary aim of dietetic treatment in overweight patients is to achieve and maintain weight loss by assessing patients' diet and nutritional status and giving practical advice to improve dietary behaviour [25-27].

The Dutch primary healthcare system

In the last decade, Dutch primary healthcare increased its preventive services and health promotion activities, with the GP as the first-contact healthcare provider [28, 29]. In 2010, clinical guidelines for the treatment of obesity were introduced by the Dutch College of General Practitioners (NHG). These guidelines recommend diagnostic and treatment for patients, who ask for help with weight reduction or who are at increased weight related health risk [30]. At the same time, a new financial approach was introduced to stimulate the cooperation between different healthcare providers in primary healthcare setting in prevention and treatment of common chronic conditions [31]. This new approach was introduced for three highly prevalent chronic conditions in primary healthcare, including diabetes mellitus type 2 (prevalence ~7 %), chronic obstructive pulmonary disease (COPD) (prevalence ~4 %), and cardiovascular disorders (prevalence ~9 %) [7]. Therefore, several indicators were developed to measure healthcare quality in terms of structure, process, and outcome performance; one such indicator is the percentage of patients with a documented BMI in the last year [31]. The initial evaluation of the program indicated that it improved the organization and coordination of care and led to better adherence to care protocols [32]. Care protocols for diabetes mellitus type 2, COPD, and cardiovascular risk management recommend regular monitoring of these patients in general practice, at least annually, and include the evaluation of the weight status [33-35]. Furthermore, in 2011, a prevention program was implemented in general practices with the aim of identifying persons at increased risk for cardio metabolic disorders and to initiate and support lifestyle changes and treatment [36].

Challenges in weight management

Diet and physical activity counselling in adults may contribute to good overall health, and evidence suggests that a weight loss of 3-5 % of initial body weight may already lead to clinical meaningful improvements on several health outcomes [37]. However, weight management and other preventive tasks are not yet common practice in primary healthcare [19, 23, 38, 39]. A survey among Dutch GPs revealed that only a quarter of the GPs actively invite patients for preventive measurements [39], and other studies showed that GPs do not always feel responsible for discussing weight with their patients or experience other barriers such as time constraints [20, 40-43]. In addition to the perspective of healthcare professionals, successful weight management also depends on other factors, such as reimbursement of healthcare and patients' behaviour and perspectives [19, 40, 44-46].

The Dutch health insurance

In the Netherlands, a basic health insurance is obligatory for all citizens. The basis health insurance fully covers medical care provided by GPs, and dietetic healthcare within the multidisciplinary healthcare approach for patients with diabetes mellitus type 2, COPD, or cardiovascular disorders. Three hours of dietetic healthcare are also covered by the basic health insurance on condition of a compulsory deductible (€ 385 in 2019) that must be paid out-of-pocket before an insurer will pay. Persons are free to have additional health insurance packages that cover more hours of dietetic healthcare. Furthermore, GPs can refer patients to lifestyle interventions in primary healthcare, which is covered by the basic health insurance since 1 January 2019, and often include dietetic healthcare [47].

The National Prevention Agreement in the Netherlands

In the Netherlands, overweight was recently highlighted as a public health issue in the National Prevention Agreement, which aims to achieve a healthier population and to reduce the prevalence of overweight to less than 40 % in 2040 [48]. This agreement has been signed by about 70 organizations from local governments and the private sector and recommends primary healthcare providers to increase health promotion activities for overweight patients.

Aim and outline of this thesis

The aim of this thesis was to study the health status and management of overweight and obese patients in Dutch primary healthcare. For the studies included in this thesis, we evaluated real life primary healthcare data obtained from general practices and dietetic practices over the period from 2009-2017.

Chapter 2 describes the study that examined several health outcomes of overweight patients who participated in a lifestyle intervention, compared to overweight patients who received usual care. Chapter 3 describes the study on overweight patients with mild to moderate COPD. Within this study population we determined the association between the degree of overweight and the prevalence of comorbid disorders and prescribed medication for obstructive airway disease. Chapter 4 presents the study on weight recording in general practices for a group of patients who self-reported as being overweight. The study assessed the association between weight recording and patient characteristics, and determined the frequency of weight recording over time for patients with and without a chronic disorder related to overweight. Chapter 5 presents the study that evaluated weight change in overweight patients who were treated by primary healthcare dietitians. Chapter 6 describes the study that evaluated intermediate weight changes during dietetic treatment of overweight patients, and examined whether weight losses at previous consultations were associated with attendance at follow-up consultations. In chapter 7 the findings of this thesis are summarised and discussed.

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Chapter 2

Evaluation of a combined lifestyle intervention for overweight and obese patients in primary healthcare: a quasi-experimental design

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Abstract

Background: Combined lifestyle interventions (CLIs) are designed to reduce risk factors for lifestyle- related diseases through increasing physical activity and improvement of dietary behaviour. The objective of this study was to evaluate the effects of a CLI for overweight and obese patients on lifestyle-related risk factors and health care consumption, in comparison to usual care.

Methods: Data on anthropometric and metabolic measurements, morbidity, drugs prescriptions and general practitioner (GP) consultations were extracted from electronic health records (timeframe: July 2009–August 2013). Using a quasi-experimental design, health outcomes of 127 patients who participated in a 1-year CLI were compared to a group of 254 matched patients that received usual care. Baseline to post-intervention changes in health outcomes between intervention and comparison group were evaluated using mixed model analyses.

Results: Compared to baseline, both groups showed reductions in body mass index (BMI), blood pressure, total cholesterol and low density lipoprotein (LDL) cholesterol in year post-intervention. For these outcome measures, no significant differences in changes were observed between intervention and comparison group. A significant improvement of 0.08 mmol/l in high density lipoprotein (HDL) cholesterol was observed for the intervention group above the comparison group ($P < 0.01$). No significant intergroup differences were shown in drugs prescriptions and number of GP consultations.

Conclusions: A CLI for overweight and obese patients in primary healthcare resulted in similar effects on health outcomes compared to usual care. Only an improvement on HDL cholesterol was shown. This study indicates that implementation and evaluation of a lifestyle intervention in primary healthcare is challenging due to political and financial barriers.

Background

Worldwide, the proportion of adults with a body mass index (BMI) of 25 kg/m^2 or greater has increased from approximately 30 % in 1980 to almost 40 % in 2013 [1]. Overweight and obesity contribute to a large proportion of lifestyle-related diseases, such as diabetes type 2 and cardiovascular diseases (CVD), and places a high burden on the healthcare system [2]. Combined lifestyle interventions (CLIs) are designed to prevent or treat lifestyle-related diseases, by improving nutritional and physical activity behaviour. Medium to high intensity diet and physical activity counselling in adults with known CVD risk factors contribute to good cardiovascular and overall health, as shown in the evidence synthesis of Lin et al. [3]

In the Netherlands, a CLI called 'BeweegKuur' (exercise on prescription) was developed with the objective to achieve health benefits through increased physical activity and improved dietary behaviour. The development of the 'BeweegKuur' was based on theories regarding the level of motivation (Theory of Planned Behaviour), and type of motivation (Self-Determination Theory) in changing physical activity and/or diet. The objectives of the CLI were based on the main determinants of sustained changes in physical activity and dietary behaviour, including autonomous motivation, enjoyment of exercise, self-efficacy, health consciousness, knowledge on serving sizes and diet–disease relationships [4]. Initially the CLI was focussed on patients with (pre) diabetes, and later on overweight and obese patients at high risk for, or established CVD and/or diabetes [5]. Commissioned by the Dutch government, this CLI was implemented in 150 primary care practices in the Netherlands in 2010, offered by a multidisciplinary team of healthcare providers. Dependent on the level of weight-related health risk, participants could be involved in one of the three programs, differing in extent and intensity of physical activity support.

Only a few previous studies on lifestyle interventions in primary healthcare settings evaluated the baseline to post-intervention changes on lifestyle-related risk factors, by comparing it to a patient group receiving usual care [6–10]. One of these studies was on the BeweegKuur intervention for (pre) diabetes patients, that evaluated changes in lifestyle-related risk factors, by comparing a patient group that participated in the intervention to a matched group of patients receiving usual care. However, no significant or clinical relevant effects were found [8]. For this evaluation, data were extracted from electronic health records (EHRs) from general practices, which is an easy method to obtain longitudinal and objective information on health outcomes [11, 12].

The BeweegKuur intervention for overweight and obese patients has been evaluated on behaviour change and protocol adherence [13, 14], and will be evaluated on cost-effectiveness, by comparing two programmes of the intervention [15]. However, an evaluation on health outcomes in comparison to usual care was not yet performed. Therefore, the aim of the current study was to examine the effects of the BeweegKuur

intervention for overweight and obese patients on lifestyle-related risk factors and healthcare consumption, in comparison to usual care, using longitudinal data of EHRs.

Methods

Study design

A quasi-experimental design was used in this study, including an intervention group and a comparison group. For the intervention group, patients were selected from general practices that participated in one of the two studies: a Prospective Multicentre Cohort Study (PMCS) [13] and a clustered Randomized Controlled Trial (cRCT) [15].

In these two studies, patients were involved in one of the three programmes of the BeweegKuur intervention. Main inclusion criteria were: BMI > 25 kg/m^2, and a large waist circumference (≥ 88 cm for women, ≥ 102 cm for men). Having one or more comorbidities (hypertension, dyslipidemia, impaired fasting glucose, osteoarthritis, sleep apnea, diabetes and/or CVD), was also allowed as inclusion criteria [5]. The intervention took 1 year and is previously described by Helmink et al. [4] (see also Supplementary information for a detailed description of the intervention). All healthcare providers who were involved in the intervention were offered a training in motivational interviewing, consisting of 48-h sessions. During monthly telephone contacts between research team and healthcare providers, number of drop-outs and reasons were discussed.

A comparison group of 'usual care' patients was selected from general practices, of which continuous data has been collected from 2008 within the Nivel Primary Care Database (Nivel-PCD). These general practices did not participate in one of the two studies [13, 15] on the BeweegKuur intervention and were supposed to deliver usual care. According to the Dutch general practitioner (GP) guidelines for management of obesity [16], cardiovascular risk [17] and diabetes mellitus type 2 [18], in usual care, non-pharmacological treatment is recommended in patients having modifiable risk factors. Non-pharmacological treatment primarily consists of lifestyle advises by a GP or practice nurse, on nutrition, physical activity, and smoking. Sometimes these patients are advised to consult a dietician and/or a physiotherapist for more intensive guidance on improving nutritional and physical activity behaviour. Additional pharmacological treatment is advised to patients if target values of blood glucose cannot be reached by non-pharmacological treatment only, or to patients at high risk for CVD.

Data collection

In 2013, the GPs connected to the 29 general practices that participated in the two initial studies [13, 15], were asked by (e-)mail to sign a permission form for extracting data of the EHRs of their patients who participated in the CLI. Electronic health records are used in

Dutch general practices to file patient information on consultations, morbidity, drugs prescriptions and anthropometric and metabolic measurements, using the International Classification of Primary Care—version 1 (ICPC-1), and the Anatomical Therapeutic Chemical (ATC) classification system. Information on sex, age, BMI, blood pressure, cholesterol, drugs prescriptions, diagnoses of diabetes and CVD and the number of GP consultations, were evaluated in this study. The date of completing the baseline questionnaire of the initial studies [13, 15], was used as the start date of the CLI (between July 2010 and August 2011). For every patient, data were selected of 1 year before the start of the CLI (baseline), and of 1 year after the end of the CLI (post-intervention). Total timeframe of data collection was from July 2009 to August 2013.

Since data collection was part of usual care, measurements were not specific registered for this study. Therefore, mean values of BMI, blood pressure and cholesterol measurements were calculated of all available recorded outcome measures for each patient, over baseline year and post-intervention year. Three lifestyle-related drug types were established based on the ATC-classification system: (i) drugs for diabetes (A10), (ii) lipid modifying drugs (C10) and (iii) antihypertensive drugs (C02, C03, C07, C08 and C09). A patient was classified as 'user' if at least one prescription within the drug category was given in the specific year. The number of GP-consultations was calculated as the sum of consultations at the general practices, home visits, telephone consultations and e-mail consultations in the specific year (only consultations with the GP were counted, with a maximum of 1 per day).

Similar information was collected from EHRs of the general practices included in the comparison group. Out of the data of these general practices, two matched patients per intervention patient were selected. Matching criteria were: sex, age (± 2 years), BMI category (≤ 25; > 25 and ≤ 30; > 30 and ≤ 35; > 35 kg/m^2) and having a GP consultation or prescription for diabetes (ICPC-1 code: T90) and/or CVD (ICPC-1 codes: K74-K76, K89-K92, K99) in baseline year. For intervention patients with missing BMI in baseline year, matched patients with a BMI > 25 and ≤ 35 kg/m^2 and a BMI > 25 and ≤ 40 kg/m^2 were selected for intervention patients from respectively the PMCS and the cRCT (mean BMI of patients in the cRCT was higher than in the PMCS).

Statistical analyses

Data management and statistical analyses were performed using STATA 13.0. Descriptive statistics were used to present baseline and post-intervention values. Only patients from whom at least one measurement of the particular outcome measure was recorded in their EHR could be incorporated in the analyses. Differences in changes in outcome measures between the intervention and comparison group were evaluated by mixed model analyses (also for changes within groups over time). To test for intergroup differences, three level

models were constructed including a group variable (intervention/comparison group), a time variable (baseline/post-intervention), an interaction term (group*time) and random intercepts to account for clustered data of patients within general practices, and for repeated measurements within patients. In the models for BMI, blood pressure and cholesterol levels, additional adjustments were made for sex and age. Further analyses were conducted, stratified by baseline BMI category (≤ 30; > 30 and ≤ 35; > 35 kg/m^2). Additional analyses (using same models) were executed to examine whether results were different by (i) excluding patients with missing data at baseline or post-intervention year, and (ii) excluding intervention patients (and their matched patients) who were known to be dropout during the intervention. Drop-outs were defined as patients that did not complete the whole intervention period according to the lifestyle advisor. For all analyses, a *P* value of < 0.05 was considered as significant.

Results

Of the 29 general practices participating in the PMCS and the cRCT, GPs of 12 general practices gave permission for data extraction. Data extraction from 3 out of 12 general practices could not be performed because permission form was received too late, or due to failures in the data extraction method. Selected patients with unknown starting date of the intervention or with incomplete data extraction (i.e. not registered in general practice for 3-year follow-up period) were excluded from this study. Eventually, data on health outcomes of 127 intervention patients were identified from EHRs in 9 general practices (Figure 2.1). From 11 general practices participating in the Nivel-PCD, a comparison group of 254 matched patients was selected.

Mean baseline age of the 127 patients and their 254 matched patients was 55 years, 39 % were men, and 77 % of the patients was classified as obese (BMI > 30 kg/m^2) (Table 2.1). Within both intervention and comparison group, mean BMI, blood pressure, total cholesterol and low density lipoprotein (LDL) cholesterol were reduced from baseline to post-intervention (Table 2.2). However, for these outcome measures no significant differences in changes were observed between the intervention and comparison group. For high density lipoprotein (HDL) cholesterol, a significant increase of 0.08 mmol/l in HDL cholesterol was shown in the intervention group above the comparison group (*P* < 0.01, intergroup difference). Within both groups, the proportion of patients who received drug prescriptions for lipid modifying drugs increased over time (*P* = 0.02, within intervention group). However, no significant intergroup differences were shown for drugs prescriptions and yearly number of GP consultations.

Further analyses (intergroup only) were performed by stratification on baseline BMI category (Table 2.3). In these analyses, 27 patients and their 54 matched patients could not

be incorporated due to an unknown baseline BMI. In patients who were severely obese at baseline (BMI > 35 kg/m^2), a significant increase in HDL cholesterol of 0.13 mmol/l was shown in the intervention group above the comparison group (P < 0.01, intergroup difference). In the other BMI groups, no significant intergroup differences were found for HDL cholesterol. In none of the BMI groups significant intergroup differences were shown for BMI, blood pressure, total cholesterol, LDL cholesterol and drug prescriptions. In patients with a BMI > 30 and ≥ 35 kg/m^2, the median number of yearly GP consultations decreased more in the comparison than in the intervention group (P = 0.03, intergroup difference). However, no significant intergroup differences were found in the other two BMI-groups.

The drop-out rate of patients participating in the intervention was 20 %. Additional analyses, i.e. exclusion of patients with missing data and exclusion of drop-out patients, did not alter the results (see Supplementary table 2.1).

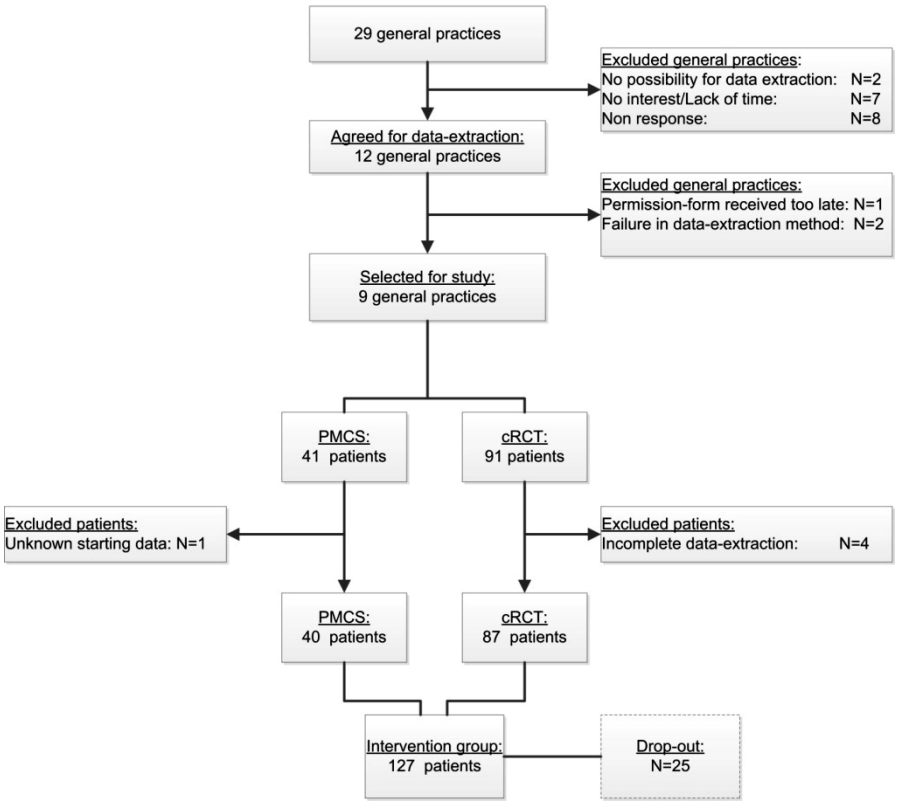

Figure 2.1 Flow diagram of intervention patients

Table 2.1 Characteristics of the study population in year before start of the BeweegKuur intervention (timeframe: July 2009–August 2011)

	Intervention group (*N* = 127)	Comparison group (*N* = 254)
Sex (% men)	39.4 %	39.4 %
Age, years [mean (SD)]	54.9 (11.9)	54.8 (11.8)
BMI category, (% patients)		
≤ 25 kg/m^2	2.0 %	2.0 %
> 25 and ≤ 30 kg/m^2	21.0 %	22.8 %
> 30 and ≤ 35 kg/m^2	39.0 %	37.4 %
> 35 kg/m^2	38.0 %	37.8 %
Diabetes (% patients)[a]	29.9 %	29.5 %
CVD (% patients)[a]	9.5 %	6.3 %

BMI body mass index, *CVD* cardiovascular diseases

[a]Having a GP consultation or drug prescription for this disease in year before start of the intervention.

Discussion

Overall, this study did not show improvements on lifestyle-related risk factors, or differences in drugs prescriptions and number of GP consultations in a patient group that participated in the BeweegKuur intervention, compared to a group of overweight or obese patients that received usual care. Only for HDL cholesterol an improvement was found.

Comparison with existing literature

Over time, mean BMI in the intervention group was reduced (−0.9 kg/m^2), but not significantly more compared to the usual care group (−0.5 kg/m^2). These modest reductions in BMI in both groups during follow-up were in line with results of previous West-European studies [9, 10], and even better than results of two studies conducted in study populations including mostly patients with already established CVD or diabetes type 2, that did not find a change in BMI during follow-up [7, 8]. A similar BMI reduction was found in an observational study in a Dutch primary healthcare setting that evaluated treatment of overweight patients given by dietitians, showing an average BMI reduction of −0.94 kg/m^2 at end of treatment. However, since only 6 % had reached a healthy BMI of < 25 kg/m^2 in this study, many patients did not achieve clinically relevant outcomes [19].

In both intervention and comparison group systolic blood pressure levels were decreased below target level of ≤ 140 mmHg in year post-intervention. Though, no intervention effects were shown on blood pressure levels. Previous studies on lifestyle interventions in primary healthcare that evaluated blood pressure levels showed varying results. A similar conducted Dutch study did not find changes in blood pressure in a

population of patients with (pre) diabetes [8]. Two other studies that evaluated blood pressure in patients at high risk for, or with established CVD, showed similar reductions in blood pressure in both intervention and comparison group [7], or greater reductions in the intervention group [6], although baseline blood pressure levels were higher in these studies (~145/90 mmHg), compared to our study (140/85 mmHg).

Other studies on lifestyle interventions in primary healthcare did not show intervention effects on total, LDL and HDL cholesterol [6, 8]. These outcomes on total and LDL cholesterol are in line with results found in our study. However, in our study an increase of 0.08 mmol/l on HDL cholesterol was found in the intervention group above the usual care group. Increased HDL cholesterol levels positively influence the total/HDL cholesterol ratio, which is used to estimate cardiovascular risk. Furthermore, a trend towards an increase in prescriptions for lipid modifying drugs (and a lowering of LDL cholesterol over time) was shown in both groups, which might be caused by the revision of the guidelines for cardiovascular management for Dutch GPs since January 2012, in which the targets for LDL cholesterol became stricter (≤ 2.5 mmol/l) [17]. So overall, lipid levels were improved during follow-up, even though baseline values were not unfavourable. Lipid-modifying drugs and high dietary fat intake mainly affect LDL cholesterol and not HDL cholesterol, while exercise training of longer than 12 weeks is associated with increased levels of HDL cholesterol from 0.05 to 0.20 mmol/l [20]. Possibly the increase in HDL cholesterol in the intervention group was attributable to improved physical activity behaviour. Information on physical activity behaviour was not available in this study, as it is mostly not registered in EHRs. However, an earlier study on the BeweegKuur intervention showed improvements on the motivation of overweight and obese participants with respect to physical activity behaviour, but not for healthy dietary behaviour [13]. Furthermore, Berendsen et al. [14] showed in their process evaluation of the BeweegKuur intervention that although the number of meetings with healthcare providers was approximately half of that according protocol, mainly the amount of dietary guidance was lower than planned, and decreased with increasing exercise guidance by the physiotherapist.

In the previous, international studies [6–10], healthcare consumption was not evaluated. National reports on the evaluation of lifestyle interventions in primary healthcare settings in the Netherlands focusing on increment of physical activity did not show a substantial change in the number of GP consultations, which is comparable to the results in our study [21, 22].

Strengths and limitations

A strength of this study is the use of medical record analysis by means of data from EHRs. It is a feasible method to evaluate the effectiveness of an intervention implemented in primary healthcare, and avoids the problem of bias by self-report [12]. Furthermore, the

use of the Nivel-PCD enlarged the power of the study, by selecting a sample of comparable patients according to several matching criteria. Since the Nivel-PCD contains routinely updated anonymous patients records, ethical approval for specific research purposes is unnecessary. This means that the patients selected for the comparison group were unaware of being part of this study. Herewith, our study differs from studies conducted in highly selected populations and study settings.

A limitation is that registration of anthropometric and metabolic measurements is not optimal in general practice, resulting in a high number of missing values. Though, by using mixed model analyses, all available data could be incorporated, including data from patients with missing data at baseline or follow up. Additional analyses (including only patients with complete information at both baseline and follow-up), yielded similar results, indicating that the high number of missing values did not bias the results.

Another limitation is the lack of engagement of the GPs with this study, probably due to a political decision. Initially, the Dutch government intended to extend the BeweegKuur intervention throughout the Netherlands from 2012, by reimbursement of the basic health insurance. However, after a change in government in 2010, this intention was abandoned. This decision influenced further implementation and did not support the sustainability of the BeweegKuur intervention in daily practice, as was initially planned [14]. Although little effort was demanded for the current study in 2013, the political decision presumably demotivated GPs to collaborate, since less than half of them gave permission for data extraction. Additionally, data collection could not be performed for all patients due to technical problems during data extraction or incomplete data (e.g. change of GP during study period), resulting in only a small number of patients that could eventually be included in this study. Nevertheless, the 127 selected patients showed to be a representative sample of all patients who were included at baseline of the initial studies [13, 15], by means of sex, age and BMI.

The GPs who implemented the BeweegKuur intervention and gave permission for data extraction for the current study were possibly more favourable to the intervention. Little is known about GPs who were not motivated to implement the intervention [4]. Also, the selected general practices for the comparison group were possibly not a representative sample of all general practices in the Netherlands, since these general practices registered more adequate on anthropometric and metabolic measurements compared to other general practices in the Nivel-PCD. Increased attention to lifestyle- related measurements in general practices might already have a positive effect on patients' lifestyle behaviour, since self-regulation skills, such as monitoring of weight, are identified as predictor of successful outcomes on obesity-related behaviour changes [23]. Furthermore, it cannot be ruled out that patients in the comparison group also have been enrolled in a lifestyle programme as part of usual care, resulting in modest intervention effects above usual care.

Conclusions

This study showed that a lifestyle intervention for overweight and obese patients in primary healthcare resulted in similar reductions in lifestyle-related risk factors and changes in healthcare consumption compared to usual care. Only an improvement for HDL cholesterol was shown. Furthermore this study indicates that the implementation and evaluation of a lifestyle intervention in primary healthcare is challenging due to political and financial barriers resulting in poor collaboration of healthcare providers. Nevertheless, medical record analyses could be a decent method to evaluate lifestyle interventions in primary healthcare, on condition that health outcomes are routinely recorded.

Acknowledgements

We thank Rodrigo Davids for helping in processing the data and Lucas van der Hoek for helping with the statistical analyses.

Table 2.2 Baseline to post-intervention changes in risk factors, drugs prescriptions and GP consultations in intervention and comparison group (timeframe: July 2009–August 2013)

	Intervention group		Comparison group		Intergroup difference	
Risk factors	***N***	**Mean (SD)**	***N***	**Mean (SD)**	**β (95 % CI)**	***P*** [a]
BMI, kg/m^2						
Baseline	100	33.4 (4.2)	254	33.1 (4.3)		
Post-intervention	87	32.5 (4.6)*	162	32.6 (4.4)	−0.40 (−1.00 to 0.20)	0.19
Systolic blood pressure, mmHg						
Baseline	97	140.0 (16.2)	222	141.5 (16.2)		
Post-intervention	92	136.5 (14.3)	181	138.5 (14.6)*	0.25 (−3.06 to 3.57)	0.88
Diastolic blood pressure, mmHg						
Baseline	97	85.2 (8.7)	222	86.9 (8.8)		
Post-intervention	92	81.8 (9.3)*	181	83.3 (8.0)*	0.15 (−1.75 to 2.06)	0.88
Total cholesterol, mmol/l						
Baseline	101	5.21 (1.10)	179	5.04 (1.17)		
Post-intervention	84	4.92 (0.92)*	155	4.92 (1.06)	−0.15 (−0.40 to 0.09)	0.22
HDL cholesterol, mmol/l						
Baseline	101	1.21 (0.30)	179	1.27 (0.35)		
Post-intervention	84	1.28 (0.29)*	154	1.25 (0.36)*	0.08 (0.03 to 0.13)	<0.01
LDL cholesterol, mmol/l						
Baseline	97	3.17 (0.87)	177	2.93 (1.05)		
Post-intervention	80	2.87 (0.80)*	149	2.84 (0.98)	−0.19 (−0.40 to 0.09)	0.09

- Table 2.2 continues -

- Table 2.2 continued -

	Intervention group		Comparison group		Intergroup difference	
Drug prescriptions	***N***	**% Users**	***N***	**% Users**	**OR (95 % CI)**	***P*[b]**
Drugs for diabetes						
Baseline	127	23 %	254	23 %		
Post-intervention	127	26 %	254	25 %	1.41 (0.25–7.88)	0.70
Lipid-modifying drugs						
Baseline	127	35 %	254	35 %		
Post-intervention	127	43 %*	254	39 %	2.45 (0.64–9.42)	0.19
Antihypertensive drugs						
Baseline	127	58 %	254	59 %		
Post-intervention	127	57 %	254	63 %	0.35 (0.09–1.37)	0.13
GP consultations	***N***	**Median**	***N***	**Median**	**IRR (95 % CI)**	***P*[c]**
Baseline	127	6.0	254	6.0		
Post-intervention	127	6.0	254	6.0	1.02 (0.91–1.14)	0.76

BMI body mass index, *HDL* high density lipoprotein, *LDL* low density lipoprotein

[a] Intergroup difference (β) calculated by mixed effects linear regression, two groups (general practice and patient) + adjustment for sex and age.

[b] Intergroup difference (odds ratio: OR) calculated by mixed effects logistic regression, two groups (general practice and patient).

[c] Intergroup difference (incidence rate ratio: IRR) calculated by mixed effects poisson regression, two groups (general practice and patient).

*Significant within group difference ($P < 0.05$) between baseline and post-intervention.

Table 2.3 Baseline to post-intervention changes in risk factors, drugs prescriptions and GP consultations in intervention and comparison group, stratified by baseline BMI category (timeframe: July 2009–August 2013)

	BMI ≤ 30 kg/m^2					BMI > 30 and ≤ 35 kg/m^2					BMI > 35 kg/m^2				
	Intervention group		Comparison group			Intervention group		Comparison group			Intervention group		Comparison group		
Risk factors	**N**	**Mean**	**N**	**Mean**	***P*[a]**	***N***	**Mean**	***N***	**Mean**	***P*[a]**	***N***	**Mean**	***N***	**Mean**	***P*[a]**
BMI, kg/m^2															
Baseline	23	27.6	51	27.5	0.17	39	32.8	77	32.3	0.31	38	37.7	72	37.7	0.93
Post-intervention	21	27.7	37	28.0		31	32.3	54	32.2		29	36.7	47	36.8	
Systolic blood pressure, mmHg															
Baseline	22	141.6	49	136.5	0.42	34	142.7	69	144.3	0.88	36	136.7	60	142.2	0.98
Post-intervention	21	135.9	39	133.6		31	141.2	57	142.7		30	131.4	49	139.7	
Diastolic blood pressure, mmHg															
Baseline	22	82.5	49	83.8	0.77	34	86.8	69	87.8	0.76	36	84.9	60	88.7	0.53
Post-intervention	21	80.2	39	80.8		31	84.3	57	84.1		30	80.4	49	86.0	
Total cholesterol, mmol/l															
Baseline	21	5.51	40	4.94	0.19	36	5.03	57	4.83	0.32	33	5.34	47	5.27	0.86
Post-intervention	21	4.97	37	4.72		28	4.82	55	4.78		23	4.98	40	5.17	
HDL cholesterol, mmol/l															
Baseline	21	1.32	40	1.35	0.09	36	1.21	57	1.24	0.41	33	1.16	47	1.26	<0.01
Post-intervention	21	1.41	37	1.30		28	1.24	54	1.26		23	1.26	40	1.19	
LDL cholesterol, mmol/l															
Baseline	21	3.42	40	2.84	0.10	34	2.98	56	2.75	0.52	32	3.27	46	3.11	0.23
Post-intervention	21	2.90	37	2.70		28	2.86	51	2.71		21	2.81	39	3.10	

- Table 2.3 continues -

- Table 2.3 continued -

	BMI ≤ 30 kg/m^2					BMI > 30 and ≤ 35 kg/m^2					BMI > 35 kg/m^2				
	Intervention group		Comparison group			Intervention group		Comparison group			Intervention group		Comparison group		
Drug prescriptions	***N***	**% Users**	***N***	**% Users**	p^b	***N***	**% Users**	***N***	**% Users**	p^b	***N***	**% Users**	***N***	**% Users**	p^b
Drugs for diabetes															
Baseline	23	44 %	51	41 %	0.62	39	31 %	77	31 %	1.00	38	13 %	72	15 %	0.61
Post-intervention	23	48 %	51	41 %		39	36 %	77	36 %		38	16 %	72	17 %	
Lipid-modifying drugs															
Baseline	23	39 %	51	47 %	0.13	39	41 %	77	47 %	0.28	38	32 %	72	25 %	0.69
Post-intervention	23	61 %	51	51 %		39	49 %	77	48 %		38	32 %	72	28 %	
Antihypertensive drugs															
Baseline	23	52 %	51	49 %	0.44	39	64 %	77	69 %	0.69	38	66 %	72	61 %	0.09
Post-intervention	23	57 %	51	61 %		39	64 %	77	66 %		38	58 %	72	65 %	
GP consultations	***N***	**Median**	***N***	**Median**	p^c	N	**Median**	***N***	**Median**	p^c	***N***	**Median**	***N***	**Median**	p^c
Baseline	23	7.0	51	5.0	0.09	39	6.0	77	7.0	0.03	38	7.0	72	6.5	0.58
Post-intervention	23	6.0	51	5.0		39	5.0	77	5.0		38	6.5	72	6.0	

BMI body mass index, *HDL* high density lipoprotein, *LDL* low density lipoprotein

[a]Intergroup difference calculated by mixed effects linear regression, two groups (general practice and patient) + adjustment for sex and age.

[b]Intergroup difference calculated by mixed effects logistic regression, two groups (general practice and patient).

[c]Intergroup difference calculated by mixed effects poisson regression, two groups (general practice and patient).

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Supplementary information - outline of the BeweegKuur intervention

The GP of the general practices preselect potential participants and refer them to the lifestyle advisor (LSA) (often a practice nurse and sometimes a physiotherapist). The LSA makes a decision on whether to enrol a patient in the BeweegKuur intervention. After the patient has given informed consent, the intervention can start. During the intervention participants have approximately 5 consultations with the LSA to discuss progress on behavioural change and to perform clinical measurements. The LSA determines the intensity level of the exercise programme that best fits the individual participant and refers the participant to a dietician for nutritional recommendations and education (~2 individual consultations, and ~7 group sessions). Dependent on the level of weight related health risk (moderate, high, or very high), participants are attributed to three different exercise programmes to support physical activity; 1) Independent exercise programme: no support by a physiotherapist; 2) Start-up programme: 6 consultations with a physiotherapist; 3) Supervised exercise programme: 3-4 months intensive group training at least twice a week, guided by a physiotherapist. Coaching by the physiotherapist consist of supervised exercise and increase physical capacity. For all exercise programmes both the LSA and the physiotherapist help the participant find suitable existing exercise facilities during the entire intervention period.

Supplementary table 2.1

Baseline to post-intervention changes in risk factors, drugs prescriptions, and GP-consultations in intervention and comparison group (timeframe: July 2009 – August 2013)

	Complete case analyses[1]	Drop-out analyses[2]
BMI	0.23	0.30
Systolic blood pressure	0.66	0.51
Diastolic blood pressure	0.82	0.98
Total cholesterol	0.30	0.14
HDL cholesterol	< 0.01	< 0.01
LDL cholesterol	0.18	0.08
Drugs for diabetes	n/a	n/a
Lipid modifying drugs	n/a	0.10
Antihypertensive drugs	n/a	0.07
GP-consultations	n/a	0.84

BMI body mass index, *HDL* high density lipoprotein, *LDL* low density lipoprotein

*P-values of intergroup differences are shown.

[1]Exclusion of patients with missing data at baseline or post-intervention year.

[2]Exclusion of intervention patients (and their matched patients) who were known to be drop-out during the intervention.

Chapter 3

Overweight in patients with chronic obstructive pulmonary disease needs more attention: a cross-sectional study in general practice

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Abstract

Background: Guidelines for management of chronic obstructive pulmonary disease (COPD) primarily focus on the prevention of weight loss, while overweight and obesity are highly prevalent in patients with milder stages of COPD. This cross-sectional study examines the association of overweight and obesity with the prevalence of comorbid disorders and prescribed medication for obstructive airway disease, in patients with mild to moderate COPD.

Methods: Data were used from electronic health records of 380 Dutch general practices in 2014. In total, we identified 4938 patients with mild or moderate COPD based on spirometry data, and a recorded body mass index (BMI) of ≥ 21 kg/m^2. Outcomes in overweight (BMI ≥ 25 & <30 kg/m^2) and obese (BMI ≥ 30 kg/m^2) patients with COPD were compared to those with a normal weight (BMI ≥ 21 & <25 kg/m^2), by logistic multilevel analyses.

Results: Compared to COPD patients with a normal weight, positive associations were found for diabetes, osteoarthritis, and hypertension, for both overweight (OR: 1.4-1.7) and obese (OR: 2.4-3.8) patients, and for heart failure in obese patients (OR: 2.3). Osteoporosis was less prevalent in overweight (OR: 0.7) and obese (OR: 0.5) patients, and anxiety disorders in obese patients (OR: 0.5). No associations were found for coronary heart disease, stroke, sleep disturbance, depression, and pneumonia. Furthermore, obese patients were in general more often prescribed medication for obstructive airway disease compared to patients with a normal weight.

Conclusions: The findings of this study underline the need to increase awareness in general practitioners for excess weight in patients with mild to moderate COPD.

Background

Chronic obstructive pulmonary disease (COPD) is a highly prevalent chronic disease [1]. Although weight loss is common in patients with COPD, previous studies have shown that about 65% of the COPD population is overweight or obese [2-5]. Obesity is a well-known risk factor for several diseases, such as diabetes mellitus and cardiovascular diseases, also in patients with COPD [6, 7]. Moreover, obesity in patients with COPD is associated with several other health consequences, like increased symptoms of dyspnea, a higher prescription rate for inhaled medications, and increased healthcare utilization [3, 8-10]. Nevertheless, the global initiative for chronic obstructive lung disease (GOLD) that provides evidence for the assessment, diagnoses, and treatment of COPD, primarily focus on the prevention of weight loss [11], as underweight in patients with COPD is associated with a higher risk of all-cause mortality [12]. However, this mostly applies to patients with severe COPD where an increasing body mass index (BMI) is linearly associated with a better survival, while in patients with mild to moderate COPD the lowest mortality risk occurs in normal to overweight patients [13, 14].

Since both COPD and obesity places a high burden on the healthcare system, it is important to gain more knowledge on the clinical profile of overweight and obese patients with COPD. Previous studies that investigated the implications of overweight and obesity on health outcomes were conducted only in the overall COPD population, including patients with severe COPD [3, 4, 8-10].

However, in patients with COPD, excess weight is mainly present among those with milder stages of COPD [15]. These patients are generally treated in primary healthcare, and it therefore seems relevant to study the association of weight and health outcomes specifically in patients with mild to moderate COPD. This knowledge can contribute to the development of appropriate treatment strategies for patients with COPD in primary healthcare.

The aim of the current study is to determine the association of overweight and obesity on the prevalence rate of comorbid disorders and prescribed medication for obstructive airway disease in patients with mild to moderate COPD in general practice.

Methods

Study design

In this cross-sectional study, data were used from electronic health records of Dutch general practices that participated in the Nivel Primary Care Database (Nivel-PCD) in 2014. These practices were representative for all Dutch general practices regarding gender and age of the patient population [16]. Electronic health records (EHRs) are used to record patient information on consultations, anthropometric and metabolic measurements, morbidity according to the International Classification of Primary Care - version 1 (ICPC-1), and drugs prescriptions according to the Anatomical Therapeutic Chemical (ATC) classification system.

Population

Figure 3.1 shows the flow diagram of the patient selection. Initially, from 380 general practices of the Nivel-PCD, all COPD patients were selected according to the following criteria: (1) having a recorded diagnosis of COPD (ICPC R91 and/or R95), prior to 1st January 2014 and (2) registered in the same general practice from 1st January to 31st December 2014, (3) at least one recording of BMI in 2014 and (4) at least one spirometry result in 2014, based on post-bronchodilator measurements. Patients who had a forced expiratory volume in 1 s (FEV_1) divided by the forced vital capacity below 70 % were classified as having spirometry confirmed COPD. Next, the FEV_1 % predicted was employed to classify COPD. Mild COPD was defined as $FEV_1 \geq 80$ % predicted, and moderate COPD as $FEV_1 \geq 50$ and < 80 % predicted, according to the GOLD classification [11]. In case of multiple recordings of spirometry measurements, the highest value was selected [17]. Per patient the mean BMI value was calculated over all available recorded BMI (or length and weight) measures in 2014. According to the mean BMI, patients with underweight were excluded. A BMI of <21 kg/m^2 was used as a cut-off value for underweight, as this is reported as an indication for malnutrition in Dutch GP-guidelines for management of COPD [18]. The remaining patients were categorized into the following weight-groups: normal weight (BMI ≥ 21 and < 25 kg/m^2), overweight (BMI ≥ 25 and < 30 kg/m^2), and obesity (BMI ≥ 30 kg/m^2).

In addition, information on gender, age, smoking status, morbidity, and medication were extracted from the electronic health records for all selected patients.

Outcome measures

Comorbid disorders. We established common (clusters of) comorbid disorders that are known to be associated with COPD and/or obesity according to the Dutch GP guidelines for management of COPD and management of obesity [18, 19], including coronary heart diseases (ICPC K74-K76), stroke (ICPC K89-K90), hypertension (ICPC K86-K87), heart failure (ICPC K77); osteoarthritis (ICPC L89-L91); osteoporosis (ICPC L95); sleep disturbance (ICPC P06); anxiety disorders (ICPC P74); depression (ICPC P76); pneumonia (ICPC R81); lung carcinoma (ICPC R84), and diabetes (ICPC T90).

Medication. Eight classes of medication were established that were most commonly used to treat COPD, according to the GOLD recommendations and Dutch GP-guidelines for management of COPD [11, 18], including short-acting muscarinic antagonist (SAMA), long-acting muscarinic antagonist (LAMA), short acting beta2-antagonist (SABA), long-acting beta2-antagonist (LABA), inhaled corticosteroids (ICS), medication with a combination of LABA and ICS, prednisone and antibiotics. The ATC-codes of medication belonging to the eight medication-classes are presented in Supplementary table 3.2. For each medication-class a patient was classified as user if at least one prescription for a medication was recorded.

Statistical analyses

Statistical analyses were performed using STATA 14.0. Descriptive statistics were used to present baseline characteristics. Logistic regression models were applied to evaluate the prevalence rates of comorbid disorders and prescribed medication, for the groups of overweight and obese patients, compared with the group of normal weight patients. To assess the effect of potential confounding factors, logistic multilevel analyses were performed, including a random intercept to account for clustered data of patients within general practices, and with adjustment for gender, age (years), smoking status (never/former/current), and lung function (FEV_1 % predicted). Further analyses were conducted to examine interaction of BMI-category with smoking status (no current smoker/ current smoker) and COPD-status (mild/moderate). All tests were two-sided and the significance level was set at $p < 0.05$ and $p < 0.10$ for the main analyses and the interaction analyses, respectively.

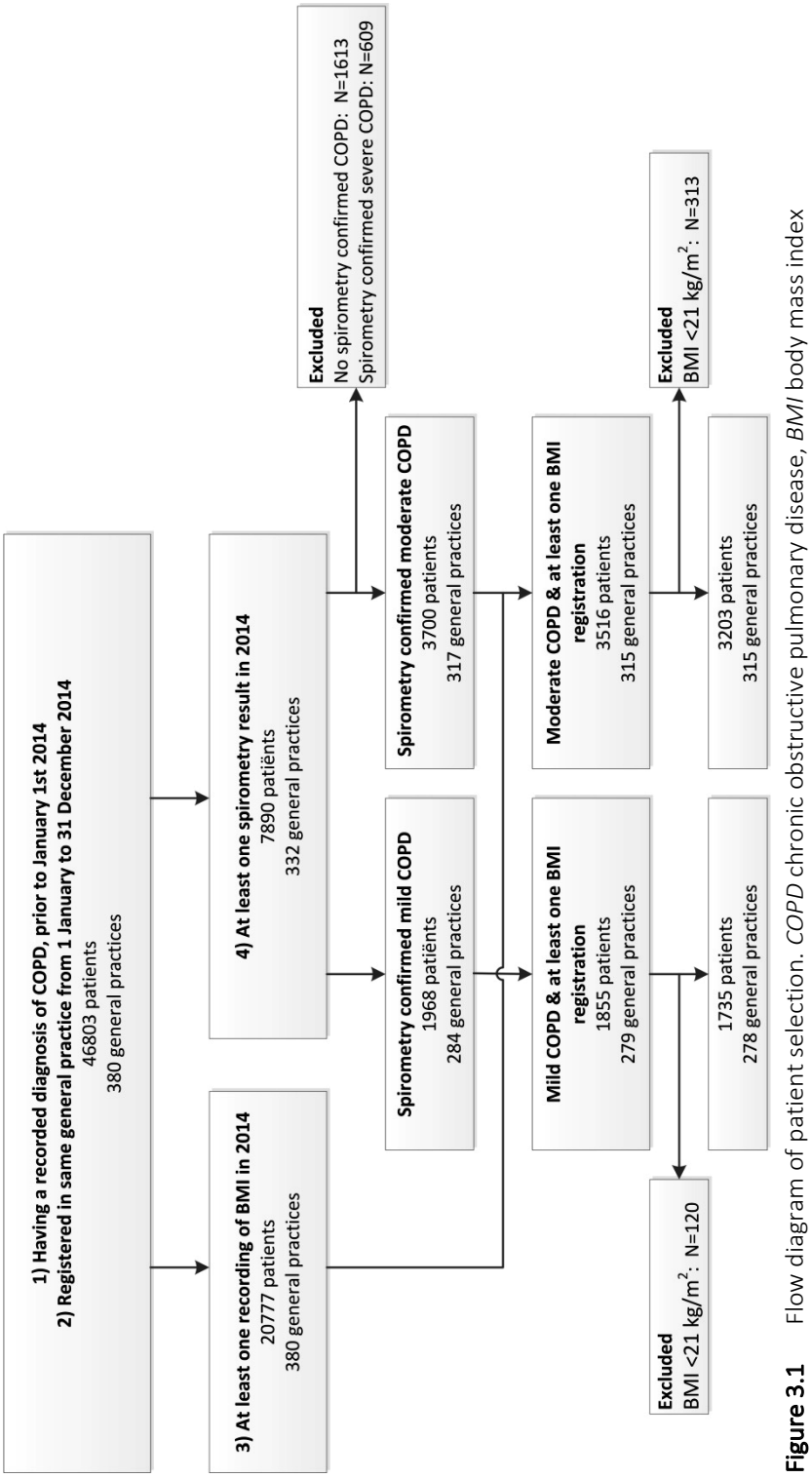

Figure 3.1 Flow diagram of patient selection. *COPD* chronic obstructive pulmonary disease, *BMI* body mass index

Results

Initially 46 803 patients were detected in the Nivel-PCD with a diagnosis of COPD prior to 1st January 2014, of which 20 777 (44 %) had a BMI recorded and 7890 (17 %) had a spirometry result in 2014. After applying all selection criteria (Figure 3.1), 4938 patients with mild to moderate COPD were eligible for inclusion in the current study. The final study population consisted of about one-third of patients with mild COPD and two-third of patients with moderate COPD. Table 3.1 shows the characteristics of the study population. In total, 54 % of the patients were men, mean age was 67 years, and mean BMI was 27.5 kg/m^2.

Comorbid disorders

In all weight categories hypertension, osteoarthritis, and diabetes are the highest prevalent comorbid disorders (Table 3.1). For the comparison of overweight and obese patients with the normal- weight patients, adjusted odds ratios (ORs) for comorbid disorders are shown in Figure 3.2 for the main analyses (also see Supplementary table 3.1). Only comorbid disorders with a prevalence rate of at least 1 % were evaluated. The strongest positive associations were found for obese patients, subsequently for diabetes (OR: 3.79; 95 % CI: 3.04, 4.71), hypertension (OR: 2.46, 95 % CI: 2.07, 2.93), osteoarthritis (OR: 2.38; 95 % CI: 1.92, 2.95), and heart failure (OR: 2.32, 95 % CI: 1.55, 3.46). Significant inverse associations were found for osteoporosis (OR: 0.51; 95 % CI: 0.37, 0.71) and anxiety disorders (OR: 0.49; 95 % CI: 0.28, 0.86). No significant associations were shown for coronary heart disease, stroke, sleep disturbance, depression and pneumonia with weight category. Interaction effects for BMI-category and smoking were shown in the associations with osteoarthritis, anxiety disorders, and depression. For osteoarthritis ORs were higher for both overweight (p for interaction = 0.09) and obese patients (p for interaction = 0.06) who were never or former smokers, as compared to current smokers. For anxiety disorders the OR was lower for overweight patients who were never or former smokers (p for interaction = 0.07), and for depression the OR was lower for obese patients who were never or former smokers (p for interaction = 0.03), as compared to current smokers. Interaction effects for BMI-category and COPD-status were shown for obese patients only. For obese patients with mild COPD, the associations were more positive for heart failure (p for interaction = 0.08), and more negative for coronary heart disease (p for interaction = 0.03) and depression (p for interaction = 0.05), as compared to obese patients with moderate COPD.

Medication

In total, 88 % of the patients was prescribed at least one medication for obstructive airway disease in 2014. Almost half of the patients were prescribed LAMA and LABA + ICS. About a quarter of the patients were prescribed SABA, prednisone and antibiotics. SAMA, LABA, and ICS were less prescribed (Table 3.1). Table 3.2 shows the ORs for the main analyses on the association of BMI-category and medication. Both overweight and obese patients were prescribed significantly more often SABA as compared to normal weight patients. Moreover, obese patients were significantly more likely to be prescribed LAMA and LABA + ICS. For the association of BMI-category with SAMA, ORs for obese patients were higher for current smokers than for never or former smokers (p for interaction = 0.07). Interaction effects for BMI-category and COPD-status were shown in the associations for SABA, LABA, prednisone, and antibiotics. For these medication-classes, associations for obese patients with mild COPD were more positive as compared to obese patients with moderate COPD. The strongest interaction effect was shown for prednisone (p for interaction <0.01), showing a significant association with obesity for patients with mild COPD (OR crude model: 1.7), but not for patients with moderate COPD (OR crude model: 1.0).

Table 3.1 Characteristics of patients with mild to moderate chronic obstructive pulmonary disease

	Normal weight	Overweight	Obesity	Total
Patients (*N*)	1534	2212	1192	4938
Gender, % men	47.3	60.3	51.9	54.2
Age, mean (SD)	66.9 (10.7)	68.1 (10.3)	66.6 (10.2)	67.3 (10.4)
BMI, mean (SD)	23.2 (1.1)	27.2 (1.4)	33.7 (3.7)	27.5 (4.4)
FEV_1 % predicted, mean (SD)	75.1 (14.8)	75.5 (14.4)	74.0 (14.1)	75.0 (14.5)
Smoking status (% patients)				
Never	9.5	8.5	8.8	8.9
Former	39.3	56.1	57.3	51.2
Current	51.2	35.4	33.9	40.0
Comorbid disorders (% patients)				
Coronary heart disease	3.9	5.2	4.7	4.7
Stroke	7.0	8.6	7.4	7.8
Hypertension	36.4	44.1	56.2	44.6
Heart failure	3.7	4.6	6.8	4.8
Osteoporosis	11.2	7.7	6.2	8.4
Osteoarthritis	14.8	19.4	26.7	19.7
Sleep disturbance	5.2	5.8	5.2	5.5
Anxiety disorder	3.6	2.5	1.6	2.6
Depression	6.4	5.1	5.5	5.6
Pneumonia	5.2	4.3	4.5	4.6
Lung carcinoma	1.2	0.9	0.4	0.9
Medication (% patients ≥ 1 prescription)				
SAMA	8.3	7.9	8.9	8.3
SABA	20.9	24.0	28.4	24.1
LAMA	42.2	45.2	48.2	45.0
LABA	11.9	13.1	13.8	12.9
ICS	12.5	13.7	11.4	12.8
LABA + ICSa	43.3	42.6	48.9	44.4
Prednisone	20.0	20.0	22.3	20.6
Antibiotics	26.8	25.2	27.1	26.1

BMI body mass index, *FEV_1* forced expiratory volume in 1s , *SAMA* short-acting muscarinic antagonist, *SABA* short acting beta2-antagonist, *LAMA* long-acting muscarinic antagonist, *LABA* long-acting beta2-antagonist, *ICS* inhaled corticosteroids.

[a] *medication with a combination of LABA and ICS.*

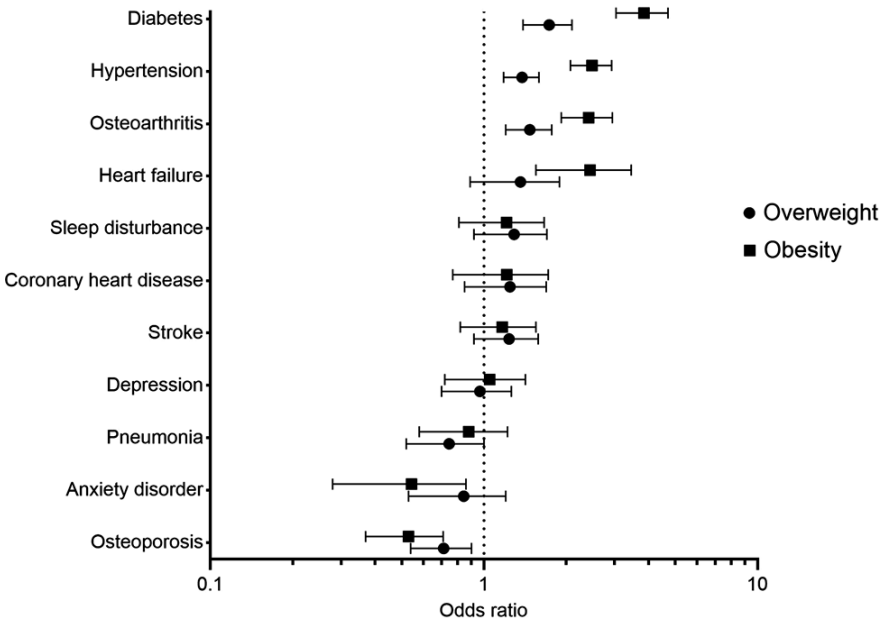

Figure 3.2 Adjusted odds ratios for the association of weight and comorbid disorders in patients with mild to moderate chronic obstructive pulmonary disease. The black dots represent the odds ratios (ORs) for the prevalence rate of comorbid disorders in overweight and obese patients, using the normal weight patients as reference category. The ORs are adjusted for clustering effect of general practice, gender, age, smoking status, and lung function. The error bars represent the 95 % confidence intervals around the ORs.

Table 3.2 Odds ratios for the association of weight and prescribed medication for obstructive airway disease in patients with mild to moderate chronic obstructive pulmonary disease

		Normal weight *N* = 1534	Overweight *N* = 2212	Obesity *N* = 1192
≥ 1 prescription SAMA	No. cases	128	175	106
	Model 1	ref.	0.94 (0.74–1.20)	1.07 (0.82–1.40)
	Model 2	ref.	0.96 (0.74–1.24)	1.13 (0.84–1.51)
≥ 1 prescription SABA	No. cases	321	530	339
	Model 1	ref.	1.19 (1.02–1.39)	1.50 (1.26–1.79)
	Model 2	ref.	1.26 (1.06–1.50)	1.55 (1.28–1.89)
≥ 1 prescription LAMA	No. cases	647	999	574
	Model 1	ref.	1.13 (0.99–1.29)	1.27 (1.09–1.48)
	Model 2	ref.	1.13 (0.97–1.31)	1.24 (1.05–1.47)
≥ 1 prescription LABA	No. cases	183	289	164
	Model 1	ref.	1.11 (0.91–1.35)	1.18 (0.94–1.48)
	Model 2	ref.	0.98 (0.79–1.22)	0.99 (0.77–1.28)
≥ 1 prescription ICS	No. cases	192	302	136
	Model 1	ref.	1.11 (0.91–1.34)	0.90 (0.71–1.14)
	Model 2	ref.	1.03 (0.83–1.27)	0.78 (0.61–1.01)

- Table 3.2 continues -

- Table 3.2 continued -

		Normal weight ***N* = 1534**	Overweight ***N* = 2212**	Obesity ***N* = 1192**
≥ 1 prescription combination LABA + ICS	No. cases	664	943	583
	Model 1	ref.	0.97 (0.85–1.11)	1.25 (1.08–1.46)
	Model 2	ref.	1.01 (0.88–1.18)	1.31 (1.11–1.56)
≥ 1 prescription prednisone	No. cases	307	442	266
	Model 1	ref.	1.00 (0.85–1.17)	1.15 (0.95–1.38)
	Model 2	ref.	1.05 (0.88–1.25)	1.20 (0.98–1.47)
≥ 1 prescription antibiotics	No. cases	411	557	323
	Model 1	ref.	0.92 (0.79–1.07)	1.02 (0.86–1.20)
	Model 2	ref.	0.93 (0.79–1.09)	1.02 (0.85–1.23)

Odds ratios are presented with their 95% confidence interval

Model 1: crude model (*N* = 4938)

Model 2: adjusted for clustering effect of general practice, gender, age, smoking status, and lung function (*N* = 4583)

SAMA short-acting muscarinic antagonist, *SABA* short acting beta2-antagonist, *LAMA* long-acting muscarinic antagonist, *LABA* long-acting beta2-antagonist, *ICS* inhaled corticosteroids

Discussion

Main findings

The present study illustrated that overweight, and to a greater extent obesity in patients with mild to moderate COPD, is associated with a higher prevalence rate for the most dominant comorbid disorders, i.e. hypertension, osteoarthritis, diabetes, and with a higher prevalence rate for heart failure in obese patients, as compared to patients with mild to moderate COPD and a normal weight. Osteoporosis and anxiety disorder were inversely associated with overweight and obesity. Furthermore, obesity was associated with increased prescription of medication for obstructive airway disease.

This study examined the association of weight and health outcomes, specifically among patients with mild to moderate COPD. The findings on comorbid disorders complement to results of previous observational studies that were conducted in the general COPD population, regarding diabetes [2-4, 6-9], hypertension [2, 6-9], osteoarthritis [9], and osteoporosis [9]. Regarding cardiovascular diseases, we found positive associations for obesity and heart failure, but not for coronary heart disease and stroke. Findings for cardiovascular diseases in previous studies were not conclusive. Lambert et al. [9] found obesity to be associated with an increased risk of coronary heart disease and heart failure, while Cecere et al. [8] did not. Other studies demonstrated that a higher BMI was associated with a higher risk of several cardiovascular diseases [2-4, 6]. However, results on cardiovascular diseases were difficult to compare since different definitions for cardiovascular diseases were used, and most studies were based on self-reported data.

Based on previous studies in the general population we would have expected positive associations of weight and mental health problems [20, 21]. However, we found mental health problems to be negatively (anxiety disorders), or not (sleep disturbance and depression), associated with increasing weight. These results also deviate from findings of a previous study conducted in a COPD population, showing a positive relation of obesity and obstructive sleep apnea [9].

The association of weight and prescribed medication for obstructive airway disease is a less studied subject. Only two previous studies evaluated this association in a COPD-population and found that overweight or obese patients were prescribed more often SABA, LABA, and ICS [3, 8]. These results are in agreement with the findings of our study. Moreover, in our study we showed that the association of obesity and prescribed medication was most strongly in patients with mild COPD, mainly for medication that is commonly used for COPD exacerbations (i.a. prednisone). The findings of our study indicate that obese patients with milder stages of COPD are suffering more from breathing problems and exacerbations as compared to normal weight patients. As already discussed by Cecere et al. [8], breathing problems among these patients are possibly more related to

obesity than to COPD-related factors, making medication for treatment of COPD less effective. Instead, focus on lifestyle for weight reduction would probably be more appropriate for these patients.

Previous studies mostly used a BMI of 18.5 kg/m^2 as lowest value for the normal weight category [3 ,4, 8-10], whereas in our study a BMI of 21 kg/m^2 was set as lowest value, based on the Dutch general practitioner (GP)-guidelines for management of COPD [18]. However, additional analyses, using BMI 18.5 kg/m^2 as lowest value for the normal weight category, yielded similar results (data not shown).

Strengths and limitations

While previous studies were mainly based on self-reported data, a major strength of this study is the use of routinely recorded data from general practices. In the Netherlands, the GP is mostly the first professional to consult for health problems. Therefore, the GP has a complete overview of all health problems of his/her patient population. This allowed us to examine the prevalence of all comorbid disorders of interest based on diagnoses recorded by GPs.

A consequence of using data from routine clinical practice is the limitation in data availability. For example, BMI and spirometry data were only available for respectively 44 and 17 % of patients with prevalent (i.e. already diagnosed) COPD. This can partly be due to the fact that patients with severe COPD are mostly treated in secondary care by a pulmonologist. Monitoring data (e.g. on BMI and spirometry) that are performed in secondary care are probably not always registered in patient files of GPs. Nevertheless, we would have expected higher data availability, at least for BMI, since the large majority of the COPD population (~70 %) is presented with mild to moderate airflow limitation [22], for whom the GP is mostly the primary healthcare professional in disease management. For these patients monitoring of the disease is recommended at least once a year, including the evaluation of BMI and/or weight.

The low availability of data on spirometry measurement is more plausible, since spirometry measurement for patients with prevalent mild to moderate COPD is only recommended to be performed at least once in 3 years [18]. Moreover, for patients with mild COPD, measurement of spirometry is only recommended for patients who experience health problems or who are still smoking. Limitations in data availability on spirometry could have resulted in a selection bias. The patients with mild COPD in this study are possibly not truly representative to the mild COPD-population in real clinical practice. However, we do not think that this potential selection bias might have influenced the conclusions, since the focus of this study was on differences between weight-groups.

Implications for further research, policy, and practice

The findings of this study underline the need to increase awareness in GPs on weight management for patients with milder stages of COPD. Moreover, the current study highlights that BMI is frequently not recorded in EHRs of patients with COPD, suggesting that weight management for these patients in general practice does not have a high priority yet.

For further research it would be interesting to investigate whether weight reduction in obese patients with milder stages of COPD is effective for increasing quality of life, and reducing the number of prescriptions for COPD-medication. In patients with asthma, weight reduction has been linked to positive outcomes, such as improvements on dyspnea, and exercise tolerance [23]. Since symptoms of asthma are very similar to those of COPD, the promising results of weight reduction in patients with asthma support the need for research on the impact of weight loss in patients with COPD.

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Supplementary table 3.1

Odds ratios for the association of weight and comorbid disorders in patients with mild to moderate chronic obstructive pulmonary disease

		Normal weight N=1534	Overweight N=2212	Obesity N=1192
Diabetes	No. cases	173	398	372
	Model 1	ref.	1.73 (1.42-2.09)	3.57 (2.92-4.36)
	Model 2	ref.	1.71 (1.39-2.10)	3.79 (3.04-4.71)
Hypertension	No. cases	558	976	670
	Model 1	ref.	1.38 (1.21-1.58)	2.25 (1.92-2.62)
	Model 2	ref.	1.37 (1.18-1.59)	2.46 (2.07-2.93)
Osteoarthritis	No. cases	225	429	318
	Model 1	ref.	1.40 (1.17-1.67)	2.12 (1.75-2.56)
	Model 2	ref.	1.45 (1.20-1.77)	2.38 (1.92-2.95)
Heart failure	No. cases	57	101	81
	Model 1	ref.	1.24 (0.89-1.73)	1.89 (1.33-2.67)
	Model 2	ref.	1.30 (0.89-1.89)	2.32 (1.55-3.46)
Sleep disturbance	No. cases	79	128	62
	Model 1	ref.	1.13 (0.85-1.51)	1.01 (0.72-1.42)
	Model 2	ref.	1.25 (0.92-1.70)	1.16 (0.81-1.66)
Coronary heart disease	No. cases	60	116	56
	Model 1	ref.	1.36 (0.99-1.87)	1.21 (0.83-1.76)
	Model 2	ref.	1.20 (0.85-1.69)	1.15 (0.77-1.72)
Stroke	No. cases	107	191	88
	Model 1	ref.	1.26 (0.99-1.61)	1.06 (0.79-1.42)
	Model 2	ref.	1.21 (0.92-1.58)	1.13 (0.82-1.55)
Depression	No. cases	98	112	65
	Model 1	ref.	0.78 (0.59-1.03)	0.85 (0.61-1.17)
	Model 2	ref.	0.94 (0.70-1.26)	1.01 (0.72-1.42)
Pneumonia	No. cases	80	94	54
	Model 1	ref.	0.81 (0.59-1.09)	0.86 (0.61-1.23)
	Model 2	ref.	0.72 (0.52-1.00)	0.84 (0.58-1.22)
Anxiety disorder	No. cases	55	56	19
	Model 1	ref.	0.70 (0.48-1.02)	0.44 (0.26-0.74)
	Model 2	ref.	0.80 (0.53-1.20)	0.49 (0.28-0.86)
Osteoporosis	No. cases	172	170	74
	Model 1	ref.	0.66 (0.53-0.82)	0.52 (0.39-0.70)
	Model 2	ref.	0.70 (0.54-0.90)	0.51 (0.37-0.71)

Odds ratios are presented with their 95% confidence interval.
Model 1: crude model (N=4938).
Model 2: adjusted for clustering effect of general practice, gender, age, smoking status, and lung function (N=4583).

Supplementary table 3.2

Classification of medication for obstructive airway disease

Medication class	ATC-codes
SAMA	R03BB01
SABA	R03AC02
LAMA	R03BB04
LABA	R03AC13; R03AC12; R03AC18
ICS	R03BA05; R03BA08; R03BA02; R03BA01
LABA + ICS	R03AK06; R03AK07; R03AK08
Prednisone	H02AB06
Antibiotics	J01CA04; J01AA02

SAMA short-acting muscarinic antagonist, *SABA* short acting beta2-antagonist, *LAMA* long-acting muscarinic antagonist, *LABA* long-acting beta2-antagonist, *ICS* inhaled corticosteroids

Chapter 4

Recording of weight in electronic health records: an observational study in general practice

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Abstract

Background: Routine weight recording in electronic health records (EHRs) could assist general practitioners (GPs) in the identification, prevention, and management of overweight patients. However, the extent to which weight management is embedded in general practice in the Netherlands has not been investigated. The purpose of this study was to evaluate the frequency of weight recording in general practice in the Netherlands for patients who self-reported as being overweight. The specific objectives of this study were to assess whether weight recording varied according to patient characteristics, and to determine the frequency of weight recording over time for patients with and without a chronic condition related to being overweight.

Methods: Baseline data from the Occupational and Environmental Health Cohort Study (2012) were combined with data from EHRs of general practices (2012–2015). Data concerned 3446 self-reported overweight patients who visited their GP in 2012, and 1516 patients who visited their GP every year between 2012 and 2015. Logistic multilevel regression analyses were performed to identify associations between patient characteristics and weight recording.

Results: In 2012, weight was recorded in the EHRs of a quarter of patients who self-reported as being overweight. Greater age, lower education level, higher self-reported body mass index, and the presence of diabetes mellitus, chronic obstructive pulmonary disease, and/or cardiovascular disorders were associated with higher rates of weight recording. The strongest association was found for diabetes mellitus (adjusted OR = 10.3; 95 % CI [7.3, 14.5]). Between 2012 and 2015, 90 % of patients with diabetes mellitus had at least one weight measurement recorded in their EHR. In the group of patients without a chronic condition related to being overweight, this percentage was 33 %.

Conclusions: Weight was frequently recorded for overweight patients with a chronic condition, for whom regular weight measurement is recommended in clinical guidelines, and for which weight recording is a performance indicator as part of the payment system. For younger patients and those without a chronic condition related to being overweight, weight was less frequently recorded. For these patients, routine recording of weight in EHRs deserves more attention, with the aim to support early recognition and treatment of overweight.

Background

Overweight and obesity, in particular, is an important public health issue which is strongly associated with multimorbidity, as well as an increased workload for general practitioners (GPs) [1, 2]. In many European countries, the GP acts as a gatekeeper, representing the first healthcare professional to address patients' health problems. Therefore, general practices are recognised to be a good starting point for the identification and subsequent prevention and management of overweight [2].

The use of electronic health records (EHRs) supports primary healthcare, as they contain complete and structured documentation of all relevant information on the health status of a patient [3, 4]. Routine recording of weight or body mass index (BMI) in EHRs could help GPs recognise and treat overweight patients, and therefore merits investigation.

Studies on EHRs in general practice have reported that BMI and/or weight recording are generally poor [5–10]. Most of these studies focused on primary healthcare in the UK, and showed that BMI and weight recording varied according to patient characteristics, and that recording slightly improved between the 1990s and 2000s [6–8]. The improvement over time was probably influenced by the publication of guidelines on obesity management, as well as the introduction of the Quality and Outcomes Framework (QOF) in the UK in 2004. As a result of the QOF, the reimbursement of GPs became dependent on a number of performance indicators, including recording of patient BMI [11].

In the Netherlands, clinical guidelines for the treatment of obesity in general practice were introduced in 2010. A bundled payment system was also introduced, meaning that health insurers pay a fixed fee to cover the entire primary healthcare needs of patients with diabetes mellitus, chronic obstructive pulmonary disease (COPD), and cardiovascular disorders. This bundled payment system obligates the primary healthcare professionals to provide the health insurance provider with performance indicators, including the proportion of patients with a recorded BMI [12].

Over recent years, there has been increased attention on the health impacts of being overweight. Therefore, weight recording in Dutch general practices is also expected to has increased over time, especially for patients with a chronic condition for whom a bundled payment system exists. However, a recent study of routinely recorded data from patients with COPD by Dutch general practices highlighted that BMI was recorded less frequently than expected [13].

The extent to which weight management is embedded in general practices in the Netherlands is currently unknown. Thus, the purpose of the present study was to assess weight recording in Dutch general practices for a group of patients who self-reported as being overweight. The primary aim was to assess the association between weight recording and patient characteristics. The secondary aim was to determine and compare the

frequency of weight recording over time in patients with and without a chronic condition related to being overweight.

Methods

Study design

In this observational study, data from the EHRs of general practices in the Netherlands that participated in Nivel Primary Care Database (Nivel-PCD) were combined with data from the Occupational and Environmental Health Cohort Study (AMIGO study). Both cross-sectional and longitudinal analyses were applied.

The Nivel-PCD comprises anonymised data from the EHRs of a representative sample (~ 10 %) of all general practices in the Netherlands [14]. In general practice, EHRs are used by GPs and practice nurses to record information on consultations, diagnostic measurements, drug prescriptions, referrals, and morbidity according to the International Classification of Primary Care version 1 (ICPC-1).

The AMIGO study is a longitudinal study on the occupational and environmental determinants of disease and well-being. Participants for this study were recruited through 99 general practices that participated in the Nivel-PCD in 2011 and 2012. All patients born between 1945 and 1981 who were registered at one of the 99 general practices were invited by their GP to participate in the AMIGO study.

In total, 14 829 patients filled in the informed consent form and completed the base-line questionnaire between April 2011 and July 2012. The design of the AMIGO study has been described in more detail by Slottje et al. [15].

Patient data

Information on the patients' sex, year of birth, height, weight, level of education, smoking status, and alcohol consumption was obtained from the baseline questionnaire of the AMIGO study. Patient age was calculated as 2012 minus their year of birth. Information on GP consultations, diagnostic measurements, and morbidity over the period from 2012 to 2015 was obtained from the Nivel-PCD.

Study population

Figure 4.1 shows the selection process for the study population included in the cross-sectional analyses, which used data from 2012. Eligibility criteria were applied at both the general practice and patient levels. Due to a failure in data extraction, data from 13 general practices that participated in the Nivel-PCD were not available. Other practices (n = 35) were excluded due to poor data quality (i.e., data recording < 46 weeks/year, or < 70% of the recorded disease episodes labelled with the relevant ICPC code).

From the selected general practices, patients were excluded if they met the following criteria: (1) incomplete registration in general practice, (2) missing data on height and/or weight in the baseline questionnaire of the AMIGO study, or (3) no consultation with their GP in 2012 (because GPs needed to have the opportunity to record the weight of their patients). In total, 6141 patients from 51 general practices fulfilled these criteria, which appeared to be a representative sample of the total AMIGO study population (see Supplementary table 4.1). Subsequently, BMI was calculated using self-reported height and weight from the AMIGO study. A total of 3446 patients were classified as being overweight (i.e. BMI ≥ 25 kg/m2), who were included in the present study.

For the longitudinal analyses, data from 2012 to 2015 was used, and the eligibility criteria at the general practice level were also applied for the years 2013, 2014, and 2015. Furthermore, only patients who attended at least one annual GP consultation between 2012 and 2015 were selected. The final study population for the longitudinal analyses included 1516 patients.

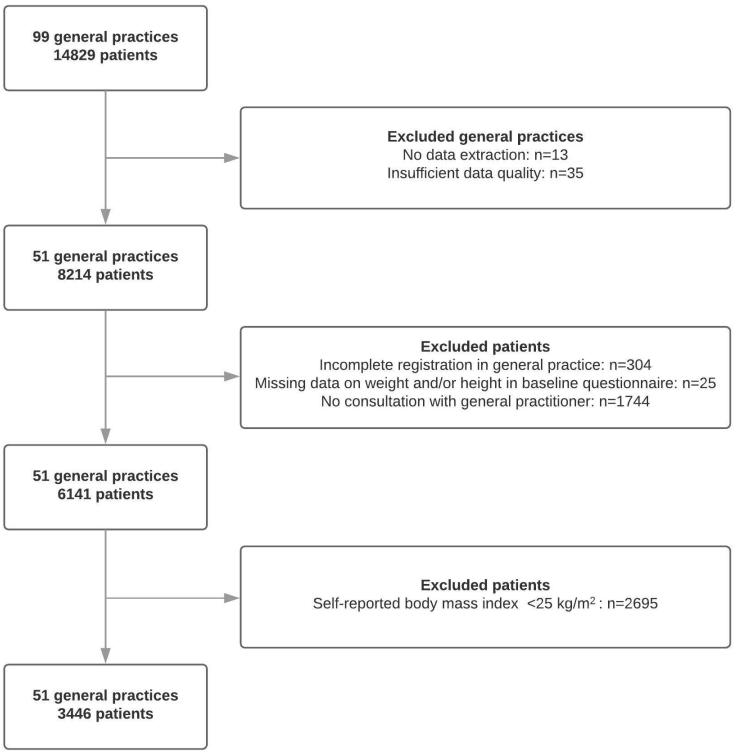

Figure 4.1 Selection process for the study population, 2012

Outcome

For the cross-sectional analyses, a binary variable termed "weight recording" was generated, which indicated whether there was at least one BMI or weight measurement recorded in the patient's EHR in 2012. For the longitudinal analyses, additional binary variables for "weight recording" were generated for the years 2013, 2014, and 2015.

Independent variables

The following variables were generated from data re- corded in the AMIGO study: BMI category (BMI ≥ 25 and < 30 kg/m^2, BMI ≥ 30 kg/m^2), sex (male, female), age (31–40 years, 41–50 years, 51–60 years, 61–67 years), highest achieved level of education (low, vocational education/ community college; intermediate, vocational/high school; high, college/university or higher), smoking status (never, former, current), alcohol consumption (never, ≤ 1 day/week, 2–3 days/week, 4–5 days/week, 6–7 days/week). These variables were similarly categorised as presented in the design article for the AMIGO study [15].

Four (clusters of) chronic conditions known to be associated with overweight were selected based on morbidity data from the 2012 Nivel-PCD: cardiovascular disorders (ICPC K74-K76, K86-K87, K89-K92, K99, T93), osteoarthritis (ICPC L89-L91), diabetes mellitus (ICPC T90), and COPD (ICPC R91, R95). We created an additional binary variable indicating whether a patient had none or at least one of the four selected (clusters of) chronic conditions related to being overweight. Furthermore, the mean BMI of each patient was calculated from all available recorded BMI (or height and weight) measures recorded in 2012.

Statistical analyses

Descriptive statistics were used to present patient characteristics for 2012 and to determine the frequency of weight recording in the period from 2012 to 2015 for patients with a chronic condition related to being overweight (cardiovascular disorder, osteoarthritis, diabetes mellitus, and COPD), and for patients without a chronic condition related to being overweight. To assess which patient characteristics were associated with weight recording, univariate and multiple logistic multilevel regression analyses were conducted on the data from 2012. For the multiple regression analyses, two models were used. The first model included socio-demographic and lifestyle determinants (sex, age, education level, BMI category, smoking status, and alcohol consumption). In the second model, five variables related to the presence or absence of the four (clusters of) chronic conditions were added. A two-sided P-value < 0.05 was considered statistically significant, and the statistical analyses were performed with STATA 14.2.

Results

Characteristics of the 3446 patients from data recorded in 2012 are presented in Table 4.1. Recordings of BMI (or height and weight) in EHRs were available for 23 % (n = 805) of the patients. Of these 805 patients, 97 % were also classified as being overweight according to their mean recorded BMI.

Table 4.2 shows the association of patient characteristics with weight recording for the 3446 patients who self-reported as being overweight in 2012. Greater age, lower education level, higher self-reported BMI, and the presence of a cardiovascular disorder, diabetes mellitus, or COPD were significantly associated with higher rates of weight recording in both univariate and multiple regression analyses. The strongest association was found for diabetes mellitus (adjusted OR = 10.3; 95 % CI [7.3, 14.5]). The presence of a chronic condition related to being overweight was also strongly associated with age. The percentage of patients with at least one chronic condition related to being overweight increased from 3 % in patients aged 31–40 years to 40 % in patients aged 51–67 years. In the period from 2012 to 2015, weight was recorded at least once for 58 % of patients.

Table 4.3 shows the frequency of weight recording over time for patients with and without a chronic condition related to being overweight. Weight was more frequently recorded for patients with diabetes mellitus. Between 2012 and 2015, 90 % of patients with diabetes mellitus had at least one weight recording in their EHR, the majority (68 %) of which had their weight recorded every year. For patients with a cardiovascular disorder or COPD, weight was recorded at least once for 80 % of patients between 2012 and 2015. Weight was less often recorded for patients with osteoarthritis and for those without a chronic disorder related to being overweight. Between 2012 and 2015, 33 % of patients without a chronic disorder related to being overweight had at least one weight measurement recorded in their EHR.

Table 4.1 Characteristics of the study population in 2012 (N = 3446)

		Number	Percent
Sex[a]	Male	1657	48.1
	Female	1789	51.9
Age category[a]	31–40 years	377	10.9
	41–50 years	954	27.7
	51–60 years	1260	36.6
	61–67 years	855	24.8
Education level[a]	Low	1224	36.6
	Intermediate	1116	33.4
	High	1002	30.0
BMI category[a]	≥ 25 & < 30 kg/m^2	2380	69.1
	≥ 30 kg/m^2	1066	30.9
Smoking status[a]	Never	1380	40.1
	Former	1528	44.4
	Current	532	15.5
Alcohol consumption[a]	Never	209	6.1
	≤ 1 day/week	1580	46.0
	2–3 days/week	734	21.4
	4–5 days/week	381	11.1
	6–7 days/week	533	15.5
Chronic condition[b]	Cardiovascular disorder	1461	42.4
	Osteoarthritis	343	10.0
	Diabetes mellitus	343	10.0
	COPD	145	4.2
Diagnostic measurements[b]	≥ 1 BMI record	756	21.9
	≥ 1 weight record	883	25.6
	≥ 1 height record	554	16.1

BMI body mass index, *COPD* chronic obstructive pulmonary disease

[a]Self-reported data (AMIGO-study)

[b]Data from electronic health records (Nivel-PCD)

Table 4.2 Association between patient characteristics and weight recording in general practice for self-reported overweight patients, 2012

	Univariate regression		Multiple regression			
			Model 1		Model 2	
	odds ratio	p-value	odds ratio	p-value	odds ratio	p-value
Sex[a]						
Male	Ref.		Ref.		Ref.	
Female	0.91 (0.77–1.06)	0.21	0.86 (0.73–1.03)	0.10	1.11 (0.91–1.35)	0.31
Age category[a]						
31–40 years	Ref.		Ref.		Ref.	
41–50 years	3.06 (1.95–4.81)	< 0.001	2.91 (1.84–4.60)	< 0.001	1.81 (1.10–3.00)	0.02
51–60 years	6.11 (3.95–9.47)	< 0.001	5.61 (3.59–8.75)	< 0.001	2.26 (1.38–3.72)	0.001
61–67 years	11.13 (7.15–17.32)	< 0.001	10.51 (6.66–16.58)	< 0.001	2.53 (1.51–4.23)	< 0.001
Education level[a]						
Low	Ref.		Ref.		Ref.	
Intermediate	0.62 (0.52–0.75)	< 0.001	0.81 (0.66–0.99)	0.04	0.83 (0.66–1.05)	0.12
High	0.52 (0.43–0.64)	< 0.001	0.63 (0.51–0.78)	< 0.001	0.70 (0.54–0.90)	0.005
BMI category[a]						
≥ 25 & < 30 kg/m^2	Ref.		Ref.		Ref.	
≥ 30 kg/m^2	1.77 (1.50–2.08)	< 0.001	1.77 (1.48–2.11)	< 0.001	1.25 (1.01–1.54)	0.04
Smoking status[a]						
Never	Ref.		Ref.		Ref.	
Former	1.43 (1.21–1.70)	< 0.001	1.11 (0.92–1.34)	0.27	1.08 (0.86–1.34)	0.52
Current	1.00 (0.78–1.28)	0.99	1.01 (0.78–1.32)	0.92	0.79 (0.58–1.08)	0.15

- Table 4.2 continues

- Table 4.2 continued -

	Univariate regression		Multiple regression			
			Model 1		Model 2	
	odds ratio	p-value	odds ratio	p-value	odds ratio	p-value
Alcohol consumption[a]						
Never	Ref.		Ref.		Ref.	
≤ 1 day/week	1.00 (0.72–1.41)	0.98	0.99 (0.69–1.44)	0.98	1.23 (0.80–1.90)	0.35
2–3 days/week	0.87 (0.61–1.25)	0.46	0.80 (0.54–1.20)	0.28	1.07 (0.67–1.72)	0.77
4–5 days/week	1.03 (0.70–1.53)	0.88	0.89 (0.58–1.37)	0.60	1.16 (0.70–1.93)	0.56
6–7 days/week	1.13 (0.78–1.63)	0.53	0.84 (0.55–1.28)	0.42	1.06 (0.65–1.74)	0.81
Chronic condition[b,c]						
Yes	Ref.		–	–	Ref.	
No	0.08 (0.07–0.10)	< 0.001	–	–	0.39 (0.25–0.60)	< 0.001
Cardiovascular disorder[b]						
No	Ref.		–	–	Ref.	
Yes	8.72 (7.23–10.51)	< 0.001	–	–	3.16 (2.16–4.62)	< 0.001
Osteoarthritis[b]						
No	Ref.		–	–	Ref.	
Yes	1.64 (1.28–2.09)	< 0.001	–	–	0.73 (0.53–1.00)	0.05

- Table 4.2 continues -

- *Table 4.2 continued* -

	Univariate regression		Multiple regression			
			Model 1		Model 2	
	odds ratio	p-value	odds ratio	p-value	odds ratio	p-value
Diabetes mellitus[b]						
No	Ref.		–	–	Ref.	
Yes	18.34 (13.70–24.55)	< 0.001	–	–	10.27 (7.28–14.48)	< 0.001
COPD[b]						
No	Ref.		–	–	Ref.	
Yes	2.87 (2.03–4.05)	< 0.001	–	–	2.00 (1.313.06)	< 0.001

Odds ratios are presented with their 95 % confidence interval

BMI body mass index, *COPD* chronic obstructive pulmonary disease

[a]Self-reported data (AMIGO-study)

[b]Data from electronic health records (Nivel-PCD)

[c]Presence of cardiovascular disorder, and/or osteoarthritis, and/or diabetes mellitus, and/or COPD (yes/no)

For both univariate and multiple regression analyses a random intercept was included to account for clustered data of patients within general practices

Multiple regression analyses, model 1: sex, age, education level, BMI-category, smoking status, and alcohol consumption, model 2: model 1 + five variables related to the presence or absence of the four (clusters of) chronic conditions

Table 4.3 Frequency of weight recording for self-reported overweight patients over the period from 2012 to 2015

	N	No weight recording (% patients)	At least one weight recording, but not annually (% patients)	Annual weight recording (% patients)
Patients with a cardiovascular disorder	730	20.1	46.2	33.7
Patients with osteoarthritis	167	34.7	47.3	18.0
Patients with diabetes mellitus	171	9.9	22.2	67.8
Patients with COPD	73	19.2	49.3	31.5
Patients without a weight related chronic disorder[a]	663	67.4	31.4	1.2

COPD chronic obstructive pulmonary disease

[a]Patients without a cardiovascular disorder, osteoarthritis, diabetes mellitus, and COPD

Discussion

Summary of findings

This study evaluated the extent of weight recording in general practices in the Netherlands among an adult population who self-reported as being overweight. Our findings show that greater age, lower education level, and higher self-reported BMI were positively related to weight recording. Furthermore, in accordance with our hypothesis, higher rates of weight recording were found for patients with diabetes mellitus, COPD, or cardiovascular disorders. These are all chronic conditions for which regular weight measurement is recommended in the clinical guidelines for GPs, and for which weight or BMI recording represents a performance indicator within a bundled payment system [12].

Comparison with existing literature

The presence of diabetes mellitus was found to be the variable most strongly associated with weight recording, consistent with the findings of other studies [6, 9, 10, 16]. Furthermore, in line with a recent review of similar studies of the UK primary healthcare system, our study indicates that some patients are less likely to be identified as being overweight by their GP, including younger patients and patients without a chronic condition [17]. These findings are also supported by an Australian study which showed a positive association between age and weight recording [10], and a study of Dutch GPs' weight management policy, which showed that weight was less often discussed with patients without weight-related comorbidities [18].

In contrast to other studies that indicate a higher frequency of weight recording in females, we found no difference between male and female patients. Furthermore, we found that a higher education level was associated with lower rates of weight recording, which differs from the results of a previous study which showed no association between education level and weight recording [16]. The discrepancy in findings related to socio-demographic characteristics may be due to differences in the selection criteria for study populations and the time-frames of studies, in addition to differences in healthcare systems between countries.

Strengths and limitations

A strength of this study is the linkage of the cohort from the AMIGO study with routinely recorded data from general practices, which enabled us to combine information on self-reported socio-demographic and lifestyle determinants with health outcomes recorded in EHRs. Furthermore, to our knowledge, this is the first study to assess weight recording in Dutch general practices for patients who self-reported as being overweight.

A limitation of this study is the generalisability to the total population, as the study population consisted only of adults aged 31–67 years. Furthermore, we selected overweight patients based on self-reported height and weight, meaning that patients who did not identify themselves as being overweight were not included in the study. However, we do not believe that this had a large effect on the external validity of the study, as the proportion of overweight individuals (56 %) in our study population is comparable to that of the general Dutch population of adults aged ≥ 20 years [19]. Additionally, our study showed good concordance between self-reported BMI and mean recorded BMI for patients with available data, so weight status does not seem to have been underestimated.

A representative sample size of the AMIGO study population was selected for the current study, even though it included only a subset of the cohort members. A large proportion of the initial study population had to be excluded due to insufficient data quality of the general practices, which might have resulted in a selection bias. The included general practices, which had higher levels of data quality, could potentially be systematically different to general practices with lower levels of data quality. However, we suspect that most of the variation in data quality among the general practices is unrelated to clinical performance, but instead due to software issues, as suggested by Van der Bij and colleagues [4].

In the present study, we only included patients who had attended at least one consultation per year with their GP. Previous studies also only included ‘active’ patients, that is those who underwent a minimal number of consultations during a certain period [5, 9, 10]. Patients who do not consult their GP regularly are probably more healthy, and would therefore have their weight recorded by a GP less often. Thus, weight recording in our

study population presumably occurred more frequently when compared to the total overweight population.

Implications of findings

Routine weight recording in EHRs could help GPs identify overweight patients and monitor and support them in weight management programs, such as prevention programs that are embedded in primary healthcare [20, 21].

This study showed reasonable completeness of weight recording for overweight patients with a chronic condition, for whom regular weight evaluation is recommended in the clinical guidelines for GPs, and for which weight recording is incorporated as a performance indicator with in a bundled payment system. In (relatively younger) overweight patients without a chronic condition related to being overweight, for whom weight measurement is not specifically required, we found that weight was recorded in only a third of these patients over a 4-year time frame. However, in the group of relatively young adults aged 31–40 years, the presence of overweight was already considerably high, with about 40 % of patients classified as being overweight. To prevent weight-related health problems and their associated healthcare costs, discussing weight at an early stage should be recommended for this patient group.

Overweight management has been shown to be more frequent among patients with a documented weight status [22]. The importance of discussing overweight was illustrated by a large study conducted in the US, which found that patients were more likely to perceive themselves as being overweight, accompanied by an increased desire to lose weight, if they had been told by their healthcare professional they were overweight [23]. However, research from the UK suggests that GPs can feel uncomfortable talking about overweight, and may not always feel responsible for discussing weight management with their patients [24]. In the Netherlands, most GPs consider weight management to be part of their responsibility of providing care, but they face other barriers such as time constraints [18]. A solution may be for GPs to delegate some weight management tasks to practice nurses, who already play an important role in lifestyle counselling in Dutch primary healthcare [25]. In addition, providing feedback to general practices on their recording habits could help GPs become more aware of these habits, and would probably enhance weight recording [3, 4]. Furthermore, a performance indicator payment for weight recording in all patients could possibly improve recording and support early interventions in overweight individuals.

Conclusions

This study of patients who self-reported as being overweight showed higher rates of weight recording in the EHRs of patients with a chronic condition, for whom regular weight measurement is recommended in the clinical guidelines for GPs, and for which weight recording is a performance indicator as part of a payment system. For younger patients and those without a chronic condition related to being overweight, weight was recorded considerably less often. For these patients, routine weight recording in EHRs deserves more attention in general practice, with the aim to support the early recognition and treatment of overweight individuals.

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Supplementary table 4.1

Representativeness of study population

		Study sample 2012	Total AMIGO population
Patients (N)		6141	14829
Gender (%)	Male	42.4	44.3
	Female	57.6	55.8
Age category (%)	31-40 years	14.2	14.5
	41-50 years	28.9	29.3
	51-60 years	34.2	34.5
	61-67 years	22.7	21.8
BMI category (%)	Underweight	0.7	0.6
	Normal weight	43.2	45.0
	Overweight	38.8	38.7
	Obesity	17.4	15.6
Education level (%)	Low	31.6	31.6
	Intermediate	32.0	32.2
	High	36.4	36.3
Smoking status (%)	Never	43.9	45.5
	Former	39.4	38.8
	Current	16.7	15.7
Alcohol consumption (%)	Never	5.7	5.7
	≤ 1 day/week	43.6	43.5
	2-3 days/week	22.2	22.4
	4-5 days/week	12.1	12.2
	6-7 days/week	16.5	16.2

BMI body mass index

Chapter 5

Achievement of weight loss in overweight patients during dietetic treatment in primary healthcare

Submitted as:
Verberne LDM, Leemrijse CJ, Nielen MMJ, Friele RD. Achievement of weight loss in overweight patients during dietetic treatment in primary healthcare.

Abstract

Background: Dietitians are considered as suitable healthcare professionals for nutritional care in overweight patients. Guidelines for dietitians recommend a weight reduction of ≥ 5 % of initial body weight after one year of treatment. The purpose of this study was to evaluate weight change in overweight patients who were treated by dietitians in Dutch primary healthcare, and to identify patient characteristics that were associated with it.

Methods: This observational study data was based on real life practice data of overweight patients during the period 2013–2017, derived from dietetic practices that participated in the Nivel Primary Care Database. Multilevel linear regression analyses were performed to investigate weight change after dietetic treatment and to explore associations with patient characteristics.

Results: In total, data were evaluated from 56 dietetic practices and 4722 patients with a body mass index (BMI) ≥ 25 kg/m^2. The mean treatment time was 3 hours within an average timeframe of 5 months. Overall, patients had a mean weight change of -3.5 % (95 % CI: -3.8; -3.1) of their initial body weight, and a quarter of the patients reached a weight loss of 5 % or more. The mean BMI change was -1.1 kg/m^2 (95 % CI: -1.2; -1.0). Higher weight reductions were shown for patients with a higher initial BMI and for patients with a longer treatment time. Sex and age were not associated with weight change, and patients with other dietetic diagnoses, such as diabetes, hypertension, and hypercholesterolemia, had lower weight reductions.

Conclusions: This study showed that dietetic treatment in primary healthcare coincided with modest weight reduction in overweight patients. The weight loss goals were not reached for most patients, which was possibly due to a low treatment adherence.

Background

Worldwide, the prevalence of overweight and obesity has increased over the past three decades and has become a major global health challenge [1]. Estimates for the European region indicate that more than half of the people are overweight or obese (i.e. having a body mass index (BMI) ≥ 25 kg/m^2) [2]. Overweight, and obesity in particular, is an important risk factor for cardio metabolic diseases, including diabetes mellitus type 2 and cardiovascular diseases, and is also associated with common risk factors for cardiovascular diseases, such as hypertension and hypercholesterolemia [3].

In Europe, almost all primary healthcare systems provide services for prevention, detection, and management of cardio metabolic diseases [3]. Like in many other European countries, in the Netherlands, dietitians are considered the most suitable healthcare professionals to provide nutritional care to overweight individuals [4, 5]. Dietary and lifestyle modifications are the primary treatment goals for the treatment of overweight patients. Guidelines for dietitians recommend approximately one year of intensive treatment, followed by one year with regular contact for weight maintenance. A weight loss goal of ≥ 10–15 % and ≥ 5–10 % is advocated after one year of treatment for overweight patients with and without co-morbidities, respectively [6, 7]. Evidence suggests that a weight loss of 3–5 % of initial body weight might already lead to clinically meaningful improvements, e.g. on blood glucose levels [8]. However, larger weight losses produce greater benefits, e.g. on blood pressure, and lipid levels [8–10].

A recent review of randomised controlled trials indicated that nutritional care, provided by dietitians in the primary healthcare system, resulted in improvements in several health outcomes, including weight loss, compared to usual care (not including nutritional care) [11]. Another review also showed that dietetic intervention has significant impacts on several health outcomes in obese patients, and has substantial economic benefits [12].

Most previous studies that have demonstrated the effectiveness of dietetic treatment were interventional trials. Only a few observational studies have been conducted that evaluated real life practice data [13, 14]. The observational study of Tol and colleagues showed that patients' BMI decreased by 0.94 kg/m^2 during dietetic treatment in primary healthcare in the Netherlands [14]. The study was based on routinely recorded data from overweight patients who had completed dietetic treatment between 2006 and 2012. In recent years, however, several changes have occurred in the reimbursement of primary healthcare in the Netherlands which might negatively have affected dietetic treatment. An important change was the reduction in the maximum number of hours of dietetic treatment that will be reimbursement by the basic health insurance from four to three hours per calendar year from 2013. Furthermore, the healthcare costs that have to be paid

out-of-pocket by the patient almost doubled between 2012 and 2016, which is associated with patients refraining from accessing medical care [15].

The present study updates previous results on BMI changes during dietetic treatment as reported by Tol et al. [14], with data from patients who started a dietetic treatment between 2013 and 2016. The aim of the study was to assess weight change in overweight patients who were treated by dietitians, and to identify patient characteristics that were associated with it.

Methods

Study design

This observational study was based on routinely recorded data from Dutch dietetic practices that participated in the Nivel Primary Care Database (Nivel-PCD) within the period 2013–2017. The Nivel-PCD contains anonymised patient data from electronic health records, which is extracted from software programmes of primary care dietetic practices. In the software programme, dietitians record all data needed for reimbursement, e.g. patients age, sex, dietetic diagnoses, treatment time, and dates of consultations (see also Table 5.1). Furthermore, the software programme allows dietitians to record other relevant information, e.g. anthropometric measurements, level of education, and living situation.

Table 5.1 Explanation of dietetic diagnosis and treatment time

During the initial visit, the dietitian assesses the medical condition of the patient and records one or more dietetic diagnoses, i.e. (risk factors for) diseases related to the nutritional problem, according to a nationally used coding list. In general, the initial visit takes 45–60 minutes of direct treatment time. Follow-up consultations take 15–30 minutes.

Study population

All electronic health records were selected from patients who were ≥ 18 years old, who had a recorded dietetic diagnosis of being overweight or obese, and who started a dietetic treatment between January 2013 and December 2016. A treatment was considered to have ended if a reason for ending the treatment was recorded in the software programme used by the dietitian, or if the time elapsed since the last consultation date was more than one year. In order to evaluate weight change during treatment, patients without a recorded weight measurement at start and/or end of the dietetic treatment were excluded. Furthermore, patients were excluded who had a recorded dietetic diagnosis with contraindications for weight loss, such as gestational diabetes.

Outcome measures

Three outcome measures were defined to evaluate weight change following dietetic treatment, including, “weight change in kilograms (kg)”, “weight change as a percentage of initial body weight”, and “BMI change”. “Weight change in kg” was defined as: body weight at end of treatment – body weight at start of treatment, “Weight change as percentage of initial body weight” was defined as: (body weight at end of treatment – body weight at start of treatment)/body weight at start of treatment*100, and “BMI change” was defined as: BMI at end of treatment – BMI at start of treatment.

Independent variables

All patient characteristics were selected that were available in Nivel-PCD, might affect weight change, and were recorded for most of the patients (see supplementary table 5.1). The selected variables included sex, age, treatment time (categorised), treatment duration (categorised), and a variable that defined whether a patient had other recorded dietetic diagnoses. Therefore, three categories were established: 1) no other recorded dietetic diagnosis; 2) a recorded dietetic diagnosis of diabetes mellitus type 2, hypertension, and/or hypercholesterolemia; and 3) a recorded dietetic diagnosis other than diabetes mellitus type 2, hypertension, or hypercholesterolemia. All independent variables were recorded at the start of the treatment.

Statistical analyses

Analyses were conducted using Stata 14.2. Descriptive analyses were performed to present patient characteristics. To investigate the mean weight change at the end of the dietetic treatment, three separate multilevel linear regression analyses were performed, including a random intercept to account for clustered data of patients (level 1) within dietetic practices (level 2). Patient characteristics were added to the model with the outcome “weight change as percentage of initial body weight”. The continuous variable age was centred at the mean to improve interpretation of the intercept. Due to the multicollinearity between treatment time and treatment duration, only treatment time was added to the model. All analyses were performed for the total population and for the subgroups of initial BMI-categories (25–30, 30–35, and ≥ 35 kg/m^2). Except for six patients, the initial BMI category was specified for all patients. Associations were considered statistically significant if the two-tailed p-value was < 0.05.

Results

Initially, 8816 patients were selected in the Nivel-PCD with a recorded dietetic diagnosis of being overweight and having completed treatment. After applying all selection criteria, most patients were excluded due to a missing weight measure at the end of treatment. Finally, 4722 patients who were treated in 56 dietetic practices were included in the current study.

Table 5.2 shows the characteristics of the study population. The patients had an average age of 55 years, were most likely to be female, and 63 % of the patients was obese. The mean treatment time and treatment duration were 3 hours and 5 months, respectively. Stratification by initial BMI-category showed that patients with a higher BMI were younger, had other recorded dietetic diagnoses less often, and had a shorter treatment time than patients with a lower initial BMI. Supplementary table 5.2 shows the characteristics of the patients that did not meet all the selection criteria. The characteristics of these excluded patients were comparable to those included in the present study, except for treatment time, which was substantially lower in the group of excluded patients.

Table 5.3 presents measures of weight change at the end of dietetic treatment. Overall, overweight patients had a mean weight change of -3.5 % (95 % CI: -3.8; -3.1) of their initial body weight at end of the dietetic treatment, and a quarter of the patients reached a weight loss of ≥ 5 %. The mean BMI change was -1.1 kg/m^2 (95 % CI: -1.2; -1.0) and 4 % of the total study population reached a BMI < 25 kg/m^2. The subgroup analyses showed higher weight reductions for patients with a higher initial BMI.

The results of multilevel regression analyses for the association of patient characteristics with the percentage weight change are presented in table 5.4 and show that treatment time was strongly associated with weight loss. Patients with > 3 hours of treatment time had an average weight change of -4.6 % of their initial body weight, compared to -2.0 % for patients with ≤ 2 hours of treatment time (with mean values for the other independent variables). Furthermore, the results show that patients with one or more other dietetic diagnoses had lower weight reductions than patients with overweight or obesity as their only dietary diagnosis. Sex and age were not associated with weight change.

Table 5.2 Patient characteristics

	BMI 25–30 kg/m^2	BMI 30–35 kg/m^2	BMI ≥ 35 kg/m^2	Total
Patients, N	1733	1731	1252	4722
Sex, % female	60.1	59.7	69.1	62.3
Mean age in years (SD)	56.2 (15.8)	55.3 (15.0)	51.9 (15.3)	54.7 (15.5)
Mean initial body weight in kg (SD)	82.3 (10.0)	94.4 (11.7)	113.2 (18.9)	95.2 (17.9)
Mean initial BMI (kg/m^2) (SD)	27.8 (1.4)	32.2 (1.4)	39.4 (4.1)	32.5 (5.2)
Dietetic diagnosis, % patients				
No other diagnosis	31.5	38.6	46.0	38.0
Diagnosis of diabetes mellitus type 2, hypertension, and/or hypercholesterolemia	54.9	52.4	43.4	50.9
A diagnosis other than diabetes mellitus type 2, hypertension, or hypercholesterolemia	13.6	9.0	10.6	11.1
Treatment time, % patients				
≤ 2 hours	29.7	24.4	19.8	25.1
2–3 hours	42.5	39.6	40.6	40.9
> 3 hours	27.8	36.1	39.6	34.0
Treatment duration, % patients				
≤ 6 months	73.7	66.7	68.5	69.7
6–12 months	19.1	23.2	21.4	21.4
> 12 months	7.2	10.1	10.1	9.0

BMI body mass index

Table 5.3 Weight change at the end of dietetic treatment

	BMI 25–30 kg/m^2	BMI 30–35 kg/m^2	BMI ≥ 35 kg/m^2	Total
Weight change (kg)	-2.7 (-3.0; -2.4)	-3.3 (-3.8; -2.8)	-4.2 (-4.9; -3.5)	-3.3 (-3.7; -3.0)
Weight change (% of initial body weight)	-3.1 (-3.5; -2.8)	-3.4 (-4.0; -2.9)	-3.7 (-4.3; -3.1)	-3.5 (-3.8; -3.1)
BMI change (kg/m^2)	-0.9 (-1.0; -0.8)	-1.1 (-1.3; -0.9)	-1.4 (-1.7; -1.2)	-1.1 (-1.2; -1.0)

BMI body mass index

Regression coefficients are presented with their 95 % confidence interval. A random intercept was included to account for clustered data of patients within dietetic practices.

Table 5.4 Regression coefficients for associations between patient characteristics and weight change (as % of initial body weight)

	BMI 25–30 kg/m^2	BMI 30–35 kg/m^2	BMI ≥ 35 kg/m^2	Total
Sex				
Male (reference)				
Female	0.00 (-0.42; 0.42)	0.23 (-0.24; 0.70)	0.58 (-0.05; 1.21)	0.25 (-0.04; 0.53)
Age (reference mean)	0.00 (-0.01; 0.01)	-0.01 (-0.03; 0.01)	-0.01 (-0.04; 0.01)	-0.01 (-0.02; 0.00)
Dietetic diagnosis				
No other diagnosis (reference)				
Diagnosis of diabetes mellitus type 2, hypertension, and/or hypercholesterolemia,	-0.02 (-0.53; 0.48)	0.51 (-0.03; 1.05)	0.76 (0.09; 1.44)*	0.41 (0.09; 0.74)*
A diagnosis other than diabetes mellitus type 2, hypertension, or hypercholesterolemia	0.57 (-0.08; 1.21)	0.74 (-0.12; 1.61)	0.79 (-0.20; 1.78)	0.76 (0.29;1.23)*
Treatment time				
≤ 2 hours (reference)				
2–3 hours	-1.44 (-1.90; -0.97)*	-1.53 (-2.12; -0.94)*	-1.26 (-2.05; -0.46)*	-1.39 (-1.73; -1.05)*
> 3 hours	-2.40 (-2.92; -1.88)*	-2.56 (-3.18; -1.95)*	-3.11 (-3.92; -2.30)*	-2.67 (-3.03; -2.31)*
Intercept	-1.92 (-2.54; -1.30)	-2.38 (-3.16; -1.60)	-2.59 (-3.52; -1.67)	-2.41 (-2.89; -1.94)

BMI body mass index

Regression coefficients are presented with their 95 % confidence interval. A random intercept was included to account for clustered data of patients within dietetic practices.

*Significant regression coefficient (P < 0.05)

Intercept: male, mean age, no other dietetic diagnosis, treatment time 0–2 hours.

Discussion

Main findings

By evaluating real life practice data from dietitians during the period 2013–2017, this study showed that dietetic treatment in overweight patients coincided with a mean reduction of 1.1 BMI point, corresponding to a weight loss of 3.5 % of initial body weight, with an average treatment time of 3 hours within a timeframe of 5 months.

The results for the BMI change were consistent with the study by Tol et al. [14] that evaluated similar data over the period 2006–2012. Comparable findings were presented in a study evaluating a lifestyle programme for overweight patients implemented in Dutch primary healthcare that reported a mean weight reduction of 0.9 kg/m^2 one year after the intervention [16]. Higher weight reductions were shown in an observational study from the USA investigating a weight loss programme for obese patients in a physician's office [17]. In this study, 80 % of the patients had a weight loss of 5.6 % of their initial body weight at end of the follow up. However, the average follow-up was 21 months, which was much longer than the follow-up in our study.

Other studies that have reported weight changes after dietetic treatment were mostly randomised controlled trials. Willaing et al. [18] showed comparable results in a randomised controlled trial implemented in Danish primary healthcare. Patients at high risk of ischaemic heart disease and with a mean BMI of 33 kg/m^2 were allocated to a general practitioner or a dietitian to receive nutritional care according to usual practice. After one year, a mean reduction of 1.1 BMI point was found in the dietitian group. Furthermore, a meta-analysis of 46 randomised controlled trials among overweight patients comparing nutritional care based weight loss programmes with usual care showed a mean treatment effect of -1.9 BMI point and a 6 % reduction of initial body weight after one year [19]. However, the interventions, study samples, and weight changes of the underlying studies were heterogeneous, and the studies were generally of moderate to poor quality.

The results of our study showed that treatment time was positively associated with weight reduction, which has also been observed in previous studies [13, 14]. Moreover, in accordance with other studies, a higher initial BMI was associated with a higher weight change [13, 14, 20]. This finding can be explained by the fact that people with a higher body weight have a higher basal metabolism, and therefore, can have a higher energy intake than people with a lower weight to lose the same amount of weight [21]. Another significant finding of the study was that patients with one or more other dietetic diagnosis had lower weight reductions than patients with overweight as their only dietary diagnosis. This was also found in the study by Tol et al. [14] and might be explained by the probability that patients with other dietary diagnoses, such as diabetes mellitus type 2, use medication that could negatively influence weight loss [22].

Strengths and limitations

A major strength of this study is the use of anonymous patient data that are routinely recorded by dietitians in regular dietetic practices. We evaluated data of many patients within a realistic context, without bias from self-reporting. Herewith, our study differs from most other studies that have been conducted in an intervention setting.

A limitation of our study was the data availability, since many dietitians did not routinely record all patient information in their software programme. For many patients, weight was not recorded at the end of treatment, and therefore, these patients could not be included in the present study. Treatment time was substantially lower in the group of excluded patients, and we therefore assume that our study population is not fully representative of the total overweight population that visits dietitians, since it probably includes the more motivated patients. However, data on characteristics of motivation were not collected in this study.

Implications of the findings

The present study showed that only a quarter of the patients reached the weight loss goal of ≥ 5 % of their initial body weight at end of dietetic treatment. Furthermore, this study highlights that most patients did not meet the recommended treatment duration of at least one year, suggesting that many patients quit dietetic treatment prematurely. Our data revealed that only 9 % of the patients had a treatment duration of one year or longer. Nevertheless, the treatment duration in the period 2013–2017 was comparable to the treatment duration in the period 2006–2012 [14]. This suggests that the financial changes in primary healthcare in recent years did not affect the use of dietetic healthcare.

The value of dietetic treatment is hard to measure if patients do not adhere to the recommended treatment guidelines. Studies evaluating the effectiveness of dietetic treatment in randomised controlled trials indicated a longer follow-up as an important factor to enhance weight loss and reduce weight regain [11]. For further research, it would be interesting to gain more insight into the factors that are associated with quitting dietetic treatment.

Conclusions

This study showed that dietetic treatment in primary healthcare resulted in modest weight reduction in overweight and obese patients. Furthermore, this study revealed that a longer treatment time and a higher initial BMI were associated with higher weight loss. Weight loss goals were not reached for most patients, which was probably due to a low treatment adherence.

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Supplementary table 5.1

Completeness of patient information (N=4722)

Recorded patient characteristics	Completeness (N)	Completeness (%)
Sex	4721	99.9
Age	4722	100
Education	816	17.3
Living situation	2293	48.6
Had a previous dietetic treatment	989	20.9
Communication problems	1004	21.3
Psychological problems	979	20.7
Intellectual problems	996	21.1
Dietetic diagnoses (min.1, max.4)	4722	100
Treatment time	4722	100
Treatment duration	4722	100

Supplementary table 5.2

Characteristics of excluded patients

	BMI 25-30 kg/m^2	BMI 30-35 kg/m^2	BMI ≥35 kg/m^2	Total
Patients, N	1473	1328	923	3809
Sex, % female	40.3	41.2	34.3	38.9
Mean age in years (SD)	56.1 (16.4)	54.7 (15.3)	51.2 (15.4)	54.4 (15.9)
Mean initial body weight in kg (SD)	81.3 (10.5)	94.7 (11.7)	114.3 (17.5)	94.2 (18.5)
Mean initial BMI (kg/m^2) (SD)	27.5 (1.4)	32.3 (1.4)	39.4 (4.0)	32.2 (5.3)
Dietetic diagnosis,% patients				
No other diagnosis	26.1	33.7	44.6	33.9
Diagnosis of diabetes mellitus type 2, hypertension, and/or hypercholesterolemia	55.0	53.1	44.5	51.4
A diagnosis other than diabetes mellitus type 2, hypertension, or hypercholesterolemia	18.9	13.2	10.8	14.7
Treatment time,% patients				
≤ 2 hours	60.4	48.8	43.1	52.0
2–3 hours	22.5	25.4	27.8	24.9
> 3 hours	17.1	25.8	29.0	23.2
Treatment duration, % patients				
≤ 6 months	83.2	73.8	71.2	78.0
6–12 months	11.5	18.8	18.7	16.0
> 12 months	5.2	7.4	10.1	7.3

BMI body mass index

Excluded patients were those with a missing weight measure at the start and/or the end of treatment and those who had a recorded diagnosis (next to overweight), for which weight loss might not the goal for treatment.

Missing: 85 for initial BMI category, 693 for initial weight, 720 for initial BMI.

Chapter 6

Intermediate weight changes and follow-up of dietetic treatment in primary healthcare: an observational study

Submitted as:
Verberne LDM, Leemrijse CJ, Nielen MMJ, Friele RD. Intermediate weight changes and follow-up of dietetic treatment in primary healthcare: an observational study.

Abstract

Background: Primary healthcare data have shown that most patients who were treated for overweight or obesity by a dietitian did not accomplish the recommended treatment period. It is hypothesised that a slow rate of weight loss might discourage patients from continuing dietetic treatment. This study evaluated intermediate weight changes during regular dietetic treatment in Dutch primary healthcare, and examined whether weight losses at previous consultations were associated with attendance at follow-up consultations.

Methods: This observational study was based on real life practice data of overweight and obese patients during the period 2013–2017, derived from Dutch dietetic practices that participated in the Nivel Primary Care Database. Multilevel regression analyses were conducted to estimate the mean changes in body mass index (BMI) during six consecutive consultations and to calculate odds ratios for the association of weight change at previous consultations with attendance at follow-up consultations.

Results: The total study population consisted of 25 588 overweight or obese patients, with a mean initial BMI of 32.7 kg/m^2. The BMI decreased between consecutive consultations, with the highest weight losses between the first and second consultation (-0.5 kg/m^2). After six consultations, a mean weight loss of -1.5 kg/m^2 was estimated. Patients who lost weight between the two previous consultations were more likely to attend the next consultation than patients who did not lose weight or gained weight.

Conclusions: Overall, BMI decreased during consecutive consultations, and intermediate weight losses at previous consultations were associated with a higher attendance at follow-up consultations during dietetic treatment in overweight and obese patients. Dietitians should therefore focus on discussing intermediate weight loss expectations with their patients.

Background

In Europe, almost all primary healthcare systems provide services for the prevention and treatment of overweight and obesity (i.e. having a body mass index (BMI) ≥ 25 kg/m^2) [1]. Dietitians are important healthcare professionals for providing nutritional healthcare to overweight and obese patients, with the primary aim to achieve and maintain weight loss [2, 3]. Data from Dutch primary healthcare show that most patients who visit a dietitian are referred by their general practitioner, and approximately half of these patients are diagnosed with overweight or obesity [4]. Further studies on these data demonstrated that overweight patients who were treated by a dietitian lost approximately one BMI point, corresponding to a weight loss of 3.5 % of initial body weight. However, most patients did not reach the weight loss goal of ≥ 5 % of initial body weight, and did not accomplish the recommended treatment duration of at least one year, as recommended in the guidelines for dietitians [5, 6].

Treatment adherence, which is defined as the extent to which a person's behaviour corresponds with the agreed recommendations from the healthcare provider [7], therefore, appears to be an important aspect that needs further exploration in dietetic healthcare. Previous studies in primary healthcare settings found patients' health status, sex, age, and socio economic status to be important determinants in healthcare utilisation [8–10]. Similar determinants were indicated in a meta-analysis of adherence to weight loss interventions, which showed that a poor health, a lower age, and a lower socio economic status were associated with a lower adherence [11]. Several other studies have indicated early weight loss as a predictor for lower drop-out rates in weight loss programmes [12–18], suggesting that a slow rate of weight loss might discourage patients from continuing with treatment. However, to our knowledge, it has not been studied whether this also applies to regular dietetic treatment in a primary healthcare setting. Accordingly, the current study evaluated real life practice data to examine the degree of weight loss during the follow-up of dietetic treatment and its association with attendance at follow-up consultations.

Methods

Study design

This observational study was based on routinely recorded data by Dutch dietetic practices that participated in the Nivel Primary Care Database (Nivel-PCD) within the period 2013–2017. The Nivel-PCD contains anonymised patient data from electronic health records, extracted from software programmes used by primary care dietetic practices. In the software programme, dietitians record all the data needed for reimbursement, e.g. patient's age, sex, diagnoses, and dates of consultations. Furthermore, the software programme allows dietitians to record other relevant information, including anthropometric measurements.

Study population

All electronic health records were selected from the Nivel-PCD for patients ≥ 18 years who had a recorded diagnosis of being overweight or obese (BMI ≥ 25 k/m^2), and who started a treatment with the dietitian between January 2013 and December 2016. Patients were excluded if they had an additional recorded diagnosis for which weight loss might not be the goal for treatment, e.g. for gestational diabetes.

Measures

Information on sex, age, BMI, dietetic diagnoses, four digit-postal codes of the patient's neighbourhood, and consultation dates, were derived from the electronic health records of the patients. A variable with three categories was established that defined whether a patient had other recorded dietetic diagnoses 1) no other recorded diagnosis; 2) a recorded diagnosis of diabetes mellitus type 2, hypertension, and/or hypercholesterolemia; and 3) a recorded diagnosis other than diabetes mellitus type 2, hypertension, or hypercholesterolemia. The neighbourhood social status score in 2014 was obtained from the Netherlands Institute for Social Research (SCP) [19]. This is a composite measure on the four digit-postal code level, established with four indicators, i.e. mean income, the proportion of people with a low education level or a low income, and unemployment. For the present study, the social status score was categorised according to the quartiles of the status score in the Netherlands.

Statistical analyses

Statistical analyses were performed using STATA 14.2. Descriptive statistics were used to present patient characteristics. All recorded one to one consultations were counted that took place within one year after start of the treatment to calculate the attrition rate. A multilevel linear regression analysis was performed to estimate the mean changes in BMI

during six consecutive consultations, using data from all patients who had a recorded BMI at the first consultation (the initial BMI) and an available BMI measures at one or more of the five following consultations. The initial BMI was used as reference to calculate the change in BMI at each time point. Random intercepts were included to account for clustered data of patients within dietetic practices and for repeated measurements within patients.

Weight changes between two consecutive consultations were calculated by subtracting the BMI recorded at the first consultation from the BMI recorded at the last consultation for all patients with available BMI measurements. Subsequently, three categories of weight change were established. The category "no weight loss" (change in BMI: ≥ 0 kg/m^2) was used as a reference. Furthermore, two categories of weight loss were created: "moderate weight loss", and "high weight loss". The cut off value for these two categories was based on the median weight loss between consultations, which was approximately -0.5 kg/m^2. We used a multilevel logistic regression, including a random intercept to account for clustered data of patients (level 1) within dietetic practices (level 2), to calculate the odds ratios for attendance at consultation 3, 4, 5, and 6, across the categories of weight change between consultation 1 & 2, consultation 2 & 3, consultation 3 & 4, and consultation 4 & 5, respectively. A second model was used to control for potential confounding factors, and included variables for sex, age, initial BMI, dietetic diagnosis, and social status score. A two-tailed P-value of < 0.05 was considered statistically significant.

Results

The total study population consisted of 25 588 patients from 77 dietetic practices. Table 6.1 shows the characteristics of the study population. Patients were on average 54 years old, had a mean BMI of 32.7 kg/m^2 at the start of treatment, and 64 % were female. Sixteen percent of the 25 588 patients dropped out after one consultation and approximately a quarter of the patients attended six consultations or more, corresponding to a mean treatment duration of 3.5 months (Figure 6.1). The time between consultations increased from 28 days between the first and second consultation to 42 days after the third consultation. For 79 % of the study patients, a BMI was recorded at the first consultation (i.e. the initial BMI). At each following consultation, BMI was recorded for approximately 70 % of the patients. The BMI decreased during consecutive consultations, with the highest weight losses occurring between the first two consultations. After six consultations, a mean weight change of -1.5 kg/m^2 was estimated (Figure 6.2). This is equivalent to a weight reduction of 4 % of initial weight (average initial weight 95.9 kg). A similar weight loss pattern was shown in additional analyses that included only patients who attended six or more consultations with a recorded BMI at each consultation. Table 6.2 shows the association of attendance at a consultation with the weight change between the two previous consultations. Patients who lost weight between the two previous consultations were more likely to attend the next consultation than patients who did not lose weight or gained weight. These associations were present in both the crude and adjusted models.

Table 6.1 Patient characteristics (N=25 588)

	Percent/Mean (SD)
Sex (female)	63.9
Age (years)	53.7 (15.2)
Initial body mass index (kg/m^2)	32.7 (5.4)
Initial body weight (kg)	95.9 (18.5)
Dietetic diagnosis:	
No other diagnosis	38.9
Diagnosis of diabetes mellitus type 2, hypertension, and/or hypercholesterolemia	48.3
A diagnosis other than diabetes mellitus type 2, hypertension, or hypercholesterolemia	12.9
Neighbourhood social status score:	
Quartile 1—low	36.7
Quartile 2	23.9
Quartile 3	18.1
Quartile 4—high	21.3

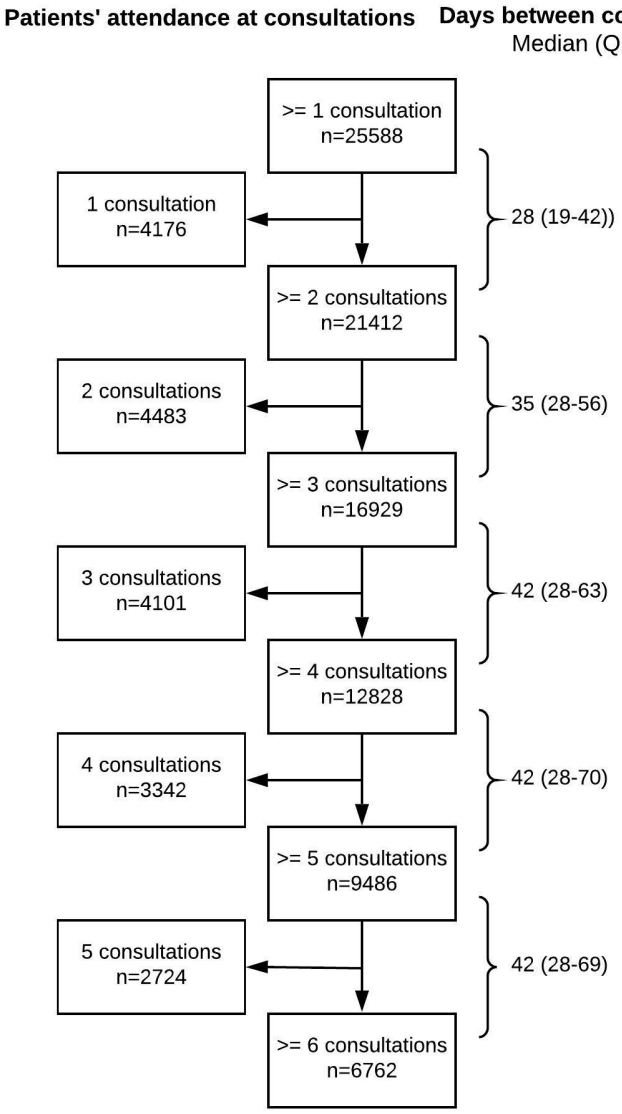

Figure 6.1 Attrition rate during dietetic treatment

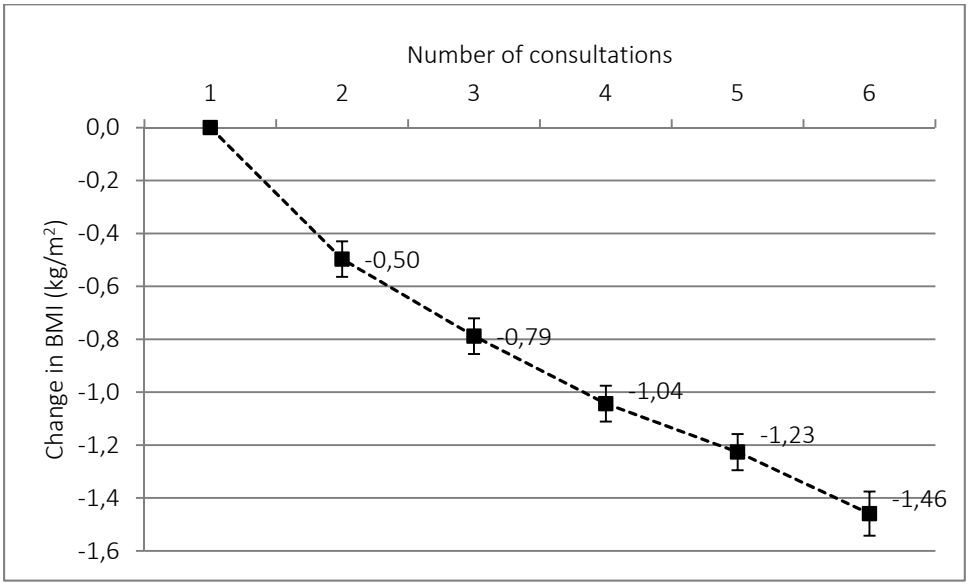

Figure 6.2 Mean change in body mass index (BMI) between six consecutive consultations. Means are adjusted for clustered data of patients within dietetic practices, and for repeated measurements within patients. The error bars represent the 95 % confidence intervals around the means.

Table 6.2 The association of attendance at a consultation with weight change between the two previous consultations

	Category of weight change between two previous consultations		
	no weight loss	moderate weight loss	high weight loss
Attendance at 3rd consultation			
N (yes/no)[1]	2548/705	3322/706	4810/864
Model 1	ref.	1.28 (1.14–1.44)	1.48 (1.33–1.67)
Model 2	ref.	1.28 (1.14–1.44)	1.40 (1.25–1.57)
Attendance at 4th consultation			
N (yes/no)[2]	2363/762	2914/662	2803/639
Model 1	ref.	1.40 (1.24–1.58)	1.40 (1.24–1.58)
Model 2	ref.	1.44 (1.27–1.64)	1.35 (1.19–1.54)
Attendance at 5th consultation			
N (yes/no)[3]	2131/786	2100/527	1844/497
Model 1	ref.	1.43 (1.26–1.62)	1.33 (1.17–1.52)
Model 2	ref.	1.40 (1.21–1.60)	1.27 (1.11–1.47)
Attendance at 6th consultation			
N (yes/no)[4]	1739/735	1511/422	1035/357
Model 1	ref.	1.44 (1.25–1.66)	1.21 (1.04–1.41)
Model 2	ref.	1.46 (1.25–1.70)	1.17 (0.99–1.38)

Odds ratios are presented with their 95 % confidence intervals.

Model 1: adjusted for clustered data of patients within dietetic practices.

Model 2: model 1+ adjustment for sex, age, initial body mass index (BMI), dietetic diagnosis, and social status score.

[1] Weight loss category according to change in BMI between consultations 1 & 2.

[2] Weight loss category according to change in BMI between consultations 2 & 3.

[3] Weight loss category according to change in BMI between consultations 3 & 4.

[4] Weight loss category according to change in BMI between consultations 4 & 5.

Discussion

Main findings

This study evaluated intermediate weight changes during regular dietetic treatment and its association with attendance at follow-up consultations in Dutch primary healthcare. The study elaborates on our previous study which showed that a higher weight loss was associated with a longer treatment duration [6]. Accordingly, the present study demonstrated that BMI decreased during consecutive consultations, with the highest weight loss between the first two consultations. Furthermore, it was found that patients who lost weight between previous consultations were more likely to attend the next consultation than patients who did not lose weight or gained weight.

Our study showed that 16 % of the patients only had one consultation, which is corresponding to findings of a similar, Italian, study that reported a dropout rate of 21 % after one month in an obesity treatment programme in a clinical setting [13]. Furthermore, we showed that the mean change in BMI between consultations decreased from approximately -0.5 kg/m^2 at the second consultation to approximately -0.25 kg/m^2 at the following consultations, which is in accordance with reviews on clinical trials that also observed a diminishing trend for weight loss over time [20–22]. We found intermediate weight losses during dietetic treatment in primary healthcare to be associated with a higher attendance rate at the next consultation. Similar findings have also been shown in other studies in real life settings, other than primary healthcare [13, 15], and in studies on dietary weight loss interventions, demonstrating an association of early weight loss with the dropout rate [12, 14, 16-18]. For example, Batterham et al. found that people with a weight loss ≤ 2 % were five times more likely to dropout from a weight loss trial than those with a weight loss > 2 % in the first month [12].

Strengths and limitations

We used a large database with real life practice data from overweight and obese patients treated by dietitians in Dutch primary healthcare. This database includes all information relevant for reimbursement and treatment purposes. In addition, we could link data on social status score to the patient records. We were therefore able to control for important variables related to healthcare utilisation.

A limitation of the study was the availability of anthropometric data. Measurements of BMI were not recorded at all consultations or for all patients. Additional analyses showed that patients who attended the next consultation were more likely to have had their BMI recorded during the previous consultation (approximately 70 %) than patients who did not attend the next consultation (approximately 60 %) (data not shown). We could, however, not check whether missing data on BMI were affected by disappointing weight loss results.

Another issue that needs consideration is that we only evaluated attendance at follow-up consultations. Attendance at consultations is one aspect of treatment adherence, but does not necessarily mean that a patient is following the instructions for lifestyle changes as recommended by their dietitian. Information about the patients' compliance with the recommended lifestyle changes by their dietitian was not available in our database. Furthermore, we were not able to evaluate the dietitian-patient relationship, which has been shown to have an important role in adherence to nutritional treatment [23].

Implications of the findings

We showed that the BMI of overweight and obese patients who were treated by dietitians decreased between consecutive consultations, with the highest weight loss between the first and second consultation. This early weight loss is important, since it has been associated with successful weight loss and weight maintenance in the long-term [14, 24–26]. However, after these first consultations, dietitians should focus on discussing realistic weight loss expectations with their patients. Refining intermediate weight loss goals would possibly help to improve the continuation of treatment. Furthermore, a higher frequency of consultations with a dietitian might aid an earlier intervention in patients who are not complying with the advice from their dietitian [21, 27]. Future research is recommended to examine the frequency of consultations that is most beneficial for patients' health outcomes.

Conclusions

This study was conducted to gain a greater understanding of the adherence to dietetic treatment in primary healthcare. We demonstrated that the BMI of overweight and obese patients who were treated by dietitians in primary healthcare decreased between consecutive consultations, and found that intermediate weight losses during dietetic treatment were associated with a higher attendance at follow-up consultations. In order to improve the retention rate of patients during dietetic treatment, dietitians should focus on discussing intermediate weight loss expectations with their patients.

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Chapter 7

General discussion

In the last decade, preventive services and health promoting activities became more important in Dutch primary healthcare. The focus of the research described in this thesis was on the health status, and management of overweight and obese adults in Dutch primary healthcare. In this chapter, the main findings are summarised and discussed, including the main methodological issues and implications for practice.

Main findings

- A lifestyle intervention, focusing on improvement of dietary behaviour and physical activity, resulted in similar effects on lifestyle related risk factors and healthcare consumption, compared to usual care for overweight patients. Only an improvement for high density lipoprotein (HDL) cholesterol was shown (Chapter 2).
- About two-thirds of the patients with mild to moderate chronic obstructive pulmonary disease (COPD) are overweight. In these patients, being overweight or obese was associated with a higher prevalence of common disorders including hypertension, osteoarthritis, and diabetes mellitus, and with an increased prescription of medication for obstructive airway disease, compared to being normal weight (Chapter 3).
- In 2012, weight was recorded in electronic health records (EHRs) of general practices, for a quarter of patients who self-reported as being overweight. Weight was most frequently recorded for patients with a chronic condition for whom regular weight measurement is recommended in clinical guidelines. Weight was recorded less frequently for younger patients and those without a chronic condition related to being overweight (Chapter 4).
- Most overweight patients who had a dietetic treatment did not achieve the weight loss goal of ≥ 5 % of initial body weight. Greater weight reductions were shown for patients with a higher initial body mass index (BMI) and a longer treatment time (Chapter 5).
- During dietetic treatment, the BMI of overweight patients decreased between consecutive consultations, with the highest weight losses between the first and second consultation. Intermediate weight losses were associated with a higher attendance at follow-up consultations (Chapter 6).

Reflection on main findings

Weight management in general practice

In the Netherlands and the UK, most inhabitants visit their general practitioner (GP) at least once a year, with an average consultation rate of approximately four to five times a year [1, 2]. Chapter 4 shows that in 2012 a quarter of the Dutch adult population who self-reported as being overweight had their BMI or weight documented in their EHR in general practice. This is much lower than estimates of UK primary healthcare studies, which demonstrate that about half of the overweight patients had a recent documented BMI [3]. The higher rate of BMI recording in the UK might be due to the Quality and Outcomes Framework (QOF), an incentive program which was introduced in 2004. Through this program general practices receive financial rewards for practice achievement results based on several indicators, including the indicator "establishing and maintaining a register of patients aged ≥ 18 years who have a recorded BMI of ≥ 30 kg/m^2 within the previous 12 months" [4]. These financial incentives seemed to have improved weight recording in UK general practices, and the QOF has accelerated the widespread use of electronic medical records and multidisciplinary management of chronic diseases [5].

In the Netherlands, comparable indicators were introduced in primary healthcare guidelines for patients with diabetes mellitus type 2, COPD, and cardiovascular disorders. These guidelines recommend annual evaluation of a patients' weight status [6]. Chapter 4 showed that weight was annually recorded for about two third of the overweight patients who were diagnosed with diabetes mellitus in the period 2012-2015. However, for overweight patients with a diagnosis for a cardiovascular disorder or for COPD, annual weight recording was only presented in about a third of the patients within this timeframe. For the definition of cardiovascular disorders we included a broad range of disorders for which different weight recording habits would probably exist. This was, however, not explored further in this research. In patients with COPD there is a is paradoxical effect of BMI. Prevention of weight loss is recommended for these patients, since a low BMI has been linked to an elevated mortality risk [7]. However, overweight is highly prevalent among patients with COPD, as previous studies demonstrated that about 65 % of COPD patients are overweight or obese [8-11]. Chapter 3 demonstrated that overweight, and in particular obesity, was associated with several comorbidities and with increased use of medication in patients with mild to moderate COPD, compared to COPD patients with a normal weight. The findings imply that airflow problems in these patients are possibly more related to their excess in weight than to their COPD. Focussing on lifestyle and weight reduction would, therefore, be appropriate for these patients [12].

Differences exist in the recording of anthropometric and metabolic measurements between general practices. In the study described in Chapter 2, the comparison "usual

care" group was selected from general practices with adequate recording of anthropometric and metabolic measurements. The findings of this study show that, over time, BMI and other risk factors reduced in both the intervention and comparison groups, suggesting that increased attention to anthropometric measurements, like BMI, in general practices may already have a positive effect on patients' lifestyle behaviour. These findings are strengthened by results from other studies. A review on health checks conducted within general practices showed improvements on several major risk factors, including BMI [13], and other studies identified monitoring and discussing weight by healthcare professionals as predictor for successful behaviour changes in overweight patients [14, 15].

Effectiveness of dietetic treatment

Chapter 5 showed that overweight patients started a dietetic treatment with an average BMI of 32.5 kg/m^2. At the end of the treatment they had a mean weight reduction of 1.1 BMI unit, corresponding to a weight loss of 3.5 % of their initial weight. Herewith, only a quarter of the patients reached the weight loss goal of ≥ 5 % of their initial weight, and most patients did not reach a weight within the normal weight category (BMI 18.5-25 kg/m^2). Similar findings were previously found with 2006-2012 data [16], and in a comparable study in Danish primary healthcare [17]. The study on the evaluation of the BeweegKuur intervention, which included treatment from a dietitian, also showed similar results on weight change (Chapter 2).

Furthermore, in accordance with previous studies, greater weight reductions were shown in patients with a higher initial BMI and in patients who had a longer treatment time (Chapter 5) [16, 18-20]. However, discontinuation of weight loss treatment is often reported [21], also in our study. Chapter 5 shows that the treatment time for overweight patients in regular dietetic practice was on average three hours within a timeframe of five months, while guidelines recommend a treatment time of at least one year [22, 23].

Several studies indicated early weight loss as a preventive factor of drop-out in weight loss programmes [24-30], and as indicator for better weight loss results and weight maintenance in the end [26, 31-33]. This was confirmed by our study on real-life primary healthcare data in Chapter 6, showing that intermediate weight losses during regular dietetic treatment of overweight patients were associated with a higher attendance rate at follow-up consultations. It therefore seems to be important for dietitians to keep focusing on their patients' motivation and on discussing intermediate weight loss expectations with their patients.

Methodological reflections

All studies described in this thesis made use of data from the Nivel Primary Care Database, an ongoing database that routinely collects anonymised EHR-data from several primary healthcare providers. The database includes data from about ten percent of all general practices and primary healthcare dietitians in the Netherlands and covers a representative sample of the Dutch population in terms of sex and age [1, 34]. The EHR-data contain structured documentation on patients' health status and further information that is relevant for treatment purposes, including patients' demographics, and prescribed medication [35, 36].

A major strength of this database is that it allowed us to study real-life clinical care during multiple years without the bias of self-report [37]. Moreover, due to the large size of the database, associations could be estimated with a higher level of precision. An additional strength is the possibility of linkage with other databases to enhance datasets for research purposes. For example, the linkage of data from the Occupational and Environmental Health Cohort Study (AMIGO study) enabled us to extend the dataset with information on lifestyle determinants and to select a group of persons who self-reported as being overweight (Chapter 4).

A consequence of using real-life practice data is that the quality of data is dependent on the recording habits of the healthcare professionals, because data are recorded during routine consultations and not for specific research purposes. To stimulate adequate recording, primary healthcare practices participating in the Nivel Primary Care Database do annually receive quality feedback information to make them aware of their recording habits [36]. However, comprehensive data quality checks are still necessary, and for the studies in this thesis only practices that had a certain level of data quality were included, such as those that had continuous data recording over a year. This could consequently have caused a selection bias. Software issues were shown to be a major factor in data-quality differences, which is fortunately unrelated to clinical performance [36]. However, weight measurements and other anthropometric measurements are more often recorded in patients with a related health issue, as is presented in this thesis (Chapter 4), and also indicated in an evaluation of an UK primary healthcare database [38]. Chapter 5 highlights the consequences of the limited data availability, as most of the initially selected patient population had to be excluded because of missing weight measurements at the end of treatment. Treatment time appeared to be substantially lower in the group of excluded patients, indicating that weight measurements were not missing at random.

Another issue of consideration is the use of BMI as indicator of weight status. A BMI measure does not distinguish between muscle mass and fat mass and its use is therefore cautioned in persons who have divergent proportions of muscle masses, such as athletes.

However, despite this limitation, BMI is generally thought to be a good measure for classifying persons into weight categories. The calculation of the BMI requires only height and weight, is easy to use for clinicians, and has the advantage that extensive reference data is available, since it is frequently used in clinical and epidemiological studies [39]. Furthermore, we proposed BMI or weight recording as indicator for recognition of overweight by GPs (Chapter 4). However, absence of recording does not necessarily mean that weight is not measured or discussed between patient and GP. Furthermore, weight may also be recorded as a medical code for overweight (ICPC T83), or obesity (ICPC T82). These medical codes were not evaluated in this thesis, as they were only recorded for < 5 % of the patients.

Implications for practice

Prevention activities, including the reduction of overweight and obesity, are particularly effective within an integrated and multidisciplinary approach. This means that it not only addresses persons directly, but also modifies the physical and social environment. For smoking, this approach has successfully been implemented in the Netherlands, and includes the provision of information on health consequences, pricing measures, and smoking bans in public places, in collaboration with health institutes, the government, industry, and the scientific field. While the obesity epidemic is more complex than smoking, the comparison with smoking demonstrates that an integrated and multidisciplinary approach may be effective [40]. Accordingly, the recent publication of the National Prevention Agreement emphasizes that a reduction of the overweight rate in the Netherlands is a collective interest that requires collaboration from serval parties, including local governments, health insurance companies, and healthcare professionals [41].

General practitioners and practice nurses could play a key role in assessing their patients' weight status, assessing the need for further treatment, and monitoring requirements for medication change as weight loss progresses [42-46]. However, adequate weight management depends on several factors such as reimbursement of healthcare and the perspectives of healthcare professionals and patients.

Reimbursement

Payment policy is an important aspect in the access and use of primary healthcare, and inadequate reimbursement is indicated as important barrier for GPs to implement prevention programs in their practice [47, 48]. The political decision to abandon the basic health insurance reimbursement of the BeweegKuur intervention, as was initially intended by 2012, possibly demotivated the GPs to continue with the study on the evaluation of the intervention (Chapter 2). Furthermore, it has been shown that limiting the reimbursement

of dietetic treatment resulted in fewer patients visiting the dietitian, since many patients cannot or are unwilling to pay for dietetic treatment [49].

To arrange adequate reimbursement for health promoting activities, it is important that these activities have been proven to be cost effective [50]. Regular monitoring on lifestyle interventions, and other preventive activities in primary healthcare, is therefore recommended and may help to intervene in processes that need improvement. A real-life database, such as the Nivel Primary Care Database, might therefore be a decent method.

Perspectives of healthcare professionals and patients

Now, in 2019, the Dutch government decided that the basic health insurance should cover the costs for some lifestyle interventions. However, it remains to be seen whether these lifestyle interventions are broadly implemented in daily practice, as GPs do not always feel responsible for weight management or other prevention tasks, or experience a lack of patient motivation as a barrier [43, 48, 51-55]. Surveys among the Dutch population revealed that about a third of the population do not feel the need for their GP to perform preventive tasks, and that about half of the population is willing to participate in either a lifestyle intervention or a health check [55, 56]. Moreover, referring patients for weight loss treatment does not necessarily mean that these patients are motivated enough for successful behavioural change. A Dutch study indicated that patients who started dietetic treatment on their own initiative used more consultations and had better treatment results compared to patients who were referred to a dietitian [57].

In contrast to other preventive programs, such as the influenza vaccination program or the cervical cancer screening program, participation in a weight loss program demands great effort from patients and requires a long-term investment [50]. Empowering overweight patients to make health-promoting behaviour changes is therefore an important but challenging task for primary healthcare professionals [58].

Main conclusions and recommendations

Weight recording in EHRs occurs less frequently than recommended by clinical guidelines used in Dutch general practices, and participation in a lifestyle intervention or dietetic treatment coincided with only modest weight loss results in overweight and obese patients. The findings show evidence for GPs to improve regular screening and recording of the weight status of their patients. To improve continuation of dietetic treatment, more attention to discussing intermediate weight loss expectations between dietitians and patients is recommended.

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Summary

About half of the Dutch adult population is overweight or obese, and during the last decades this has become a major public health problem worldwide. A person's weight status is generally described by the body mass index (BMI), defined as a person's weight in kilograms divided by the square of the person's height in meters (kg/m^2). Overweight is defined as a BMI of 25 kg/m^2 or more, and obesity as a BMI of 30 kg/m^2 or more. Overweight, and in particular obesity, is a risk factor for several chronic diseases, and places a high burden on healthcare systems.

In the Netherlands, and many other European countries, clinical guidelines exist for the treatment of overweight patients in primary healthcare. General practitioners (GPs) and practice nurses play a key role in the identification and monitoring of overweight individuals, as most persons visit their GP about four to five times a year. Weight management tasks of GPs and practice nurses consist of regular weight measurements, advisement on nutrition and physical activity, and may include referral to a lifestyle intervention, or a dietitian. The primary aim of dietetic treatment is to achieve and maintain weight loss by assessing patients' diet and nutritional status and giving practical advice to improve dietary behaviour.

The aim of this thesis was to study the health status, and the management of overweight and obese patients in general practices and dietetic practices in the Netherlands.

Chapter 2 describes a lifestyle intervention for overweight patients in primary healthcare. Baseline to post intervention changes in lifestyle-related risk factors and healthcare consumption were studied in the intervention group, and compared to a group of overweight patients, who received care as usual. Compared to baseline, both groups showed reductions in BMI, blood pressure, total cholesterol, and low density lipoprotein (LDL) cholesterol in year post intervention, however, without significant differences between groups. For high density lipoprotein (HDL) cholesterol, a significant improvement was observed for the intervention group, above the comparison group. No significant intergroup differences were shown in drugs prescriptions and number of GP consultations. This study highlights that implementation and evaluation of a lifestyle intervention in primary healthcare is challenging due to political and financial barriers.

Chapter 3 describes a cross-sectional study that examined the association of overweight with the prevalence of comorbid disorders and prescribed medication for obstructive airway disease, in patients with mild to moderate chronic obstructive pulmonary disease (COPD). Compared to COPD patients with a normal weight, positive associations were found for diabetes mellitus, osteoarthritis, and hypertension, for both overweight and obese patients, and for heart failure in obese patients. Osteoporosis and anxiety disorders

were less prevalent in overweight and obese patients. No associations were found for coronary heart disease, stroke, sleep disturbance, depression, and pneumonia. Furthermore, obese patients were in general more often prescribed medication for obstructive airway disease compared to patients with a normal weight. More attention to weight reduction in this patient group would possibly reduce symptoms and the use of medication.

Chapter 4 describes a study that evaluated the frequency of weight recording in electronic health records in general practices for patients who self-reported as being overweight. In 2012, weight or BMI was recorded for a quarter of the patients who self-reported as being overweight and who visited their GP at least once that year. Greater age, lower education level, higher self-reported BMI, and the presence of diabetes mellitus, COPD, and/or cardiovascular disorders were associated with higher rates of weight recording. Weight was less frequently recorded for younger patients and those without a chronic condition related to being overweight. For these patients, routine recording of weight deserves more attention in general practices, to support early recognition and treatment of overweight.

Chapter 5 describes weight change in overweight patients during dietetic treatment. The mean treatment time was 3 hours within an average timeframe of 5 months. Overall, patients had a mean weight change of -3.5 % of their initial body weight at the end of treatment, and mean BMI change was -1.1 kg/m^2. Higher weight reductions were shown for patients with a higher initial BMI and for patients with a longer treatment time. Sex and age were not associated with weight change, and patients with other dietetic diagnoses, such as diabetes mellitus, hypertension, and hypercholesterolemia, had lower weight reductions. The recommended weight loss goal of ≥ 5 % of initial body weight was not reached for most patients, which was possibly due to a low treatment adherence.

Chapter 6 describes a study that evaluated intermediate weight changes in overweight patients during dietetic consultations that took place within one year after start of the treatment. At the start of the treatment the patients had a mean BMI of 32.7 kg/m^2. The BMI decreased during consecutive consultations, with the highest weight losses between the first and second consultation (mean weight change: -0.5 kg/m^2). After six consultations, a mean weight change of -1.5 kg/m^2 was estimated. Patients who lost weight between the two previous consultations were more likely to attend the next consultation than patients who did not lose weight or gained weight. To improve the continuation of dietetic treatment, dietitians should focus on discussing intermediate weight loss expectations with their patients.

The main conclusions from this thesis are that weight recording in electronic health records of Dutch general practices occurs less frequently than recommended by clinical guidelines, and that participation in a lifestyle intervention or dietetic treatment coincided with only modest weight loss results in overweight and obese patients.

Nederlandse samenvatting

In Nederland heeft ongeveer de helft van de volwassenen overgewicht en in de laatste decennia is overgewicht wereldwijd een groot maatschappelijk probleem geworden. De gewichtsstatus wordt meestal bepaald met behulp van de body mass index (BMI). Om de BMI te bepalen wordt het lichaamsgewicht in kilogram gedeeld door de lengte in meters in het kwadraat. Bij een BMI van 25 kg/m^2 of hoger is er sprake van overgewicht en bij een BMI van 30 kg/m^2 of hoger van obesitas. Een te hoog gewicht is een risicofactor voor verschillende chronische ziekten en gerelateerd aan een hoog zorggebruik.

In zowel Nederland als in veel andere Europese landen zijn er richtlijnen in de gezondheidzorg voor de behandeling van patiënten met overgewicht. De huisartsenpraktijk wordt gezien als een belangrijke plek voor het identificeren en monitoren van mensen met overgewicht, omdat de meeste mensen daar zo'n vier tot vijf keer per jaar komen. Huisartsen en praktijkondersteuners somatiek kunnen hun patiënten met overgewicht adviezen geven over leefstijl en het gewicht van deze patiënten in de gaten houden. Ook kunnen zij doorverwijzen naar een leefstijlinterventie of een diëtist. Het doel van een behandeling bij de diëtist is het verbeteren van het eetgedrag en de leefstijl om daarmee gewichtsverlies te bereiken en te behouden.

Voor dit proefschrift is onderzoek gedaan naar de gezondheid en de behandeling van patiënten met overgewicht en obesitas in huisartsenpraktijken en diëtistenpraktijken in Nederland.

Hoofdstuk 2 beschrijft een evaluatie van een leefstijlinterventie (De BeweegKuur) voor mensen met overgewicht in de huisartsenpraktijk. In de groep patiënten die deze leefstijlinterventie gevolgd hebben zijn veranderingen in risicofactoren gerelateerd aan leefstijl en het zorggebruik in het jaar voor en in het jaar na deelname aan de interventie geëvalueerd en vergeleken met een groep patiënten met overgewicht die reguliere zorg heeft ontvangen. In beide groepen was een afname te zien in BMI, bloeddruk, totaal cholesterol en low density lipoproteïne (LDL) cholesterol in het jaar na deelname, maar er waren geen significante verschillen tussen de groepen. Voor high density lipoproteïne (HDL) cholesterol was wel een significante verbetering zichtbaar in de interventiegroep ten opzichte van de controlegroep. Tussen de groepen waren geen verschillen in medicatievoorschriften en het aantal consulten bij de huisarts. De studie zien dat goede implementatie en evaluatie van een leefstijlinterventie afhankelijk is van politieke beslissingen en financiële vergoedingen.

Hoofdstuk 3 beschrijft een cross-sectioneel onderzoek bij patiënten met milde tot matige chronische obstructieve longziekten (COPD) naar het verband tussen overgewicht en het vóórkomen van andere (chronische) aandoeningen en het voorschrijven van medicatie voor

COPD. De resultaten laten zien dat COPD-patiënten met overgewicht significant vaker diabetes mellitus, artrose en hypertensie hebben dan COPD-patiënten met een normaal gewicht. Patiënten met obesitas hebben ook vaker hartfalen. Daarentegen komen osteoporose en angststoornissen minder vaak voor bij COPD-patiënten met overgewicht. Voor coronaire hartziekten, beroerte, slaapstoornissen, depressie en longontsteking is geen verband gevonden met gewicht. Verder komt uit het onderzoek naar voren dat COPD-patiënten met obesitas vaker COPD-medicatie kregen voorgeschreven dan COPD-patiënten met een normaal gewicht. Meer aandacht voor gewichtsvermindering bij deze patiënten zou kunnen leiden tot vermindering van klachten, waardoor mogelijk ook minder vaak medicatie nodig is.

Hoofdstuk 4 beschrijft een onderzoek naar de registratie van BMI en gewicht in de huisartsenpraktijk voor patiënten met zelf-gerapporteerd overgewicht. In 2012 werd bij een kwart van de patiënten met zelf-gerapporteerd overgewicht die hun huisarts dat jaar tenminste één keer bezochten, het gewicht of de BMI geregistreerd in het elektronische patiënten dossier. Het gewicht werd vaker geregistreerd bij patiënten met een hogere leeftijd, een lager opleidingsniveau, een hogere zelf-gerapporteerde BMI en bij patiënten met diabetes mellitus, COPD en/of hart- en vaatziekten. Bij relatief jonge patiënten en bij patiënten zonder een aan overgewicht gerelateerde aandoening werd het gewicht minder vaak geregistreerd. Voor deze patiënten zou een betere registratie van het gewicht kunnen bijdragen aan tijdige erkenning en behandeling van overgewicht.

Hoofdstuk 5 beschrijft de gewichtsverandering van patiënten met overgewicht na behandeling bij de diëtist. De gemiddelde behandeltijd was 3 uur over een periode van 5 maanden. Aan het eind van de behandeling was de gemiddelde gewichtsverandering -3,5 % van het startgewicht en de gemiddelde BMI verandering was -1,1 kg/m^2. Patiënten met een hoger gewicht aan het begin van de behandeling en patiënten die een langere behandeltijd hadden, bereikten meer gewichtsverlies. Geslacht en leeftijd waren niet geassocieerd met gewichtsverandering en patiënten met andere voeding gerelateerde aandoeningen, zoals diabetes mellitus, hypertensie en hypercholesterolemie, bereikten minder gewichtsverlies. De studie laat zien dat de meeste patiënten met overgewicht de aanbevolen gewichtsafname van ≥ 5 % van hun startgewicht niet halen na behandeling bij de diëtist. Dit komt mogelijk door een lage therapietrouw.

Hoofdstuk 6 beschrijft een studie naar tussentijdse gewichtsveranderingen bij patiënten met overgewicht gedurende het eerste jaar van de behandeling bij de diëtist. Bij aanvang van de behandeling was de gemiddelde BMI van deze patiënten 32,7 kg/m^2. De BMI nam af tijdens opeenvolgende consulten, waarbij het meeste gewichtsverlies te zien was tussen de

eerste twee consulten (gemiddelde BMI verandering: -0,5 kg/m^2). Na zes consulten was de gemiddelde BMI verandering -1,5 kg/m^2. Verder laat de studie zien dat patiënten die gewicht hadden verloren tussen twee eerdere consulten vaker naar een volgend consult kwamen dan patiënten die geen gewicht hadden verloren tussen twee eerdere consulten. Het lijkt daarom belangrijk voor diëtisten om aandacht te besteden aan tussentijds gewichtsverlies, om de kans op voortzetting van de behandeling te vergroten.

De belangrijkste conclusies van dit proefschrift zijn dat het gewicht van patiënten minder vaak geregistreerd wordt in elektronische patiëntendossiers van huisartsenpraktijken dan geadviseerd wordt in de richtlijnen voor huisartsen en dat het gewichtsverlies van patiënten met overgewicht en obesitas na behandeling bij de diëtist of na deelname aan een leefstijlinterventie beperkt is.

Dankwoord

Mijn proefschrift is nu af 📗. Graag wil ik op deze plek iedereen bedanken die direct of indirect heeft bijgedragen aan de totstandkoming van dit proefschrift.

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Lisa, augustus 2019

About the author

Lisa Verberne was born on 6 September 1985 in Arnhem, the Netherlands. In 2003, she completed secondary school at Olympus College in Arnhem. After finishing her secondary education, she studied Nutrition and Health at Wageningen University. In 2009, she obtained her master degree in Nutritional and Public Health Epidemiology. From 2009 to 2011 she worked as research assistant and junior researcher at the department of Human Nutrition and Health at Wageningen University. In 2012, she began working as a researcher at Nivel, the Netherlands Institute for Health Services Research, where she conducted her PhD-research as described in this thesis.

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