Childhood Obesity in Primary Care

Not yet General Practice

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Kinderen met obesitas bij de huisarts

Nog geen dagelijkse praktijk

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Winifred Dorus Paulis
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Promotor: Prof.dr. B.W. Koes

Copromotor: Dr. M. van Middelkoop

Overige leden: Prof.dr. H. Raat
Prof.dr. I.D. de Beaufort
Prof.dr. G.E.H.M. Rutten

Voor Marian

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Chapter 1

General introduction

Mrs B, 45 years old and from Turkish origin, consults the general practitioner (GP) for control of her type 2 diabetes. She is moderately overweight. The GP discussed this at a previous consultation, but no change in weight is apparent. Because Mrs B does not speak Dutch she took her adolescent son with her to act as interpreter. The GP notices the son has excessive weight, presumable obesity. The son has rarely visited the general practice before.

The GP hesitates how to act. There is so much emphasis on tackling childhood obesity especially since obesity is related to diabetes mellitus type 2. Is it therefore permissible to discuss the excessive weight of the son and give unsolicited lifestyle advice? Or should the GP wait till the son visits the clinic himself for weight-related complaints?

This case was published a couple of years ago on a website about healthcare ethics.[1] Public reactions posted on this website about the role of the GP varied from quoting Desiderius Erasmus with 'it is better to prevent than to cure' to 'meddling is worse than gluttony'.

The aim of the present thesis is not to solve this moral dilemma, but to investigate research questions relevant to the discussion. First of all, I want to reveal whether overweight and obese children are different from non-overweight children regarding complaints they experience and how often and with what type of complaints they attend general practice. Second of all, I want to explore what GPs could do to help children lose weight. Specifically, I studied the recommendations of clinical guidelines and the effectiveness of an intervention for GPs to discuss eating and exercise behaviour. In addition I searched for treatment opportunities in primary care.

To put these aims in some perspective this first chapter gives an introductory on childhood overweight and obesity, the consequences and causes, prevention and treatment strategies and the role of primary care in the Netherlands.

CHILDHOOD OVERWEIGHT AND OBESITY

Historically, an overweight child was presumed to be a healthy child, because it was capable to survive periods of undernourishment and infections.[2] Natural selection probably favoured people with a thrifty energy metabolism (the thrifty gene hypothesis[3]). During millennia of frequent food scarcities this economical energy metabolism was favourable. However, with stable food supplies about 60 years ago society started to focus on consumers and became technologically advanced. This new society interacting with our evolutionary legacy may have led to what we now call the obesity epidemic.[4]

This epidemic is apparent with the worldwide prevalence of obesity at least doubling during the past three decades. More than half a billion adults worldwide were obese in 2008. The rising prevalence is also noticeable among the youngest; in 2010, more than

40 million children under the age of five were overweight or obese worldwide.[5] In the Netherlands, 33% of adults were overweight in 1981 which increased to 48% in 2012. The prevalence of obesity more than doubled in that time from 5% to 12%.[6] In 2009, 13–15% of the Dutch children were overweight and two percent were obese. Although these percentages are relatively low compared to other countries, rates are three to respectively six times the prevalence's found in 1980.[7] Most recent data show the prevalence of childhood overweight and obesity appears to stabilize in western countries.[8]

There has been debate on the question whether obesity is a disease or not. An expert panel concluded in 2008 that there is no clear agreed-on definition of disease, but that there are compelling reasons, related to both causes and consequences, to consider obesity a disease.[9] The World Health Organization (WHO) defines overweight and obesity as "abnormal or excessive fat accumulation that may impair health".[5]

To classify overweight and obesity the Body Mass Index (BMI) is commonly used. It is defined as a person's weight in kilograms divided by the square of his height in meters (kg/m^2). Among adults, obesity is generally defined as a BMI greater than 30 kg/m^2, and overweight as a BMI between 25 and 30 kg/m^2.[5] This relates to an increased risk of (co) morbidities for a BMI of 25 to 29.9, and moderate to severe risk of (co)morbidities, such as diabetes and heart disease, for a BMI greater than 30.[10] For children there are difficulties in defining a single standard to classify overweight and obesity since growing children show significant fluctuations in the relationship between height and weight. Many countries use their own country-specific charts. Widely used thresholds for overweight or obesity in childhood are 110% or 120% of ideal weight for height and a BMI at the 85^{th}, 90^{th}, 95^{th} and 97^{th} percentiles of the country-specific reference population.[11] The International Obesity Task Force (IOTF) developed an international standard growth chart to enable global comparisons. These age and gender specific cut-off values of the BMI correspond to the adult thresholds of 25 for overweight and 30 for obesity[12] and are used in the present thesis to classify overweight and obesity in children.

CONSEQUENCES

The dramatic rise in childhood obesity the last decades will most likely have an impact on adult disease rates in the next few decades. The persistence of obesity from childhood to adulthood has been well documented. Overweight children have a risk twice as high as normal-weight children of becoming an overweight adult and for obese children this risk is even higher.[13-15]

Overweight and obesity in adulthood are associated with increased risks of diabetes mellitus, cardiovascular disease and certain types of cancer.[16 17] Moreover, obesity is associated with a decreased mean life expectancy of almost seven years.[18]

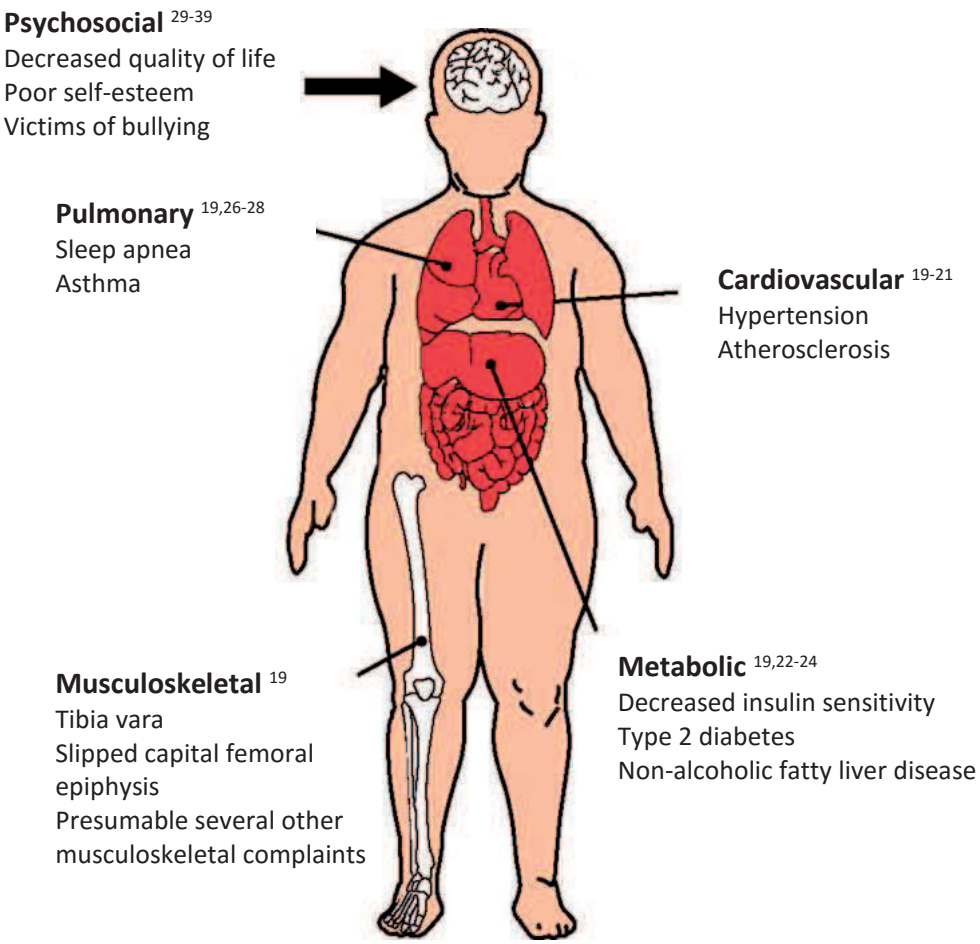

Figure 1. Complications of childhood obesity
Adapted version from: Ebbeling, Pawlak and Ludwig: Lancet Volume 360: 2002; 473-82.[2]

Besides the known increased risk on chronic diseases of adult obesity, childhood obesity is already associated with a number of physical and psychosocial comorbidities too. Figure 1 shows a selection of complications which have been associated with obesity in childhood:

Parameters of cardiovascular disease such as hypertension and atherosclerosis have been associated with excessive weight in school-aged children.[19-21]

Also metabolic consequences like decreased insulin sensitivity and even the onset of type 2 diabetes in children have been reported.[19 22 23] In addition, obesity is the most important risk factor for non-alcoholic fatty liver disease.[19 24]

Excess weight is also related to several disorders of bones and joints. In adults the relationship between overweight and osteoarthritis is well known.[25] In children the relationship between weight and musculoskeletal complaints seems to be present, but is less well understood. However, tibia vara and slipped capital femoral epiphysis appear to result from the impact of increased weight on the developing skeletal system.[19]

Obesity is also associated with pulmonary complications. Obstructive sleep apnea is closely related to obesity in both adults and children.[26] Since sleep apnea leads to daytime sleepiness and changes appetite and eating patterns it may even contribute to

an increase of the severity of obesity.[19] In addition, cross-sectional studies have shown an association between obesity and asthma in children.[27] Also prospective studies seem to show that childhood obesity is related to asthma later in life.[28] However, it remains unclear whether obesity is associated with the development of asthma or whether it makes symptoms worse if asthma is already present.[19 27 28]

Finally, psychosocial comorbidities have been reported to have the most widespread health impact of obesity in childhood.[29 30] There is the stigmatization of obesity in society, and children with obesity become victims of bullying more often than their normal-weight peers.[31 32] Literature shows poor self-esteem and decreased quality of life in overweight and obese children.[33-39]

As listed above there are several health consequences associated with childhood obesity, however exact numbers of children affected by comorbidities are difficult to obtain. BMI may not be measured if children visit clinics and in the open population the early stages of chronic diseases may not be diagnosed. So far, for most comorbidities it is unknown how many children are affected and if only children with severe obesity are affected or children who are slightly overweight too. Most of the literature mentioned above studied complications of obese children reported in secondary care. It is unclear whether these complications are presented in primary care as well. Therefore it is uncertain whether primary care is well prepared to respond to the current levels of childhood obesity.[40]

In addition to the health consequences listed above, obesity also leads to extra costs for society. Obesity in adults is associated with lower productivity[41] and extra direct medical costs.[42-44] The incremental lifetime medical costs of an obese child compared to a normal-weight child are estimated to be $19.000.[45] This shows that prevention and treatment of obesity starting in childhood already could potentially be highly cost-effective.

CAUSES

The cause of becoming overweight can be simply described as an imbalance in the energy balance equation: if energy intake increases above energy expenditure the excess is used to build new fat tissue and weight gain results.[46] With a cause that simple it raises the question how obesity can be so persistent and difficult to treat. That small sustained changes in the energy balance could produce large long-term weight changes was noted as one of the seven myths about obesity.[47]

Last decades many determinants and risk factors associated with childhood obesity have been identified.[48] A large number of studies indicate a genetic component for obesity.[49] It has been suggested that 21% of BMI variation can be accounted for by common genetic variation.[50] In addition to the direct influence of genes on obesity, several stud-

ies suggest an indirect effect too since eating behaviour is also influenced by genes.[51-55] Together with all the revealed personal and environmental determinants[56] it can now be stated that obesity is a complex disorder which is affected by many interacting genetic and non-genetic factors.[4]

A model which nicely visualizes the complexity of the interacting factors was presented in 2004 by Swinburn and Egger. They proposed that obesity emerged from a series of vicious cycles in combination with the increasing obesity promoting (obesogenic) environment.[57] They illustrated this situation with a "runaway weight gain train" (see Figure 2).

The train already has a high momentum because of the obesogenic environment, it is getting faster because of vicious cycles acting as accelerators and in case of getting obese the brakes are not strong enough to stop the train. For example, knowledge about the fundamental causes of weight gain (eating too much and exercising too little) is common, but knowledge alone seems to be a weak predictor of human behaviour and therefore a weak brake on the train.

With the discovery of leptin (a hormone influencing satiety, first described in 1994[58]) the understanding of human physiology controlling the energy balance has rapidly advanced. Human physiology tries to slow weight gain. With increased levels of leptin, reduced appetite and increased energy expenditure, metabolism of an obese individual seems a powerful brake for the train. However, leptin has a strong functional bias in favour of the preservation of body fat stores.[59] In response to weight loss the physiological mechanisms are vigorously reversed and energy expenditure decreases.[60] This clarifies why it is very hard to maintain weight loss and why most people regain weight after dieting. Therefore dieting is displayed as an accelerator of the train instead of a brake.

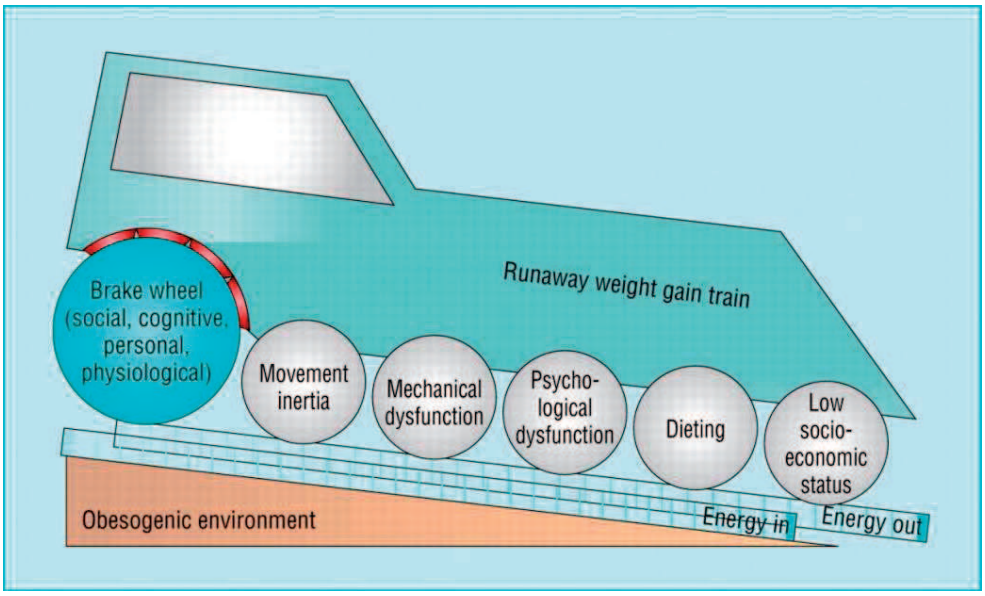

Figure 2. The runaway weight gain train: too many accelerators, not enough brakes
From: Swinburn and Egger: BMJ Volume 329(7468): 2004; 736-9.[57]

Regarding the accelerators excessive weight leads to increased effort needed for physical activity, which might reduce the levels of physical activity and thereby promoting further weight gain. Also the physical and psychosocial consequences of obesity described in the previous section might lead to reduced physical activity or comfort eating resulting in extra weight gain and a vicious cycle. The last vicious cycle in the model is low socioeconomic status. A lower income reduces the range of healthy choices, such as fruits and vegetables and expensive sports. In addition, low income is associated with higher levels of chronic stress which may lead to high levels of cortisol and unhealthy lifestyle[61] and thereby increasing weight gain. Finally, neighbourhoods where a lot of people with a low socioeconomic status live are usually more obesogenic.

The obesogenic environment represents the environment which makes the unhealthy choices easy. The promotion of fast food outlets, energy dense snacks and high sugar drinks to children; the low cost and large servings of those foods; and the urban design that inhibits active transport and active recreation are examples of easy unhealthy choices.[57] The 2015 Lancet series on obesity added that the relationship between the environment and individuals is reciprocal; with unhealthy foods being the easy choice, these foods are bought, reinforcing the demands for these foods and furthering the unhealthy food environment.[62] Considering the environment of children one should add parents to the model. Parental practices, styles and modelling seem to influence both eating[63-66] and exercise behaviour[67-69] of children.

Of course a model is a simplification of reality and there are many more risk factors associated with obesity which were not mentioned above. We can however conclude that the cause of childhood obesity is a complex interaction between the environment and risk factors at a personal level. Although genetic factors play a large role, heritability is not destiny; if modifiable risk factors are identified and positively influenced, clinically significant reductions in obesity can be achieved.[47] It has been suggested that modifiable and common (>10% prevalence) risk factors for childhood obesity include high levels of television watching, low levels of physical activity, parents' inactivity, and consumption of dietary fat, carbohydrate, and sweetened drinks.[70] Although literature shows lots of associated determinants the truly causal modifiable risk factors for childhood obesity, which could be subject of prevention and treatments programs, remain unknown.

PREVENTION AND TREATMENT

Prevention was universally viewed as the best approach to diminish the global prevalence of childhood obesity.[4] A 2011 Cochrane review found growing evidence to support beneficial effects of child obesity prevention programmes on BMI.[71] However, the authors state that these findings must be interpreted cautiously. Many of the included

studies were small and small studies are more likely to be biased. For example, small studies are likely to be published if they report positive results but not so likely if they report negative results. Furthermore, the identified prevention programs in this review used a broad range of programme components and therefore it is not possible to distinguish which of these components contributed most to the beneficial effects observed. Nevertheless, the authors noted that prevention programs in schools including a curriculum with healthy eating and exercise, extra sessions of physical activity, healthier food in the canteen and support of teachers and parents are promising.[71]

Last couple of years more and more attention went to integrated multilevel community-based prevention strategies to tackle childhood obesity. EPODE ('Ensemble Prévenons l'Obésité De Enfants' or 'Together let's Prevent Childhood Obesity') is such a large-scale, centrally coordinated, capacity-building approach and has since 2004 been implemented in over 500 communities in six different countries.[72] The theory behind EPODE reflects a multifactorial approach to prevent childhood obesity by trying to change different levels involved (from political support to publicity in media and local initiatives on schools to try to change eating and physical activity habits of children).[73] This approach not only aims to change individuals behaviour but also aims to change the environment. It has been acknowledged that to change the environment and make real changes government leadership is needed.[74] Influenced by EPODE, in the Netherlands relevant stakeholders work together on all levels, from governments to schools and healthcare centres, in order to create healthier environments stimulating healthy choices and hopefully prevent childhood obesity.[75] However, the effectiveness of all these integrated approaches is still unknown; there are no results of evaluation studies yet and it may take a while before changes in children's BMI on population level are noticeable.

Although prevention strategies are promising for a population approach, there are and probably always will be individuals who become obese. Therefore, in addition to prevention programs effective treatment options need to be available.

Systematic reviews of interventions for treating obesity in children and adolescents showed that family-based lifestyle programs can help to reduce weight with a clinically meaningful amount at least at short term.[76,77] According to these reviews drug treatment with Orlisat® could be considered for adolescents with severe obesity in addition to these lifestyle programs. Lifestyle programs show best results for young children[78] and a combined intervention with dietary, physical activity and behavioural components appears most effective.[76] The principles and techniques of these behavioural therapies aim to help adopt new diet and physical activity habits. The child's environment also needs to be targeted as a part of the intervention. It has been shown that programs that involve parents and the home setting lead to greater weight loss and maintenance.[47]

An Expert Committee recommended four stages of obesity care for treatment of childhood obesity: 1) Prevention Plus with brief counselling on eating and physical activity habits; 2) Structured Weight Management with more support and structure; 3) Comprehensive Multidisciplinary Intervention with specialists involved and increased frequency of visits; 4) Tertiary Care Intervention for severely obese youth if all previous stages failed. The appropriateness of a stage is influenced by the child's age and degree of excess weight. The first two stages are suggested to take place in primary care.[79]

With the increased prevalence of childhood obesity last decades management in secondary care has been suggested to become an inappropriate and unsustainable solution.[80] It has been recognised that an important part of managing childhood obesity can take place in primary care in countries which have a family doctor or GP as first point of contact in healthcare.[81] Especially since access to GPs is easy and children are frequently seen by GPs.[82 83] Interventions in primary care can be effective in treating childhood obesity according to a systematic review.[84] This review shows, in accordance with the Cochrane review on childhood obesity interventions, that a combined intervention with dietary, physical activity and behavioural components shows positive effects in this setting too. However, it was specifically highlighted that training healthcare professionals before intervention delivery is an important and essential step in primary care interventions.[84] The review highlights important components for interventions, but how effective interventions exactly are, which combination of components leads to the best results for whom and how healthcare professionals should be trained remains open.

The role of primary care professionals in the management of childhood obesity is relatively new. So far little is known on overweight and obese children in primary care. Clinical practice guidelines for the management of overweight and obesity to support professionals in their new role have only been published since 2003.[85-90] It is unclear whether managing weight of overweight and obese children is indeed daily practice for GPs and if these clinical guidelines provide enough support.

MANAGEMENT OF CHILDHOOD OBESITY IN THE NETHERLANDS

In the Netherlands the Ministry of Health facilitates three complementary initiatives to tackle overweight and obesity[75]: 1) the Knowledge Centre Overweight (since 2002) to enhance knowledge about prevention and treatment of overweight in the Dutch population[91], 2) the Covenant on Overweight (since 2005) later called Covenant Healthy Weight, a public-private partnership in which all partners involved aim to reduce the prevalence of overweight[92], 3) the Partnership Overweight Netherlands (since 2008) focussing on health care, to implement strategies for accurate early diagnosis of individuals at risk and for appropriate lifestyle interventions[93]. It has been recognized that

such an integration of community and clinical approaches is necessary for sustained weight loss.[94]

The Dutch government emphasized that the prevention of obesity should start in childhood. In 2009 it was especially noted that primary care should play a key role in weight management of children at risk of becoming obese.[95] For diagnoses and treatment the Dutch government refers to the national clinical guideline for obesity.[85] In

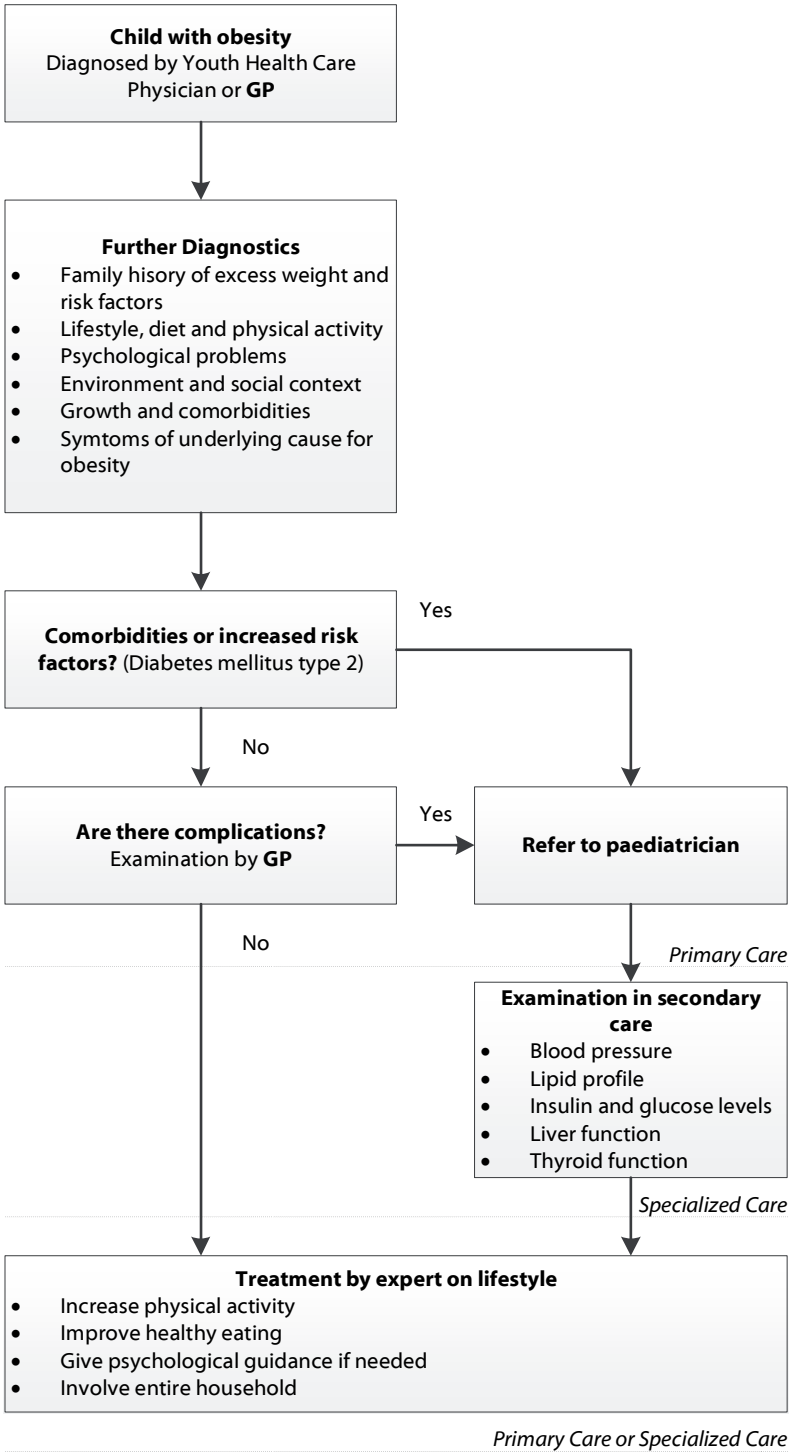

Figure 3. Flowchart for diagnoses and treatment of children with obesity in the Netherlands
Adapted version from: Clinical guideline for diagnoses and treatment of obesity. Dutch Institute for Healthcare Improvement (CBO): 2008.[85]

primary care both the youth health care physician and the GP can identify children with obesity (see Figure 3). The GP examines children for complications. If no complications are apparent treatment can take place in primary care.

In the Netherlands every resident is registered in one general practice. If patients seek health care one of the GPs in their practice is the first doctor to visit. In total there are more than 12.000 GPs registered in the Netherlands.[96] Since general practices are situated in the neighbourhood of a patient, access is easy, children are regularly seen, GPs often know all members from the household and have a personal, trustworthy relationship with children, it is assumed that GPs could play a key role in the management of childhood obesity.[95]

To help GPs fulfil this role, the Dutch College of General Practitioners (NHG) introduced an obesity-guideline in 2010.[97] This guideline recommends that GPs measure height and weight of all children presenting with weight complaints and all children who appear to be obese regardless of the reason for consultation. If a child is obese they should discuss this subject and treat or refer all children that need help in weight reduction.

With GPs being the first doctor to visit and easy access for everyone, they could indeed play a role in the management of childhood obesity. Whether childhood obesity is a common problem for GPs to deal with and whether weight management is daily practice for them is still unclear. Furthermore it is unknown what GPs themselves think about their role in the management of childhood obesity .

In summary, the prevalence of childhood obesity increased the last decades. Obesity is a complex disorder and there is not one effective treatment. There are several comorbidities associated with obesity but for most comorbidities it is unclear how many children are affected, with what degree of excess weight children are at increased risk and if these comorbidities are also presented in primary care. Primary care has been suggested as a suitable setting to manage childhood obesity since access is easy and children are frequently seen. However, so far little is known on overweight and obese children in primary care. It is unknown how weight management can effectively be incorporated in primary care, whether weight management at present is common practice for GPs and if the new guidelines provide enough support. Furthermore, it is unknown what GPs consider to be their own role in the management of childhood obesity.

AIMS AND OUTLINE OF THIS THESIS

Please take another look at the case in the beginning of this introduction and generalize the situation of the boy to all overweight and obese children. You might wonder whether overweight children will consult the GP more often, which would give the GP

the opportunity to start the conversation at that time. Are there already complaints associated with obesity in childhood presented in general practice? Would his mother be aware of the excess weight of her child? Would she agree with the GP mentioning the excess weight of her son? What do international guidelines recommend GPs to do? Do they give tools to start the conversation? Do GPs in general give lifestyle advice to children and/or refer children to secondary care or dieticians for a weight intervention? Can GPs be trained to mention healthy eating and exercise in regular consultations more often? And what do GPs themselves consider to be their own role in the management of childhood obesity?

The present thesis aims to answer these questions studying overweight and obese children in the general practice setting. For this purpose a cohort study including children attending general practices in the South-West of the Netherlands was set-up, literature was reviewed, a survey was sent to GPs all over the Netherlands and data from an Australian trial were analysed.

The thesis consists of four parts. In the first part *complaints* of overweight and obese children are studied. In **chapter 2** the design of the DOERAK cohort study investigating children attending Dutch general practices is presented. **Chapter 3** shows the baseline results of this study comparing number and type of complaints between overweight, obese and normal-weight children. In **chapter 4** the health profiles of Australian young people from different weight categories attending general practice are displayed. In **chapter 5** the literature studying the relationship between weight and musculoskeletal complaints in children is reviewed. In the second part *awareness* of excess weight is studied. **Chapter 6** systematically reviews the literature reporting actual weight status of children and perceived weight status by parents. In the third part *attitudes*, practices and perceived barriers by GPs in the management of childhood obesity are studied. In **chapter 7** the results of a survey questioning these items and send to GPs all over the Netherlands are displayed. In the last part *treatment* options in general practice are discussed. **Chapter 8** compares national clinical guidelines of different countries and their advices for the management of childhood obesity in primary care. In **chapter 9** the results are shown of an Australian intervention study training GPs to screen youth on several health risk factors and discuss these topics (including healthy eating and exercise) using motivational interviewing techniques. In **chapter 10** GPs weight management in overweight and obese children included in the DOERAK cohort study is discussed. Finally, **chapter 11** addresses the strengths and limitations of these studies, the most important findings and the implications for practice and future research.

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PART I

Complaints

Chapter 2

Determinants of (sustained) overweight and complaints in children and adolescents in primary care: the DOERAK cohort study design

WD Paulis, M van Middelkoop, HJ Bueving, PAJ Luijsterburg, JC van der Wouden & BW Koes

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ABSTRACT

Background Almost half of the adult Dutch population is currently overweight and the prevalence of overweight children is rising at alarming rates as well. Obese children consult their general practitioner (GP) more often than normal weight children. The Dutch government has assigned a key role to the GP in the prevention of overweight.
Objective The DOERAK cohort study aims to clarify differences between overweight and non-overweight children that consult the GP; are there differences in number of consultations and type and course of complaints? Is overweight associated with lower quality of life or might this be influenced by the type of complaint? What is the activity level of overweight children compared to non-overweight children? And is (sustained) overweight of children associated with parameters related to the energy balance equation?
Methods/Design A total of 2000 overweight (n=500) and non-overweight children (n=1500) aged 2 to 18 years who consult their GP, for any type of complaint in the South-West of the Netherlands are included.

At baseline, height, weight and waist circumference are measured during consultation. The number of GP consultations over the last twelve months and accompanying diagnoses are acquired from the medical file. Complaints, quality of life and parameters related to the energy balance equation are assessed with an online questionnaire children or parents fill out at home. Additionally, children or parents keep a physical activity diary during the baseline week, which is validated in a subsample (n=100) with an activity monitor. Parents fill out a questionnaire about demographics, their own activity behaviour and perceptions on dietary habits and activity behaviour, health and weight status of their child. The physical and lifestyle behaviour questions are repeated at 6, 12 and 24 months follow-up.

The present study is a prospective observational cohort in a primary care setting.
Discussion The DOERAK cohort study is the first prospective study that investigates a large cohort of overweight and non-overweight children in primary care. The total study population is expected to be recruited by 2013, results will be available in 2015.

BACKGROUND

Obesity is one of the main threats to public health in the western world.[1] The prevalence of overweight and obesity has at least doubled over the last 30 years.[2-5] Almost half of the adult Dutch population is currently overweight and the prevalence of overweight children is rising at alarming rates as well.[6]

The cause of becoming overweight is an imbalance in the energy balance equation: if energy intake increases above energy expenditure, the excess is used to build new fat tissue, and weight gain results.[7] For adults, overweight is defined as having a body mass index (BMI) of ≥25 and obesity as a BMI of ≥30, where BMI = weight (kg)/height^2 (m^2). For children aged from 2 to 18 years, gender and age specific BMI cut-off points for overweight and obesity are available.[8]

Overweight children have a risk twice that of normal weight children to become an overweight adult[9], which is associated with increased risk of diabetes mellitus, cardiovascular disease and certain malignancies.[10] Additionally, obesity decreases mean life expectancy by almost 7 years.[11] Even overweight and obesity in childhood are associated with serious physical and psychosocial health problems: poor pulmonary function, hypertension, insulin resistance, early maturity, asthma, otitis media externa, sleep apnoea and musculoskeletal complications occur relatively more often in overweight children than in their normal weight peers.[12-16] Besides, overweight children are known to frequently become victims of bullying[17,18] and report lower health related quality of life (QoL) compared to normal weight children.[19,20]

In the Netherlands everyone is registered in one general practice and when patients seek health care the general practitioner (GP) is usually the first doctor to visit. Obese children consult their GP with more complaints and more often than normal weight children.[21,22] The Dutch government noted in December 2009 that the prevention of (sustained) overweight and obesity should start in childhood and that the GP should play a key role in this.[23] To help GPs fulfil this role, the Dutch College of General Practitioners recently introduced an obesity guideline.[24] This guideline states that GPs should examine all presenting children who appear to be obese to diagnose obesity and should treat or refer children that need help in weight reduction. However, little is known on overweight children in primary care. In what way do they differ from non-overweight children? If they consult the GP more often, with different complaints or with a different course of complaints a different treatment policy might be warranted for these children. Besides, if certain lifestyle behaviour parameters are related to sustained overweight, this knowledge might be used in developing an effective treatment for overweight children in a primary care setting.

The DOERAK cohort study will provide knowledge on the differences between overweight and non-overweight children that consult the GP. The study aims to answer the following research questions regarding children in primary care:

1. Is overweight associated with the type of complaint for which children consult their GP?
2. Is overweight associated with a different course of the complaint for which children consult their GP?
3. Is overweight associated with a higher number of GP consultations?
4. Is overweight at baseline associated with lower quality of life and is this association influenced by the type of complaint?

Secondary research questions

a. What is the physical activity level of overweight children at baseline compared to non-overweight children?
b. Is (sustained) overweight at two year follow-up associated with parameters related to the energy balance equation?

METHODS

Study Design

DOERAK "Determinants of (sustained) Overweight and complaints; Epidemiological Research among Adolescents and Kids in general practice" is a prospective observational cohort study with a follow-up period of two years.

The Institutional Review Board of the Erasmus University Medical Center, Erasmus MC, has approved the study. All parents of children provide written informed consent and children aged twelve years and older also give written informed assent.

GP trainees

GP trainees in their third, and last year of education at the Erasmus MC are engaged in this study. During this last year they work four days a week in a general practice in the South-West of the Netherlands and see a representative half of the patient population. Additionally they follow a newly developed course. During this course they are taught on how to design and conduct scientific research. They are encouraged to formulate specific research questions, choose outcome measures and determinants, questionnaires and data-analysis. Besides, they recruit children for inclusion in the DOERAK cohort study from the general practice in which they are trained. They are taught on subjects as reliability of measurements and selection bias. For this last reason they are

encouraged to recruit all children who consult them. To help them remember to recruit for DOERAK during consultations a DOERAK reminder in the medical information system will be used for all children between 2 and 18 years of age who consult them. Furthermore, the researcher will be in contact with all GP trainees by e-mails for weekly updates and will encourage them to approach children for the study. The present study design is the framework from which GP trainees are expected to formulate and answer different specific research questions, relevant for their daily practice. This scientific education program is evaluated in a cluster randomized controlled trial.

Study Population

All children who consult a participating GP trainee for any type of complaint between December 2010 and April 2013 are invited to participate in the study.

Inclusion criteria

Children must be aged 2 to 18 years. Both children and parents should have at least basic understanding of the Dutch language.

Exclusion criteria

Mentally or physically disabled children, children with serious co-morbidities affecting weight and children who consult their GP with emergency problems are not invited to participate in the study.

Procedure

Children presenting in general practices in the south-west of the Netherlands are invited to participate by a GP trainee. About sixty general practices divided over different socio-economic areas will participate in the study. An average practice has 532 children from 2 to 18 years registered in their practice; which would lead to a total source population of 31920 children. On average 75% of children consult their GP at least once a year.[25] The GP and GP trainee are asked to equally divide the patient population in their practice, so a representative sample is seen by the GP trainee. It is assumed that of all the approached children who are eligible 20% will finally be included in the study. An estimation of the recruitment is schematically shown in a flowchart (figure 1).

All children and their parents who are eligible for the study receive verbal study information by the GP trainee. If they show interest to participate in the study, height, weight and waist circumference of the child are measured. Contact information is faxed to the one researcher connected to this cohort study who is based at the University Medical Center. Parents and children receive written study information and an informed consent form (children aged 12 years and older receive an informed assent form as well) from their GP trainee. After two workdays and within two weeks the researcher contacts

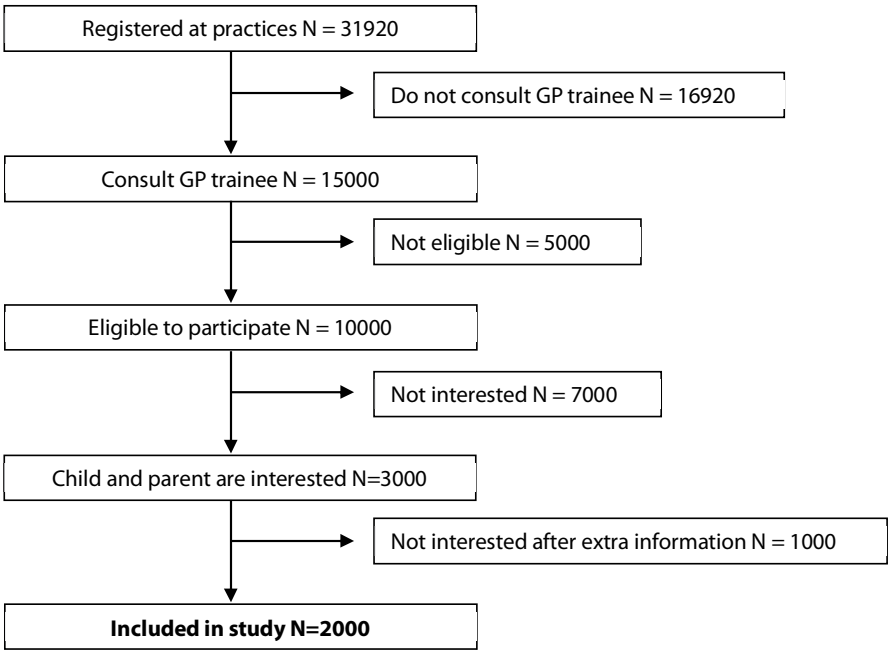

Figure 1. Scheduled recruitment flowchart

the family to answer possible additional questions and to check if they are still willing to participate. The day they agree to participate is the inclusion date and a baseline web-based questionnaire is sent to child, parents and GP trainee (if children and parents do not have internet access the questionnaires are mailed by post). If the family is on holiday or children are too sick to answer the questions, researchers will organise with the parents to send the questionnaires later. Children aged nine years and older at time of consultation will fill out their own questionnaires. Parents will answer the questions with proxy forms for younger children. Both parents sign informed consent paperwork (children aged twelve years and older sign informed assent) and send it to the researcher. When the informed consent form (and if applicable the informed assent form) is received, the child is formally included in the study.

If questionnaires are not completed after one week a reminder will be send. This will be repeated for the period of eight weeks.

Follow-up is planned for each child individually 6, 12 and 24 months after inclusion. For follow-up an appointment is made by trained research staff to measure height, weight and waist circumference of the child in the same general practice where they were measured at baseline. Additionally, the follow-up questionnaires are e-mailed to children and parents. If questionnaires are not filled-out after one week reminders will be send, as also done for the baseline questionnaire. After the last follow-up measurement the researcher collects data on the number of consultations and type of complaints of the last two years from the children's medical records in general practice (as covered by informed consent). The schedule of measurements is shown in figure 2.

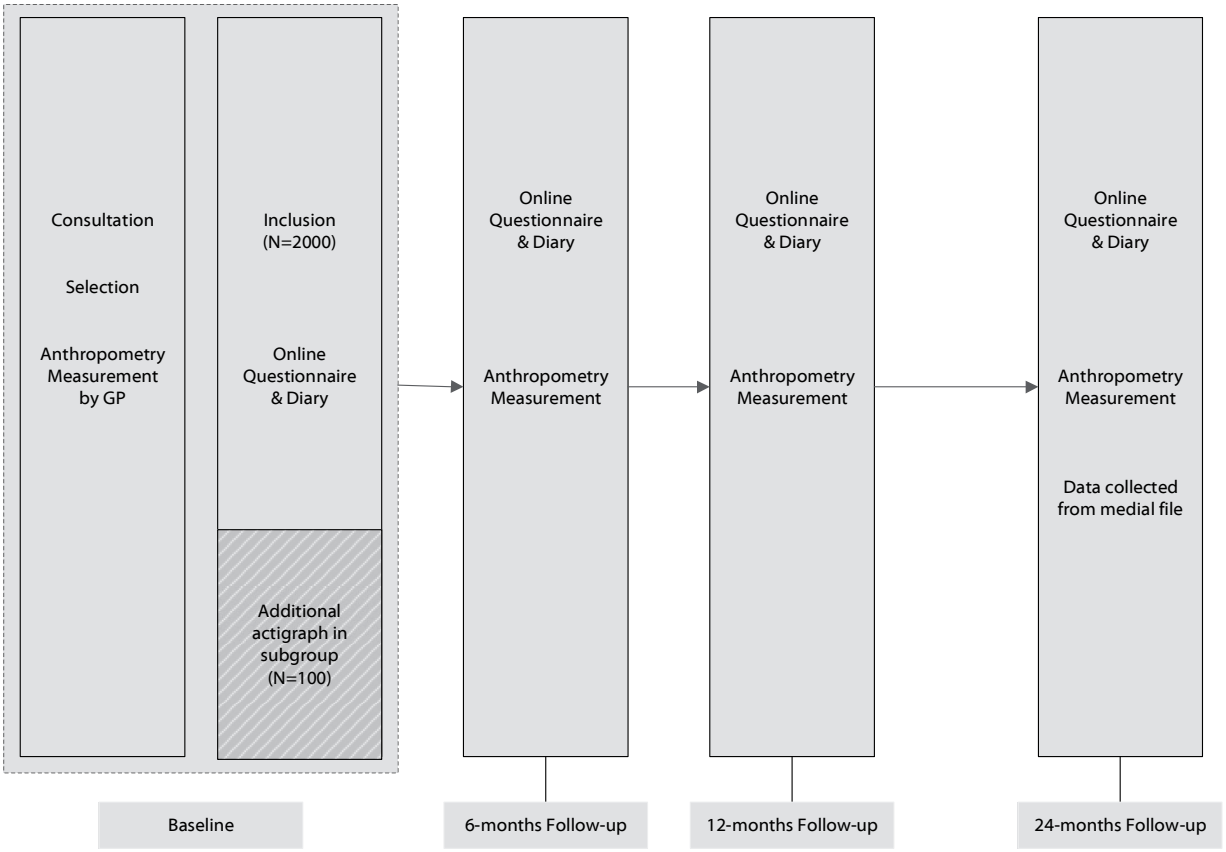

Figure 2. Measurements schedule

While participating in the cohort study, patients receive care from their GP (trainee) as usual. For the management of obese children GP trainees are advised to follow the new obesity guideline.[24]

Measures

The primary outcome parameters of this study are weight status, number of GP consultations, type and course of complaints presented to the GP, quality of life and physical activity level. At baseline, 6, 12 and 24 months follow-up participating children, parents and GP trainees all fill out questionnaires. See table 1 for an overview of the timing of all study measurements.

Baseline questionnaire GP trainee

During consultation the GP trainee measures height, weight (to calculate BMI) and waist circumference of the child (see figure 3).

Age and gender specific cut-off point of the BMI are used to classify the weight status of the child in underweight, normal weight, overweight and obese.[8,26] All GP trainees receive baseline training on how to measure waist circumference and to use the applicable study standard operating procedure. Waist circumference is measured midway

Table 1. Timing of study measurements

	Baseline	6-months	12-months	24-months
Demographics	x			
BMI and waist circumference	x	x	x	x
Type of complaint, recovery time	x	x		
Medical consumption	x			x
Quality of life (PedsQL)	x	x	x	x
Somatic complaints (SCL)	x	x	x	x
Birth weight and breastfeeding of child	x			
Parental perception weight/health of child	x	x	x	x
Parental perception activity behaviour of child	x	x	x	x
Eating behaviour of child (CEBQ)	x	x	x	x
Diary: breakfast consumption, hours of sedentary behaviour, outdoor play, sports and sleep	x	x	x	x

between the lowest rib and the top of the iliac crest at the end of gentle expiration.[27] For assessing height and weight calibrated height and weight measures are used.

The complaints that children report during consultation and medical consumption (number of GP consultations and accompanying diagnoses of the previous twelve months) are registered by the GP trainee using ICPC-coding.[28] Possible lifestyle advice given by the GP trainee to children with obesity (and optionally to children who are overweight), is recorded as well because it might influence children's lifestyle. Furthermore, possible co-morbidities are reported by the GP trainee.

All parameters mentioned above are documented by the GP trainee in the baseline questionnaire for GP trainees.

Baseline questionnaire, diary and activity monitor child

All children receive a baseline questionnaire and additionally a diary which has to be filled out each day for one week. The questionnaire includes questions on somatic complaints, measured with the Somatic Complaint List[29] and health related quality of life, measured with the PedsQL.[30] Furthermore, it contains questions regarding weight status perception and the type of complaint children consulted the GP for. The diary reports on the recovery of this complaint on a 4-point scale from fully recovered to complaint has worsened. Besides, parameters related to the energy balance equation are measured through this diary. Data is collected on breakfast consumption and hours of sleep, outdoor play, sports and sedentary behaviour. A subsample of all children wears a validated activity monitor, based on accelerometry (Actigraph GT3X, Pensacola, Florida), during the same week. This provides objective information about the total physical activity.[31] This subsample exists of 100 children (50 overweight, 50 non-overweight) of different

Figure 3. GP trainee measures waist circumference of child. Written parental permission to publish picture was given.

ages from both urban and rural areas. For these measurements the same protocol is used as in the ENERGY-study[32]: children wear the Actigraph at the waist at the right side of the body in an elastic belt for seven days; five weekdays and two weekend days. The time interval/epoch length is set at 10 seconds.

Baseline questionnaire parent

Demographic factors, such as age, gender, ethnicity and education from both child and parents are assessed in the parental baseline questionnaire. Furthermore, parents answer questions considering socio-economic status (SES), marital status, their own weight, height and sedentary behaviour.

Birth weight of the child and if the child was breastfed is asked to parents. Additionally, their perceptions on sedentary behaviour, activity behaviour and weight and health status of their child are reported. Children's eating behaviour is measured with the Children's Eating Behaviour Questionnaire for parents.[33]

Follow-up measurement of weight status

For the 6, 12 and 24 months follow-up measurements, trained staff from the Erasmus MC, University Medical Centre, measure height, weight and waist circumference of all participating children with the same calibrated equipment as at baseline.

Follow-up questionnaires and diaries child

The questionnaires and diaries children fill out at 6, 12 and 24 months follow-up are the same as the baseline questionnaire and diary except for questions on demographics and the complaint they consulted the GP for at baseline. Demographics are only questioned at baseline. At 6 months follow-up it is questioned what the baseline complaint was and if they are recovered. This is not repeated in later questionnaires.

Follow-up questionnaires parents

At 6, 12 and 24 months follow-up parents record their perceptions on their child's weight, health status, and activity and eating behaviour of their child, with the same instruments as in the baseline questionnaire.

Follow-up medical consumption

At 24 months follow-up the researcher collects the number of GP consultations and accompanying diagnoses of the last two years from the medical records in the general practices.

Sample Size Calculation

One of the primary aims of the present study is to investigate if overweight is associated with certain type of complaints. For example, literature shows that overweight is related to a higher incidence of self-reported respiratory diseases in children.[16] Therefore it is hypothesized that overweight is associated with an increased incidence of respiratory diseases diagnosed by the GP trainee. Based on the incidence of self-reported respiratory diseases in overweight (=0.311) and non-overweight children (=0.217)[16] the formula of Fleiss[34] with a two-sided significance level of 0.05 and a power of 90% shows a sample size of 461 children in each group. Taking about 10% of drop-outs into account the number of participants in each group is 500.

When more controls are included in the analysis more robust estimates are feasible.[35] A 1:3 cases and controls ratio is a conventional and efficient strategy to assess the influence of exposure to certain factors on cases and controls. Therefore a total of 500 overweight and 1500 non-overweight children that consult the GP are scheduled to be included. Since, approximately 15% of the Dutch youth are overweight[36] and previous research noted that the prevalence of overweight children in primary care is higher than in the population-based research[21] the odds that overweight children consult the GP

trainee and are invited to participate in the study increases. By approaching all children who consult a GP trainee a proportion of 25% overweight children in the study population seems feasible.

For the subsample of the Actigraph 100 children are recruited (50 overweight, 50 non-overweight). Based on the formula of Fleiss[34] with a two-sided significance level of 0.05 and a power of 90% and the median result of 580 counts/min in a day from Riddoch et al[37] 50 participants in each group are needed to find a difference of 10% between the groups.

Data-analyses

Descriptive statistics are used to describe the frequencies of complaints among overweight and non-overweight children. From children and parents who finally refuse to participate in the study gender, age, weight status and reason of refusal are recorded. With these data non-response analyses can be conducted and independent t-tests will reveal if the study population is different from the recruited population.

To assess if overweight is associated with certain types of complaints (question 1) logistic regression analyses is used. The course of complaints is expressed in the number of days until recovered and the scale from recovered to worsening of complaint. To asses if overweight is associated with the course of complaints respectively cox regression and logistic regression analyses are used. Linear regression analyses are used to analyze the association between overweight and number of GP consultations (question 3). These analyses will be adjusted for measured confounders. A variable is considered a confounder if the regression coefficient changes by more than 10% when the variable is added to the analysis. Possible confounders are SES, demographic factors and lifestyle advice given to obese children by the GP. Linear regression analysis is used to assess whether overweight is associated with lower quality of life (question 4), stratified for type of complaint as potential confounder. Associations with a risk ratio higher than 2, a risk difference above 10% and $p < 0.05$ are considered statistically significant and clinically relevant.

For the physical activity measurements in the subgroup, non-wearing time is defined as a period of at least 20 minutes of consecutive zero counts.[32] Actigraph data are considered valid when the daily wearing time is at least 10 hours for weekdays and 8 hours for weekend days and if there are at least 3 valid weekdays and 1 valid weekend day. The chosen cut-off points (in counts per minute (cpm)) for the various activity levels are <100 cpm for sedentary behaviour, <3000 cpm for light, <5200 cpm for moderate and > 5200 cpm for vigorous physical activity. Data of the Actigraph are correlated, using Spearman's correlation efficient, with self-reported physical activity in the diaries. Independent sample t-tests reveal if physical activity data of overweight children differ from non-overweight children (question 5). Differences between overweight and non-

overweight children in self-reported activity and the correlations between objectively measured physical activity and self-reported activity are demonstrated using independent sample t-tests as well. In case the subgroup analysis reveal that activity monitor data differ from the self-reported activity in the diary a correction can be made for the entire study population in the analysis.

Prognostic studies need a multivariable approach to determine the important predictors of the studied outcomes.[38] Multivariate regression analyses are therefore used to identify the prognostic predictors in the demographic, physical and lifestyle behaviour domains on sustained overweight at follow-up (question 6).

DISCUSSION

The DOERAK cohort study is to our knowledge the first prospective study that investigates a cohort of overweight and non-overweight children in primary care. Since the study is prospective it is not feasible to match overweight and non-overweight children at time of inclusion. A cases and controls 1:3 ratio is a conventional way to overcome this problem and the choice for extra controls will make estimates in analysis more robust.

The sample size of 500 overweight and 1500 non-overweight children should be sufficient to answer the primary research questions. Lasagna's Law states that medical investigators overestimate the number of patients available for research and this law applies for Dutch primary care research as well.[39] However, by educating the GP trainees that recruit the children on how to design and administer research in practice it is attempted to increase the inclusion. Besides, 60 practices will participate in the DOERAK study, which corresponds to a source population of more than 30.000 children, who can be included for any type of complaint. More than 75% of all children consults their GP at least once a year[25] and therefore inclusion of 2000 children seems feasible. If however, inclusion is disappointing, more practices will be approached to help recruit children for the study. Taking into account the average percentage of overweight Dutch youth[36] and the relatively high prevalence of overweight children in primary care[21], inviting all children in general practice will approximately lead to a 1:3 ratio of overweight and non-overweight children.

Since GP trainees invite children to participate in the study one must be aware of a possible selection bias. To minimize this bias GP trainees are taught about the hazards of a selection bias and encouraged to invite all children who consult them.

The main outcome parameters of this study are weight status, type of complaints, number of GP consultations, quality of life and physical activity. BMI will be measured by GP trainees at baseline and trained research staff at follow-up, since self-reported height and weight lead to underestimation of the weight status.[40]

Waist circumference is a good predictor of metabolic risk factors[41]. However, literature shows mixed results on interobserver reliability.[42-44] To increase interobserver reliability all GP trainees receive baseline training on how to measure waist circumference and to use the applicable study standard operating procedure.

Complaints are measured thoroughly and will be registered by both the GP trainee and children. Somatic complaints children experienced last month will be measured with the validated Somatic Complaints List at all time points.

There is no questionnaire for youth which measures physical activity and has acceptable reliability and validity.[45] Self-reported physical activity in diaries might lead to biased estimates.[46] To measure physical activity objectively accelerometry is often used.[31] Therefore, in the present study a representative subsample of overweight and non-overweight children wears an Actigraph activity monitor for one week, in order to validate the activity diary.

For this cohort study, multiple testing procedures are necessary to answer all research questions, which might introduce a bias related to multiple testing. However, to reduce this bias, all analyses and results are hypothesis driven and biologically plausible.[47]

To answer the question whether sustained overweight at follow-up is associated with parameters with weight status and energy balance equation data, baseline data are compared with follow-up data. Furthermore, in time it might be interesting to compare weight status or weight gain at follow-up with number and type of complaints and quality of life at baseline and vice versa.

The DOERAK cohort study will provide knowledge on the differences between overweight and non-overweight children in primary care. If overweight children consult their GP more often or with different complaints a different treatment approach might be needed for these children. Besides, if certain lifestyle behaviour parameters are related to sustained overweight at follow-up, this knowledge might be used in developing an effective treatment program for overweight children in primary care.

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Chapter 3

Complaints of overweight, obese and normal-weight children attending general practice

WD Paulis, M van Middelkoop, HJ Bueving, PAJ Luijsterburg & BW Koes

Submitted

ABSTRACT

Background Little is known on overweight children in primary care. We studied whether weight status is related to 1) how often children visit their general practitioner (GP), and 2) the type of complaints registered during these consultations. In addition, we studied if weight status is related to somatic complaints children experience and parental perception of their child's health status.

Methods Baseline data from a prospective cohort studying children (2-18 years) presenting in 73 general practices in the Netherlands were used.

Height and weight of children were measured during regular consultation. Data from the medical files were recorded and children and parents filled-out questionnaires about complaints, health and background.

Results 733 children were included; 17.5% was underweight, 63.2% normal weight, 14.3% overweight and 5.0% obese. Obese children consulted the GP more often the previous twelve months (3.7 times) than normal-weight children (3.3 times) (p=0.02). However, after adjusting for potentially selective response this association disappeared. There were no associations between weight status and type of complaints recorded by the GP. Significantly more overweight than normal-weight children reported several somatic complaints on a questionnaire filled-out at home. Most parents, irrespective of weight status of the child, reported the health status of their child to be good to excellent.

Conclusions Weight status does not appear to be related to how children present themselves in general practice. Therefore no different treatment approach is needed for overweight or obese children compared to normal-weight children. However, GPs should be aware that overweight children might experience somatic complaints.

BACKGROUND

Childhood obesity is a serious health problem, especially in Western countries.[1] Prevalence rates at least doubled the last 30 years.[2] Currently, 13–15% of Dutch children are overweight.[3] This prevalence is relatively low compared to other countries.[4,5] However, rates tripled since 1980 and the proportion of obesity among those children increased.[3]

Childhood obesity is of concern to primary care professionals because of immediate physical and psychosocial health problems children may experience[6], but also because of the increased likelihood to develop adult obesity.[7] This translates into increased risk for chronic diseases, including diabetes mellitus type 2, cardiovascular disease[8], certain types of cancer[9] and other malignancies.[10] Therefore, effective management of obesity is necessary already in childhood.

Since overweight and obese children are frequently seen by general practitioners (GPs) in primary care, this setting has the potential to start effective weight management.[11] Several Western countries recognized the opportunity for primary care to manage childhood obesity and developed clinical guidelines.[12] The Dutch government stated in 2009 that the prevention of overweight and obesity should start in childhood and GPs should play a key role.[13] The Dutch guideline for GPs recommends to signalize obesity, discuss the issue with child and parents, and if necessary help by treating or referring children.[14]

However, so far little is known on overweight and obese children in primary care. It can be hypothesized that overweight and obese children are more frequently seen in general practice and might present with different complaints than normal-weight children. Potential differences might give insight in the aetiology of complaints and it might reveal opportunities for treatment of complaints as well as of excessive weight.

In order to address these topics in children attending general practice, the following research questions were formulated: is weight status related to 1) how often children visit their GP, and 2) the type of complaints children report during these consultations? And secondary, is weight status related to somatic complaints children report on a questionnaire filled-out at home and what is the parental perception of the general health status of their child?

METHODS

Study Design

A cross-sectional study using the baseline data from the DOERAK cohort study. DOERAK "Determinants of (sustained) Overweight and complaints; Epidemiological Research among Adolescents and Kids in general practice" is a prospective cohort studying children in general practices in the South-West of the Netherlands. The study protocol has

previously been published.[15] The Institutional Review Board of the Erasmus University Medical Center, Erasmus MC, has approved the study.

Study Population

All children (2-18 years) were eligible to engage in the study if they consulted one of the 73 GP trainees or 18 GPs (both from here on referred to as GPs) in the 73 participating general practices for any type of complaint between December 2010 and April 2013. GPs were encouraged to invite all consulting children. Children were not invited if they were mentally or physically disabled or if they consulted their GP with emergency problems. All participating children and parents had at least basic understanding of the Dutch language to be able to provide informed consent and fill-out questionnaires.

Procedure

Eligible children were approached by the GP who gave them verbal study information during regular consultation. If children and accompanying parents showed interest to participate in the study, height, weight and waist circumference of the child were measured and contact information of the parents were faxed to the research team. All GPs followed the same protocol to invite and measure children (see protocol paper[15]). Then parents and children received written study information and an informed consent form (children aged 12 years and older also received an informed assent form).

The research team contacted the family after two days for any additional questions and to ask for their willingness to participate. When signed informed consent forms were received, the child was formally included in the study. Baseline web-based questionnaires were sent to child, parents and GP (or mailed by post in case of no internet access). If questionnaires were not completed within one week a reminder was send, weekly for a period of eight weeks.

Children aged nine years and older at recruitment consultation filled-out their own questionnaires. Parents answered the questions with proxy-forms for younger children.

Measures

To answer the current research questions the following data were used:

GP questionnaire:

- Contact form:
  - Age and gender of child
  - Initial perceived weight status of child by observation of the GP (categorized as overweight or non-overweight)
- Physical measures:

    - Height and weight of child; measured during recruitment consultation by GP using calibrated scales and stadiometers
- Data from medical file (recorded from the file by either the GP trainee or a trained research assistant):
    - Type of complaints children reported during recruitment consultation, registered by the GP using coding of the International Classification of Primary Care (ICPC)[16]
    - Number of GP consultations of the previous twelve months and ICPC-coding of accompanying diagnoses

Child questionnaire:

- Somatic complaints experienced the last four weeks, measured with the Somatic Complaint List (SCL)[17] using a 5-point Likert scale (from experienced this complaint 'not at all' to 'a whole lot'), filled-out on a questionnaire at home by children or with proxy-forms by parents

Parents questionnaire (one questionnaire filled-out per child):

- Demographic factors:
    - Ethnicity (both parents born in the Netherlands, at least one parent born in another country)
    - Highest education level in household (comparable to the international standard classification of education[18]; classified as 'up to lower secondary level', 'upper secondary level', 'at least bachelor level')
    - Socio-economic status (SES) based on net household income (<€2000/month, ≥€2000/month) using monthly general labour income of 2012 as cut-off point[19]
    - Marital status reported by parents (parents together, parents separated)
- General health status of child on a 5-point Likert scale (from poor to excellent)

Variables and Analyses

Primary outcome measures were weight status, number of GP consultations in previous twelve months and ICPC-coding of type of complaints presented to the GP. Secondary outcomes were somatic complaints and parental perception of the general health status of their child.

From height and weight Body Mass Index (BMI) was calculated and weight status was determined using international age and gender specific cut-off points.[20,21] The registered type of complaints were categorized to their ICPC-chapter defined by the initial letter of the code.[16] Chapters reported in less than 5% of the consultations were combined and categorized as 'other'. Somatic complaints measured with the SCL were reported for each item separately and dichotomized into had this complaint the last four weeks 'a lot' to 'a whole lot' versus 'not at all' to 'some'.

Statistical analyses

Age, gender and child's weight status perceived by the GP were compared for included children to those who initially showed interest to the GP but finally did not participate using chi-square for categorical data and independent samples t-test for continuous data.

We conducted logistic regression analyses to test associations between weight status and type of complaints or general health status of the child. Poisson regression was used to test associations between weight status and the number of previous GP consultations. Normal weight was used as reference category in all analyses. Regression analyses were adjusted for confounders. Variables were considered a confounder if the average regression coefficient changed more than 10% if added to the analyses. Age, gender, socioeconomic status, ethnicity and marital status were added as possible confounders. In addition, for type of complaints the last twelve months analyses were adjusted for number of consultations and for somatic complaints analyses were adjusted for whether child or parent filled-out the questionnaire. All analyses used robust standard errors to adjust for clustering at general practice level. P-values <0.05 were considered statistically significant. The strength of associations was determined using Odds Ratios (OR) and Incidence Rate Ratios (IRR) with 95% Confidence Intervals (CI). STATA/SE 12.0 (Statacorp, College Station, Texas USA) was used for statistical analyses.

RESULTS

GPs faxed contact details from 1109 children to the research team. Finally 733 children were included in the study (see Figure 1). Non-participating children were significantly older (p=0.002) than included children (mean age 9.5 years sd (4.4) versus 8.2 (4.0)). GPs reported perceived overweight/obesity in 21.8% of the non-participating children compared to 16.9% of the included children (p=0.059).

Table 1 shows characteristics of the included children. Height and weight data were available for 715 children. Of those 17.5% were determined as underweight, 63.2% normal weight, 14.3% overweight and 5.0% obese. Most children came from families with middle/high SES (77.2%), had parents who were both born in the Netherlands (84.8%), and the majority of parents were living together (83.4%).

On average children consulted the general practice 3.3 (0.1) times (median 3, IQR 1-5) in the previous twelve months (recruitment consultation excluded). Table 2 shows the mean number of consultations for each weight category with accompanying IRR's. Adjusted for confounders obese children consulted the GP significantly more often than normal-weight children (IRR 1.37 95%CI: 1.09-1.71).

Table 3a shows the type of complaint reported during recruitment consultation according to weight status. No differences were observed between overweight, obese and

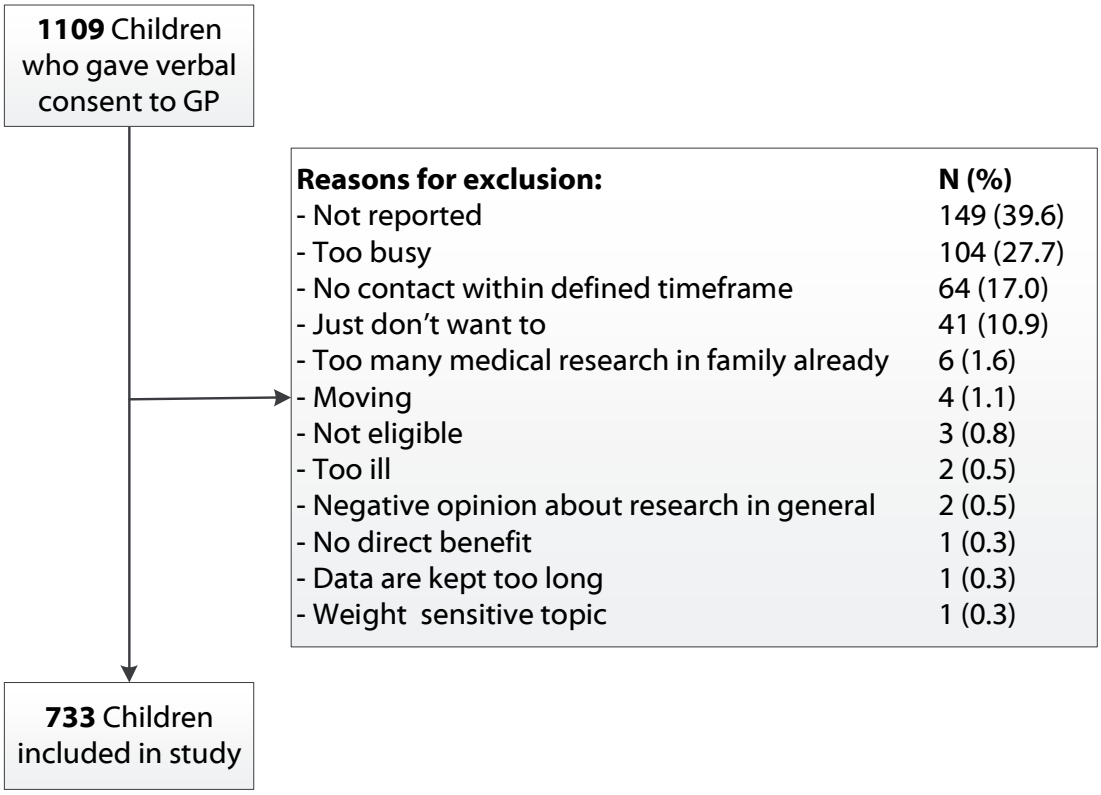

Figure 1. Inclusion flow of children in the cohort

Table 1. Demographics of included children (Total includes missing weight status N=18)

Characteristics	Total N=733 n (%)	Underweight N=125 n (%)	Normal Weight N= 452 n (%)	Overweight N=102 n (%)	Obese N=36 n (%)
Gender m (%)	342 (46.5)	58 (46.4)	213 (47.1)	47 (46.1)	17 (47.2)
Age in years (mean (sd))	8.2 (4.0)	6.8 (3.8)	8.3 (4.1)	9.2 (3.7)	9.6 (3.6)
SES (N=580) [19]	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Middle/High (>=2000*)	448 (77.2)	82 (80.4)	273 (77.6)	64 (78.0)	16 (59.3)
Low (<2000)	132 (22.8)	20 (19.6)	79 (22.4)	18 (22.0)	11 (40.7)
Highest education in household (N=624) [18]	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Low (up to lower secondary level)	106 (17.0)	20 (18.0)	62 (16.5)	15 (15.3)	7 (24.1)
Middle (upper secondary level)	250 (40.1)	37 (33.3)	154 (41.1)	42 (45.7)	13 (44.8)
High (at least bachelor level)	268 (42.9)	54 (48.6)	159 (42.4)	35 (38.0)	9 (31.0)
Ethnicity (N=607)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Both parents born in Netherlands	515 (84.8)	95 (85.6)	313 (86.2)	71 (79.8)	21 (75.0)
At least one parent born in another country	92 (15.2)	16 (14.4)	50 (13.8)	18 (20.2)	7 (25.0)
Marital status (N=621)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Parents separated	103 (16.6)	17 (15.3)	60 (16.0)	13 (14.3)	10 (35.7)
Parents together	518 (83.4)	94 (84.7)	314 (84.0)	78 (85.7)	18 (64.3)

*more than 2000 euros monthly net income per household

Table 2. Number of consultations last 12 months

Number of consultations last 12 months	Mean (S.D.)	IRR (95%CI)	Crude combined p-value N=708	IRR (95%CI)#	Adjusted Combined p-value# N=602
Underweight (N=124)	3.0 (2.9)	0.93 (0.80-1.08)		0.86 (0.72-1.03)	
Normal weight (N=447)	3.3 (2.9)	Ref	0.48	Ref	0.02
Overweight (N=102)	3.3 (2.8)	0.99 (0.84-1.17)		1.06 (0.89-1.25)	
Obese (N=35)	3.7 (2.7)	1.13 (0.89-1.44)		1.37 (1.09-1.71)	

All analyses are adjusted for clustering at general practice level
adjusted for Age and Marital status

normal-weight children. For underweight children respiratory complaints were significantly more often registered as reason for presentation than for normal-weight children (OR 1.86 95%CI: 1.11-3.11). On the other hand they presented less often (OR 0.48 95%CI: 0.24-0.95) with complaints categorized as other (e.g. eyes, neurological, endocrine or genital problems).

Table 3a. Type of complaint coded at recruitment consultation (Total includes missing weight status)

ICPC-Chapter	Total N=733 n (%)	Underweight N=125 n (%)	Normal Weight N= 452 n (%)	Overweight N=102 n (%)	Obese N=36 n (%)	Combined p-value N=715	Adjusted# combined p-value N#
A (General and unspecified)	39 (5.3)	10 (8.0)	23 (5.1)	6 (5.9)	0 (0.0)	0.32	0.42
D (Digestive)	60 (8.2)	9 (7.2)	35 (7.7)	8 (7.8)	6 (16.7)	0.23	0.49
H (Ear)	80 (10.9)	22 (17.6)	44 (9.7)	9 (8.8)	2 (5.6)	0.07	0.95
L (Musculoskeletal)	80 (10.9)	6 (4.8)	52 (11.5)	15 (14.7)	6 (16.7)	0.05	0.31
R (Respiratory)	161 (22.0)	39 (31.2)*	89 (19.7)	20 (19.6)	9 (25.0)	0.07	0.06
S (Skin)	169 (23.1)	26 (20.8)	109 (24.1)	23 (22.5)	5 (13.9)	0.46	0.70
Other chapters (B,F,K,N,P,T,U,W,X,Y,Z)	120 (16.9)	9 (7.4)*	83 (19.1)	20 (19.8)	7 (20.0)	0.02	0.17
No codes recorded	24 (3.3)	4 (3.2)	17 (3.8)	1 (1.0)	1 (2.8)	0.50	0.68

All analyses are adjusted for cluster at general practice level;
* p <0.05 significantly different from Normal Weight, adjusted for confounders
# A, N=523, adjusted for SES and Ethnicity
D, N=545, adjusted for SES and Ethnicity and Marital status
H, N=549, adjusted for Age and SES and Ethnicity
L, N=545, adjusted for Age and SES and Ethnicity and Marital status
R, N=545, adjusted for Age and SES and Ethnicity and Marital status
S, N=545, adjusted for SES and Ethnicity and Marital status
Other chapters, N=545, adjusted for Age and SES and Ethnicity and Marital status
No codes recorded, N=545, adjusted for SES and Ethnicity and Marital status

Most children consulted the GP in the previous twelve months for skin or respiratory problems. No differences were observed in type of complaints registered the last twelve months between the different weight categories (see Table 3b). Neither did the type of complaints children visited the GP for more than once (data not shown).

The number of children that experienced a whole lot and a lot of somatic complaints the last four weeks are shown in Table 4. Significantly more overweight than normal-weight children reported to experience tiredness, pain, weakness and nausea. In addition, a higher percentage of overweight children reported to feel less well. Obese children more often reported stomach complaints and a few underweight children reported to feel weak, which was significantly more compared to normal-weight children.

Only 3.5% of the parents rated the health status of their child as fair or poor with no significant differences between the weight status groups (data not shown).

Table 3b. Complaints children consulted the GP at least once for last 12 months (Total includes missing weight status)

ICPC-chapter	Total N=733 n (%)	Underweight N=125 n (%)	Normal Weight N= 452 n (%)	Overweight N=102 n (%)	Obese N=36 n (%)	Combined p-value N=708	Adjusted[#] combined p-value N[#]
A (General and unspecified)	95 (13.0)	21 (16.8)	60 (13.3)	9 (8.8)	1 (2.8)	0.11	0.30
D (Digestive)	130 (17.7)	30 (24.0)	78 (17.3)	15 (14.7)	6 (16.7)	0.06	0.31
H (Ear)	128 (17.5)	25 (20.0)	76 (16.8)	20 (19.6)	4 (11.1)	0.25	0.39
L (Musculoskeletal)	126 (17.2)	12 (9.6)	77 (17.0)	26 (25.5)	8 (22.2)	0.05	0.33
R (Respiratory)	228 (31.1)	46 (36.8)	133 (29.4)	28 (27.5)	13 (36.1)	0.18	0.49
S (Skin)	273 (37.2)	46 (36.8)	174 (38.5)	35 (34.3)	11 (30.6)	0.51	0.49
Other chapters (B,F,K,N,P,T,U,W,X,Y,Z)	203 (27.7)	31 (24.8)	130 (28.8)	28 (27.5)	12 (33.3)	0.91	0.80
No codes recorded	52 (7.1)	9 (7.2)	28 (6.2)	9 (8.8)	5 (13.9)*	0.21	0.22
Did not consult last 12 months	105 (14.3)	18 (14.4)	67 (14.8)	12 (11.7)	6 (16.7)	0.78[1]	0.50

All analyses are adjusted for cluster at general practice level and for number of consultations last 12 months;
[1] Did not consult was not adjusted for number of consultations last 12 months
* p <0.05 significantly different from Normal Weight, adjusted for confounders
[#] A, N=544, adjusted for SES and Ethnicity and Marital status
D, N=544, adjusted for Age and SES and Ethnicity and Marital status
H, N=544, adjusted for Age and SES and Ethnicity and Marital status
L, N=544, adjusted for Age and SES and Ethnicity and Marital status
R, N=547, adjusted for Age and SES and Ethnicity
S, N=544, adjusted for SES and Ethnicity and Marital status
Other chapters, N=544, adjusted for Age and SES and Ethnicity and Marital status
No codes recorded, N=586, adjusted for Ethnicity and Marital status
Did not consult, N= 545, adjusted for Age and SES and Ethnicity and Marital status

Table 4. Somatic complaints reported on the SCL[17]

Somatic complaints Last 4 weeks a whole lot/ a lot	Total N=733 n (%)	Underweight N=125 n (%)	Normal Weight N= 452 n (%)	Overweight N=102 n (%)	Obese N=36 n (%)	Combined p-value	Adjusted[#] combined p-value N[#]
Dizzy (N = 611)	12 (2.0)	0 (0.0)	7 (1.9)	4 (4.6)	1 (3.8)	0.63	0.43
Tired (N=614)	104 (16.9)	17 (15.6)	56 (15.1)	26 (28.6)**	4 (15.3)	0.03	0.05
Stomach (N=614)	68 (11.1)	15 (13.8)	34 (9.1)	12 (13.3)	6 (23.0)*	0.06	0.08
Well^ (N=615)	27 (4.4)	6 (5.5)	12 (3.3)	7 (7.7)*	2 (7.6)	0.26	0.16
Pain (N=611)	40 (6.5)	5 (4.7)	23 (6.2)	11 (12.2)*	1 (3.8)	0.09	0.09
Weak (N=614)	21 (3.4)	4 (3.7)*	9 (2.4)	7 (7.7)**	1 (3.8)	0.02	0.0001
Healthy^ (N=613)	21 (3.4)	5 (4.6)	11 (3.0)	3 (3.3)	1 (3.8)	0.88	0.90
Headache (N=611)	48 (7.9)	4 (3.7)	28 (7.6)	13 (14.3)	2 (7.7)	0.13	0.29
Ill (N=607)	29 (4.8)	6 (5.6)	16 (4.3)	5 (5.5)	2 (8.0)	0.74	0.79
Shaky (N=608)	13 (2.2)	0 (0.0)	7 (1.9)	4 (4.5)	1 (3.8)	0.32	0.16
Nauseous (N=610)	20 (3.3)	2 (1.8)	9 (2.4)	8 (8.9)*	1 (3.8)	0.04	0.04

All analyses are adjusted for cluster at general practice level and for whether the Somatic Complaint List was filled-out by children or by parents using proxy-forms

^reverse coded

* p<0.05 significantly different from Normal Weight, adjusted for confounders

** p<0.01 significantly different from Normal Weight, adjusted for confounders

[#] Dizzy, N= 444, adjusted for Age and SES

Tired, N=530, adjusted for Age and SES and Ethnicity

Stomach, N=526, adjusted for SES, Ethnicity and Marital status

Well, N=545, adjusted for SES

Pain, N=594, not adjusted

Weak, N=507, adjusted for Age, SES, Ethnicity

Healthy, N=530, adjusted for SES and Ethnicity

Headache, N=524, adjusted for Age, SES, Ethnicity and Marital status

ill, N=525, adjusted for Age, SES, Ethnicity

Shaky, N=457, adjusted for Age, SES, Ethnicity

Nauseous, N=541, adjusted for SES

DISCUSSION

Summary of main findings

Our results show that obese children consult their GP significantly more often than normal-weight children. However, weight status is not related to the type of complaints registered by the GP during these consultations. Somatic complaints reported on a questionnaire at home were more often addressed by overweight children than by normal-weight children, while all most all parents perceived the general health status of their child as good to excellent with no differences between the weight categories.

Strengths and limitations

To our knowledge this is the first cohort study comparing overweight and non-overweight children in general practice. Height and weight were measured using calibrated scales, complaints were recorded from medical files and GP trainees were trained on the reliability of measurements, which implies that the main outcomes of this paper are based on valid data.

Although GPs were trained on the concept of selection bias and encouraged to invite all children who consulted them, the included population might not be representative for all children in general practices in the South-West of the Netherlands. In comparison to the average Dutch household parents from children in our cohort were more often highly educated (43% versus 32%) and both born in the Netherlands (85% versus 79%).[22]

The group of obese children in this study was small (N=36, 5%). However, this percentage is higher than in the general Dutch population.[3] Besides, when analyses were performed using three weight categories to increase power (overweight and obese children in one group) identical associations were found as reported.

There were less children included in this cohort as aimed for.[15] To increase inclusion rates in addition to GP trainees GPs were encouraged to recruit children too. Since we included less children than expected a power problem might explain why we did not find associations between type of complaints and weight status. Nonetheless, there are no obvious trends noticeable which would imply missed associations.

A reasonable percentage (30.8%) of children and parents did not (fully) fill-out the questionnaires. These missing values might have influenced the adjusted estimates of effect since these cases were excluded from analyses if confounders with missing data were included. Therefore, we repeated our analyses including missing data by adding missings as category in a variable. This resulted in comparable associations as the adjusted associations reported except for the number of consultations; the adjusted IRR for obese children was no longer significant 1.20 (95% CI 0.94 – 1.53), which implies potentially selective response.

Comparison with existing literature

The average number of consultations per year of all children in this study is relatively high compared to national data (3.3 versus 2 times a year).[23] This might be explained by the fact that included children had to be children consulting general practice and the chance to be invited increased with a higher frequency of visits.

In contrast to our findings, previous literature reports that excessive weight at young age is already associated with several health problems.[24-26] An explanation for this contradiction might be that previous studies found these associations for children who were more severely obese and for adolescents, while our cohort consists of relatively young children and the group of obese children is small. Another explanation might be

that literature so far reports on complaints children report in either open population studies using questionnaires or on complaints children report in secondary care, while we study complaints of children attending general practice. We do see that overweight children report somatic complaints on a questionnaire more often, but it is plausible that experienced complaints do not prompt children to see their GP or mention it during consultation.[27]

More overweight children reported experienced somatic complaints than normal-weight children. This is in line with literature reporting overweight is associated with lower quality of life, which includes items on tiredness, pain and weakness too.[28] It is important to be aware that children might experience these kind of complaints, especially since literature shows that somatic complaints influence treatment success of weight management programs.[29]

CONCLUSIONS

Weight status does not appear to be related to how children present themselves to the GP. Based on the number of consultations and the type of complaints recorded during these consultations, there is no reason for a different treatment approach for overweight or obese children compared to normal-weight children attending general practice. However, GPs should be aware that overweight children might experience more somatic complaints.

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Chapter 4

Health profiles of overweight and obese young people attending general practice

WD Paulis, M Palmer, P Chondros, S Kauer,
M van Middelkoop & LA Sanci

Submitted

ABSTRACT

Background Primary care is considered an appropriate setting for weight management. For effective management, it is essential for general practitioners (GPs) to understand the health profile of their patients.

Aim To identify health profiles of underweight, overweight and obese young people attending general practice and compare them to normal-weight youth and also to explore the weight-related health risks of eating and exercise behaviour in the four different weight categories.

Design and Setting A cross-sectional design with baseline data from a trial including 683 young people (14-24 years of age) presenting to general practice was used.

Method Through computer assisted telephone interviews (CATIs) data were obtained on number and type of health complaints and consultations, emotional distress, health related quality of life (HRQoL) and eating and exercise behaviour.

Results GPs were consulted more often by overweight (IRR: 1.28, 95%CI [1.04, 1.57]) and obese youth (IRR: 1.54, 95%CI [1.21, 1.97], but not for different health problems compared to normal-weight youth. The reason for presentation was seldom a weight issue. Obese youth reported lower physical HRQoL. Obese and underweight youth were less likely to be satisfied with their eating behaviour than their normal-weight peers. Exercise levels were low in the entire cohort.

Conclusion Our study shows potential for regular attention to weight issues given that overweight and obese youth consult their GP more often. Since young people do not present with weight issues, it becomes important for GPs to find ways to initiate the discussion about weight, healthy eating and exercise with youth.

INTRODUCTION

The worldwide prevalence of overweight and obesity among children, adolescents and adults has increased enormously since the 1970s.[1] Data from the Australian National Health Survey (ANHS) demonstrate that obesity rates in Australia are high, with more than one quarter of its adolescents currently overweight or obese.[2] Adolescent overweight and obesity are linked to an increased risk of developing chronic obesity in adulthood, which increases the likelihood of weight-related adult morbidities and mortality.[3]

Specialist services designed to manage obesity are limited and lack the capacity to deal with the current level of overweight and obese patients.[4] It is therefore important that effective management can also occur in primary care settings.[5] Literature shows that general practitioners (GPs) acknowledge their potential role in the management of childhood obesity, but the majority of GPs do not address weight in regular consultations.[6] Barriers include the limited evidence base for effective management[7] and perceptions held by primary care providers that parents and children lack the motivation to change.[8] Notwithstanding these issues, with young people attending primary care at least annually, there are many opportunities for detection of weight issues and preventive health advice.[9]

Population based studies have suggested that overweight and obese young people utilise health services more often[10], and have lower quality of life or experience more emotional distress than normal-weight youth[11] but this awaits confirmation in studies of youth attending primary care. Understanding the clinical profile of these young people will better inform the design of effective clinical approaches for this group in primary care.

The present study is a secondary analysis of baseline data collected from patients attending Australian general practices that were enrolled in a cluster randomised trial of a training intervention for primary care clinicians in screening and counselling young people for health risks. We aim to describe the health profiles of underweight, overweight and obese youth and compare them to normal weight youth. In addition, we will explore the weight-related health risks of eating and exercise behaviour among young people in the different weight categories.

METHODS

Study Design

We used a cross-sectional design, drawing on data from the Prevention, Access and Risk Taking In Young People (PARTY) project. The PARTY project was a stratified cluster

randomised controlled trial involving 40 general practices in Victoria, Australia. The study was designed to assess the effectiveness and acceptability of an intervention for general practice clinicians (GPs and practice nurses [PNs]) addressing risk-taking behaviour in youth. The full protocol for this project has been published.[12] After practices were randomised, data from young people were collected at three time points: immediately after the recruitment consultation ('exit interview') and at three months and 12 months post-consultation. To answer the current research questions only the 'exit interview' data were used (see Figure 1).

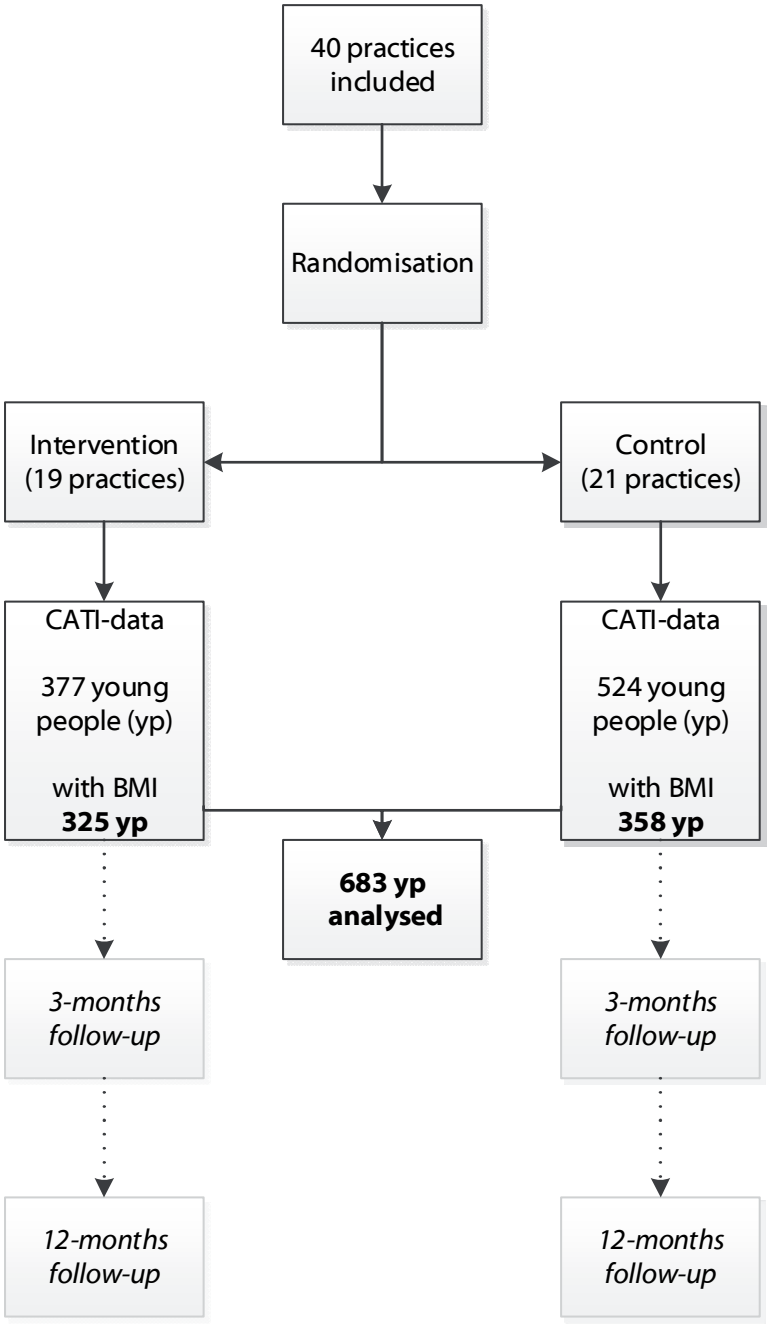

Figure 1. Flowchart of study design and inclusion
CATI = computer assisted telephonic interview
BMI = Body Mass Index

Participants

All young people aged between 14 to 24 years attending the participating general practices between 2007 and 2010 were eligible for participation. Youth and young people are used as composite terms to combine adolescence (14-19 years old) and young adulthood (20-24 years old).[13] Youth were excluded from the study if they were very unwell (vomiting, febrile, weak, psychotic or cognitively impaired), could not speak English or if they were unable to give informed consent and unwilling to obtain consent from guardians.

Procedure

Young people were approached in the clinical setting after their consultation by their clinician who provided a brief overview of the study and asked for permission to pass on their contact details to the study researchers. The researchers phoned each young person and provided a detailed explanation of the study and obtained informed consent. As an incentive for participating, all young people were given the option to enter a draw for an iPod valued at A$200.

However, clinicians were inconsistent with approaching all eligible youth and with timelines under threat, research assistants were placed in the remaining practices to systematically recruit, following the same procedure as the clinicians.[12]

Researchers conducted a computer assisted telephone interview (CATI) with the consenting young people. The duration of the interview was approximately 50 minutes. All researchers were masked to the allocation status of the practices and young people also were not informed of their practice's allocation status.

Measures

The interview contained self-reported measures of the young person's experience with the clinic and clinician/s, quality of life and emotional distress, engagement in risky behaviours, willingness and readiness to change health behaviours, utilisation of health services and basic demographics.[12]

For the present analyses we used the following data:

- basic demographics (age, gender, birth country, education (student yes/no) and employment (employed yes/no))
- self-reported height and weight
- practice billing type (private, national health care funded or community health centres) and socioeconomic status of general practice (based on Socio-Economic Indexes for Areas[14] (dichotomized in Advantaged/Disadvantaged))

Presentations to general practice:

- number of consultations last 12 months
- reason(s) for presentation at current consultation

Broader health profile

- emotional distress (Anxiety and depressive symptoms, measured with the Kessler-10, K-10, questionnaire[15]; a higher score indicates more emotional distress)
- Health-Related Quality of Life (HRQoL, measured with the SF-12 questionnaire[16]; a higher score indicates better HRQoL)

Weight-related health risks (exact questions in Appendix A1)

- self-reported amount of exercise
- satisfaction with current eating behaviour

Data management and analyses

All statistical analyses were done using STATA/SE 12.0 (Statacorp, College Station, Texas USA). Body Mass Index (BMI) was calculated and young people were categorized as underweight, normal weight, overweight or obese. From 18 years onwards a BMI under 18.5 kg/m^2 was considered underweight, 18.5 – 25 kg/m^2 normal weight, 25 – 30 kg/m^2 overweight and over 30 kg/m^2 obese. For patients younger than 18 years of age international gender and age specific cut-off values were used to determine the weight status.[17,18]

The reasons for presentation to the practice were coded into categories of complaints by a trained nurse using the second edition of the International Classification of Primary Care (ICPC-2).[19] Type of complaints were analysed in the ICPC categories separately and in three broad categories; physiological/general/well-visit, sexual/reproductive health and psychosocial.

Data on exercise behaviour were dichotomised into yes/no variables (see Appendix A1, e.g. at least 20 minutes of moderate vigorous activity (like walking) every day).

Demographic data were presented as means and standard deviations (sd) for continuous data, and numbers and percentages for categorical data. Pearson chi-square tests were used to evaluate between-weight category differences in categorical demographic variables. We conducted linear regression analyses for continuous outcome variables, logistic regression analyses for dichotomous variables and Poisson regression for count variables (number of consultations and complaints) to test the associations between the outcome of interest and weight status. Normal weight was used as reference category. Regression analyses were adjusted for age, gender, education level of youth, socioeconomic status and billing type of the general practice, study arm and recruitment method (by clinician or research assistant). All analyses used robust standard errors to adjust

for clustering at general practice level. The strength of the association between weight category and outcome was determined using Odds Ratios (OR) for dichotomous measures, Incidence Rate Ratios (IRR) for the number of consultations and complaints, and difference in means (β) for continuous outcomes, all with 95% Confidence Intervals (CI).

RESULTS

Data on height and weight were available from 683 participants of the sample (901) (75.8%). A total of 122/683 (17.9%) young people were classified as overweight and 44/683 (6.4%) as obese. Table 1 shows the demographic characteristics of the participants within the different weight categories. Most youth were female (76.4%) and

Table 1. Demographic characteristics by weight status

	Underweight N=61	Normal Weight N= 456	Overweight N=122	Obese N=44	
Characteristics	**n(%)**	**n(%)**	**n(%)**	**n(%)**	**p-value***
Gender (N=683)					
Male	7 (11.5)	111 (24.3)	29 (23.8)	14 (31.8)	0.08
Socioeconomic status[14] (N=683)					
Advantaged	52 (85.2)	358 (78.5)	93 (76.2)	34 (77.3)	0.52
Education (N=683)					
Student	37 (60.7)	325 (71.3)	84 (68.8)	20 (45.5)	0.02
Employment (N=682)					
Employed	35 (57.4)	294 (64.6)	88 (72.1)	26 (59.1)	0.37
Born in Australia (N=683)					
Yes	48 (78.7)	375 (82.2)	105 (86.1)	37 (84.1)	0.87
Age (N=683)	Mean (sd)	Mean (sd)	Mean (sd)	Mean (sd)	
Age in years	19.9 (2.7)	19.6 (2.9)	19.7 (2.9)	20.6 (2.6)	0.14

*Adjusted for clustering by general practice

consulted general practices in advantaged areas. Obese youth were less likely to be a student (p=0.02).

Presentations to general practice

On average young people consulted the general practice six times in the last year (sd 6.6 and median five). Both overweight (IRR: 1.28, 95%CI [1.04, 1.57]) and obese young people (IRR: 1.54, 95%CI [1.21, 1.97]) visited their practice more often compared to normal-weight youth, but they did not report more complaints at one consultation (see

Table 2. Number of presentations to the general practice by weight status

	Mean (S.D.)	IRR (95%CI)	Combined p-value	Adjusted IRR (95%CI)*	Adjusted combined p-value*
Number of consultations last 12 months					
Underweight (N=61)	5.74 (5.26)	1.04 (0.87, 1.25)		1.00 (0.82, 1.22)	
Normal weight (N=456)	5.51 (6.07)	ref		ref	
Overweight (N=122)	7.17 (7.81)	1.30 (1.04, 1.62)		1.28 (1.04, 1.57)	
Obese (N=44)	8.55 (9.03)	1.55 (1.17, 2.05)	0.003	1.54 (1.21, 1.97)	0.001
Number of complaints at consultation					
Underweight (N=52)	1.33 (0.92)	0.94 (0.79, 1.14)		0.93 (0.78, 1.12)	
Normal weight (N=373)	1.40 (0.67)	ref		ref	
Overweight (N=91)	1.44 (0.83)	1.02 (0.90, 1.17)		1.02 (0.89, 1.17)	
Obese (N=35)	1.43 (0.50)	1.02 (0.89, 1.16)	0.91	1.01 (0.88, 1.17)	0.88

All confidence intervals and p-values adjusted for clustering by general practice
* Adjusted for: gender, age, socioeconomic status and billing type, education, recruiter and study arm

Table 3. Broader health profile; Emotional distress (Kessler-10) and Health Related Quality of Life (SF-12) by weight status

	Mean (S.D.)	Differences in means β (95%CI)	Combined p-value	Adjusted β (95%CI)*	Adjusted combined p-value*
K-10 score					
Underweight (N=61)	17.4 (5.8)	−0.05 (−1.34, 1.23)		−0.09 (−1.41, 1.23)	
Normal weight (N=454)	17.4 (6.7)	ref		ref	
Overweight (N=122)	17.6 (6.2)	0.20 (−1.19, 1.59)		0.16 (−1.23, 1.56)	
Obese (N=44)	18.8 (8.9)	1.32 (−1.38, 4.02)	0.76	1.52 (−1.37, 4.40)	0.74
SF-12 mental component score					
Underweight (N=60)	46.4 (11.4)	−0.79 (−3.65, 2.06)		−0.33 (−3.19, 2.53)	
Normal weight (N=453)	47.2 (11.0)	ref		ref	
Overweight (N=122)	47.4 (10.4)	0.18 (−1.94, 2.06)		0.24 (−1.99, 2.47)	
Obese (N=43)	47.4 (12.1)	0.26 (−2.52, 3.04)	0.89	0.25 (−2.81, 3.31)	0.98
SF-12 physical component score					
Underweight (N=60)	52.0 (8.2)	−0.80 (−2.99, 1.38)		−0.76 (−2.98, 1.45)	
Normal weight (N=453)	52.8 (7.6)	ref		ref	
Overweight (N=122)	51.0 (9.0)	−1.87 (−3.94, 0.20)		−1.93 (−4.09, 0.23)	
Obese (N=43)	49.4 (8.2)	−3.48 (−5.90, −1.06)	0.005	−3.41 (−5.96, −0.86)	0.006

All confidence intervals and p-values adjusted for clustering by general practice
* Adjusted for: gender, age, socioeconomic status and billing type, education, recruiter and study arm
K-10; higher scores indicate more emotional distress[15]
SF-12; higher scores indicate better health related quality of life[16]

Table 2). Underweight young people did not differ from their normal-weight peers in frequency of consultations.

Youth consulted the general practice for very diverse reasons; from headaches to advice on contraceptives. The reason for presentation to the practice did not differ between the weight categories (see Appendix A2). From the 1229 reported reasons for presentation only eight were for a weight issue (one from an underweight, five from normal weight and two from overweight individuals).

Broader health profile

Underweight, overweight and obese youth did not differ in their levels of emotional distress as measured by the K-10 or in the mental component of the HRQoL questionnaire (SF-12) from normal-weight youth (see Table 3). However, obese individuals had

Table 4. Eating and exercise behaviour by weight status

			OR (95%CI)	Combined p-value	OR (95%CI)*	Combined p-value*
Satisfied with eating behaviour?	**Yes n (%)**	**No n (%)**				
Underweight (N=61)	37 (60.7)	24 (39.3)	0.56 (0.33, 0.96)		0.53 (0.31, 0.92)	
Normal weight (N=455)	333 (73.2)	122 (26.8)	ref		ref	
Overweight (N=122)	84 (68.9)	38 (31.2)	0.81 (0.54, 1.22)		0.82 (0.53, 1.24)	
Obese (N=44)	25 (56.8)	19 (43.2)	0.48 (0.28, 0.83)	0.01	0.48 (0.28, 0.83)	0.007
Moderate activity behaviour every day?#	**Yes n (%)**	**No n (%)**				
Underweight (N=61)	22 (36.1)	39 (63.9)	0.96 (0.53, 1.75)		1.05 (0.58, 1.89)	
Normal weight (N=454)	168 (37.0)	286 (63.0)	ref		ref	
Overweight (N=122)	45 (36.9)	77 (63.1)	0.99 (0.60, 1.66)		1.02 (0.61, 1.68)	
Obese (N=44)	11 (25.0)	33 (75.0)	0.57 (0.29, 1.12)	0.43	0.61 (0.30, 1.23)	0.57
Vigorous activity at least twice a week?#	**Yes n (%)**	**No n (%)**				
Underweight (N=61)	33 (54.1)	28 (45.9)	0.71 (039, 1.30)		0.74 (0.39, 1.39)	
Normal weight (N=456)	284 (62.2)	172 (37.7)	ref		ref	
Overweight (N=122)	85 (69.7)	37 (30.3)	1.39 (0.85, 2.26)		1.47 (0.91, 2.37)	
Obese (N=44)	33 (75.0)	11 (25.0)	1.82 (0.84, 3.94)	0.33	1.92 (0.89, 4.16)	0.24

All confidence intervals and p-values adjusted for clustering by general practice

* Adjusted for: gender, age, socioeconomic status and billing type, education, recruiter and study arm

At least 20 minutes of moderate activity (like walking) every day / at least 20 minutes of vigorous activity (like sports) at least twice a week

significantly lower scores on the physical component of the SF-12 compared to normal-weight youth (β: −3.41, 95%CI [−5.96, −0.86]).

Weight-related health risks

Both underweight (OR: 0.53, 95%CI [0.31, 0.92]) and obese young people (OR: 0.48, 95%CI [0.28, 0.83]) are less likely to be satisfied with their eating behaviour than normal-weight youth (see Table 4).

Approximately 35% of all young people reported having at least 20 minutes of moderate vigorous activity (like walking) seven days a week. In addition, 64% of all young people reported having at least 20 minutes of vigorous activity (like sports) at least twice a week. There were no significant differences between moderate and vigorous exercise levels between the weight categories.

DISCUSSION

Summary of main findings

Our results show that overweight and obese young people consult their general practice more often but not for different health problems than normal-weight youth. The reason for presentation was seldom a weight issue. The physical component score of HRQoL of the obese individuals was lower compared to normal-weight youth. In addition, results show that obese and underweight young people were less likely to be satisfied with their eating behaviour than their normal-weight peers. The exercise levels did not differ between the groups.

Strengths and limitations

We are not aware of previous reports that have investigated health profiles and opportunities for treatment of overweight and obese youth in general practice.

We used self-reported measures of height and weight to determine the weight status of youth. This might have led to a misclassification; presumably an underestimation of the percentages determined as overweight and obese.[20] This could explain the lower prevalence of overweight and obesity found in our study compared to the prevalence in the Australian National Health Survey.[2] However, any misclassifications of the weight status are not likely to affect the direction of the associations found.

In addition, height and weight data were not available for all participants of the PARTY project. Height and weight were not included in the questionnaire at the start of the study and were added after the inclusion of the first 219 participants. Since the reason for the missing values is procedural we assume that the missing data would not bias our results.

Comparison with existing literature

The higher frequency of visits in the overweight and obese groups compared to the normal-weight group found in our study is consistent with the finding from Wijga et al that obese adolescents reported greater health-care needs.[10] The average number of consultations per year of all young people in this study is relatively high (6.0 (sd 6.6)) compared to the average in the population of young people in Australia (3.2 consultations per year).[21] The high consultation rate in our study might be explained by the fact that all participants had to visit the practice at least once to be included in the study and, in addition the chance to be invited for participation in the study increased for youth with a higher frequency of visits to general practice.

In contrast to our findings, previous literature reports that excess weight at a young age is already associated with specific health problems like musculoskeletal complaints[22] and asthma.[23] However, Wake et al[24] also found that overweight and obese adolescents do not report specific health complaints that might prompt them to see their doctor. This may also explain our finding that overweight and obese youth do not tend to consult their GP for weight issues. Another explanation for why we did not find an association between weight status and reason for presentation might be lack of study power. The reason for presentation was only recorded for the current consultation and not for all consultations in the previous 12 months. Therefore, the number of reasons for presentation might be too small to detect differences between the different weight categories. If the reason for presentation was reported at more consultations, an association might have been found.

In contrast to our expectations and previous literature[11] no association was found between emotional distress or psychosocial HRQoL and weight status. However, similar results were seen in Dutch adolescents where no association was found between mental health and weight status, while obesity was related to poorer self-perceived physical health and more health visits.[25] It could be argued that the increased number of consultations is related to obesity because of this decreased self-perceived physical health. However, when we adjusted for HRQoL the number of consultations was still significantly higher for obese youth compared to those with normal weight (data not shown).

The World Health Organization (WHO) recommends at least 60 minutes of moderate to vigorous activity every day for children (until 18 years) and 150 minutes of moderate to vigorous activity a week for adults.[26] In our study only 35% of all participants reported at least 20 minutes of moderate physical activity every day. Therefore, the majority of young people did not meet the WHO-guideline, which is in line with prior data from a national study among young people in Australia.[21]

Since a previous study showed that low level of physical activity was associated with both health complaints and lower HRQoL[27] one might have expected obese youth to report lower amounts of physical activity. However, in the present study there were no

differences found in amount of exercise between youth of different weight categories. One explanation might be that there were no differences since the activity level of all youth in our cohort was low. Another explanation might be that the dichotomized outcome measure was not sensitive enough to detect differences.

Implications for practice and research

Primary care is considered as an appropriate setting for embedding weight management programs. Our study shows potential for regular attention to weight issues by the general practitioner during the consultation given that overweight and obese youth consult their general practice more often. However, given that overweight and obese young people do not present with different reasons compared to other youth and also do not usually present with weight issues, it becomes important for GPs to find ways to initiate the discussion about weight, healthy eating and exercise with youth. Future studies should investigate how primary care can effectively help young people improve their eating and exercise behaviour.

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APPENDIX A1 QUESTIONS REGARDING EATING AND EXERCISE BEHAVIOUR

Eating behaviour

Are you satisfied with your eating habits? Yes / No

(analysed as reported)

Exercise behaviour

1. In a normal week, how many times do you engage in less vigorous exercise which lasts 20 minutes or more (i.e. exercise that does **not** make you breathe harder or puff and pant, such as walking, moderate roller blading etc)

Never / Once a week / 2 or 3 times per week / 4, 5 or 6 times a week / Once every day / More than once every day

(the last two categories were coded as "Moderate vigorous activity every day": Yes. The other categories were coded as No)

2. In a normal week, how many times do you engage in vigorous exercise lasting 20 minutes or more (i.e. exercise that makes you breathe harder or puff and pant, such as netball, squash, jogging, aerobics, vigorous swimming etc)

Never / Once a week / 2 or 3 times per week / 4, 5 or 6 times a week / Once every day / More than once every day

(the last four categories were coded as "Vigorous activity at least twice a week": Yes. The other categories were coded as No)

APPENDIX A2 REASONS FOR PRESENTATION

Table A1. Young people's reasons for presentation to general practice by weight category

	Underweight N=61	Normal Weight N= 456	Overweight N=122	Obese N=44
At least one complaint of ICPC[19]	**n(%)**	**n(%)**	**n(%)**	**n(%)**
A	15 (24.6)	93 (20.4)	21 (17.2)	10 (22.7)
B	0 (0.0)	18 (3.9)	4 (3.3)	0 (0.0)
D	2 (3.3)	25 (5.5)	8 (6.6)	4 (9.1)
F	0 (0.0)	8(1.8)	2 (1.6)	1 (2.3)
H	0 (0.0)	4 (0.9)	2 (1.6)	2 (4.5)
K	1 (1.6)	6 (1.3)	0 (0.0)	1 (2.3)
L	3 (4.9)	36 (7.9)	10 (8.2)	3 (6.8)
N	0 (0.0)	17 (3.7)	3 (2.5)	4 (9.1)
P	4 (6.6)	30 (6.6)	3 (2.5)	2 (4.5)
R	9 (14.8)	74 (16.2)	20 (16.4)	8 (18.2)
S	8 (11.5)	63 (13.8)	11 (9.0)	3 (6.8)
T	4 (6.6)	9 (2.0)	2 (1.6)	2 (4.5)
U	3 (4.9)	12 (2.6)	0 (0.0)	1 (2.3)
W	7 (11.5)	37 (8.1)	9 (7.4)	0 (0.0)
X	6 (9.8)	38 (8.3)	13 (10.7)	4 (9.1)
Y	0 (0.0)	4 (0.9)	0 (0.0)	0 (0.0)
Z	1 (1.6)	3 (0.7)	0 (0.0)	0 (0.0)
Group of complaints				
Physiological/General	41 (67.2)	321 (70.4)	82 (67.2)	33 (75.0)
Sexual/Reproductive	14 (23.0)	92 (20.2)	21 (17.2)	6 (13.6)
Psychosocial	6 (9.8)	37 (8.1)	3 (2.5)	2 (4.5)

A = General and unspecified
B = Blood, blood-forming organs, and immune mechanism
D = Digestive
F = Eye
H = Ear
K = Circulatory
L = Musculoskeletal
N= Neurological
P = Psychological
R = Respiratory
S = Skin
T = Endocrine, metabolic and nutritional
U = Urinary system
W= Pregnancy, child bearing, family planning
X = Female genital system (including breast)
Y = Male genital system
Z = Social problems

Chapter 5

Overweight and obesity are associated with musculoskeletal complaints as early as childhood: a systematic review

WD Paulis, S Silva, BW Koes & M van Middelkoop

Obesity Reviews 2014, 15: 52-67

ABSTRACT

In order to examine (i) the association between weight status and musculoskeletal complaints (MSC) in children, and (ii) whether overweight and obese children have a higher risk of developing MSC than normal-weight children Medline, Embase, Web of Science and Cochrane were searched (all years up to 2 January 2013) for observational studies studying direct associations between body mass index (or weight status) and MSC in children.

Forty studies, together studying over one million children, were included. There was moderate quality of evidence that being overweight in childhood is positively associated with musculoskeletal pain (risk ratio [RR] 1.26; 95% confidence interval [CI]: 1.09-1.45). In addition low quality of evidence was found for a positive association between overweight and low back pain (RR 1.42; 95%CI: 1.03-1.97) and between overweight and injuries and fractures (RR 1.08; 95%CI: 1.03-1.14). Although the risk of developing an injury was significantly higher for overweight than for normal-weight adolescents (RR 2.41; 95%CI: 1.42- 4.10), this evidence was of very low quality.

Overweight and obesity are associated with musculoskeletal pain, injuries and fractures as early as childhood. More high quality prospective cohort studies are needed to study the nature of this relationship.

INTRODUCTION

In 2010, more than 40 million children under the age of five were overweight or obese worldwide.[1] Overweight children have a risk twice as high as normal-weight children of becoming an overweight adult; for obese children this risk is even higher.[2] Overweight in adults is well known to be associated with increased risks of diabetes mellitus and cardiovascular disease.[3] Excessive weight also significantly increases the risk parameters for cardiovascular disease in school-aged children.[4]

Adult overweight has been associated with a higher prevalence of musculoskeletal complaints (MSC) too.[5-9] Whether the same association is already apparent in childhood is unknown. Several articles that quantified the prevalence of MSC in overweight and normal-weight children had different outcomes. Some studies report more traumas and MSC in overweight and obese children[10,11], while others find no association between overweight and acute injuries, and neither between overweight and low back pain in children.[12,13]

It is important to study the relationship between weight status and MSC, since an association might lead to a vicious circle in which being overweight, musculoskeletal complaints, and a low fitness level reinforce each other. If an association exists, healthcare professionals can help children manage their problems properly and can advise on a healthy lifestyle that prevents both overweight and complaints. The aim of this systematic review was therefore to review and synthesize all suitable literature available and examine (i) the association between weight status and MSC in children, and (ii) whether overweight and obese children have a higher risk of developing MSC than normal-weight children.

METHODS

Study design

We systematically reviewed observational studies with cross-sectional and longitudinal study designs that investigated the relationship between weight and MSC in children.

Search strategy

We conducted a comprehensive literature search of Medline, Embase, Web of Science and Cochrane for all years available up to 2 January 2013. Search terms were combined into three groups: child, weight and musculoskeletal complaints. Papers identified by the search strategy contained at least one term from each group. The search strings were adapted to the different databases to facilitate a comprehensive search (the search string is displayed in Appendix A1). In order to retrieve all relevant papers, reference lists of included papers and related reviews were screened for relevant papers by one investigator.

Eligibility criteria for selecting studies

Two authors independently selected the articles on the basis of title and abstract. A final decision about inclusion was made based on the basis of the full-text paper, which had to fulfil the following criteria: (i) body mass index (BMI) or weight status had to be subject of study of direct association with MSC; (ii) investigated individuals had to be children between 0-18 years of age and without systemic disorders (i.e. diabetes mellitus and rheumatoid arthritis); and (iii) the study design had to be cross-sectional or longitudinal with a non-MSC comparison group. Studies that fulfilled these criteria and were written in English, French, German, Swedish or Dutch were eligible.

The review focussed on musculoskeletal disorders that children perceive as complaint (reported as pain, injury or fracture). Malalignments defined as pes planus, scoliosis and tibia vara were considered to be outside the scope of this review and therefore excluded. Eligibility of the full text articles was also independently assessed by two authors. Any discrepancies were solved through discussion.

Risk of bias assessment

To assess the risk of bias, we used the methodological quality assessment list of van Rijn et al.[14] Table 1 presents the criteria for assessing the risk of bias: the list was divided into five topics with a total of 16 items (14 applicable to cross-sectional studies and all 16 applicable to longitudinal studies). Two authors independently assessed the risk of bias in the studies by rating each of the study criteria as 'positive', 'negative' or 'unclear'. Cohen's kappa was calculated to assess the inter-rater reliability. For the final risk of bias scores disagreements between the authors were solved through discussion. The final risk-of-bias score of each study was calculated by summing the total number of positive criteria, and dividing it by the total number of applicable items. If more than 50% of the items were scored positive, the study was rated as having a low risk of bias.

Data Management

Two independent reviewers extracted the following details for all included papers: publication details (author, year and country); sample characteristics (number of participants, age and gender); and study methodology (study design, setting, type and definition of MSC, assessment and definition of weight status and reported confounders). If MSC was registered by a physician and also based on self-report, the physician's data were recorded.

In order to calculate mean differences (MDs), means and standard deviations (SDs) were recorded for the MSC and control group if studies reported a continuous outcome on weight status, such as BMI or BMI-z. In order to calculate risk ratios (RRs), raw counts were registered for studies that reported the number of individuals of normal weight and overweight (= overweight and obese) in both groups. For weight status classification

the definitions of the original studies were used. If data were presented in figure form, the variables were measured and recorded. If neither former nor latter were provided in the original publication, authors were contacted for additional data.

Associations and Risk factors

Studies were divided into two groups based on their design, i.e. cross-sectional or longitudinal studies. The cross-sectional studies were used to calculate associations between overweight and MSC, and the longitudinal to calculate risk factors of overweight at baseline for MSC at follow-up.

Table 1. Risk-of-bias assessment. Scoring options included positive, negative, or unclear.

Criteria for quality score	
Study population	
1. Study groups (complaints and no complaints) are clearly defined	Positive if at least 2 of the following 3 items in both groups were reported: age, gender and weight status or BMI
2. Participation ≥ 70%	Positive if the participation of overweight and normal weight groups was ≥ 70%
3. Number of cases ≥ 50	Positive if number of cases (people with complaint) ≥ 50
Assessment of overweight	
4. Overweight definition	Positive if BMI cut-off values for overweight definition were mentioned
5. Assessment of overweight	Positive if assessment of weight and height was described
6. Blind for complaint status	Positive if weight status was measured by an independent person without knowledge of the complaint status
Assessment of complaint	
7. Complaint definition	Positive if a definition of the musculoskeletal complaint was given
8. Assessment of complaint	Positive if the method of assessment was described
9. Blind for weight status	Positive if the complaint was measured without knowledge of the weight status
Study Design	
10. Longitudinal design	Positive if the study design was longitudinal
11. Inclusion and exclusion criteria	Positive if inclusion and exclusion criteria were described
12. Follow-up period ≥ 1 year	Positive if the follow-up period was ≥ 1 year
13. Information on study completers versus withdrawals	Positive if demographic information was given for completers and withdrawals
Analysis and data presentation	
14. Data presentation	Positive if risk estimates were presented or if raw data were given that allowed the calculation of risk estimates, such as odds or prevalence ratios or relative risks
15. Consideration of confounders	Positive if the confounders that were considered were described
16. Control for confounding	Positive if the method used to control for confounding was described

Subgroups

Before data analysis, MSC were divided into two groups because of suspected different aetiology: acute complaints (e.g. injuries, traumas and fractures) and musculoskeletal pain (MSP) e.g. low back pain (LBP), neck pain or knee pain. If at least three studies reported data on the same subgroup (based on a specific joint pain, age, gender or puberty status), these data were analysed separately as well. If at least three studies reported MSC for overweight and obese individuals separately, these data were also analysed separately to investigate a potential dose-response relationship between weight and complaint.

Data Analysis

MDs with corresponding 95% confidence intervals (CI) were calculated for every individual study that reported the unadjusted mean BMI or BMI-z for children with and without MSC. Studies were pooled to calculate the weighted mean differences (WMD). Pooled RRs with matching 95% CIs were calculated for dichotomous raw data by dividing the proportion of overweight individuals in the group with MSC by the proportion of overweight individuals in the group without MSC. A random effects model was used in all calculations.[15] For the pooled studies, funnel plots were made to aid our analysis of publication bias. If the plot was symmetrical and included RR=1, no publication bias was considered.

If a meta-analysis was not possible due to clinical heterogeneity or because studies did not provide sufficient information to be included in the pooling, data were analysed descriptively. Statistical heterogeneity was tested with the Chi-square and I^2 test. RevMan software version 5.1, (Rigshospitalet, Copenhagen, Denmark) was used to pool data.

Strength of evidence

In order to evaluate the quality of evidence of the pooled results, two authors independently used the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach.[16] For the current review, as observational studies were the most appropriate to answer the questions, the rating of the evidence started at a high quality. The quality of evidence was downgraded by one level for each inconsistency (I^2>40%), uncertainty (less than 400 participants) or probability of bias (a study included had a high risk of bias or a funnel plot that indicated publication bias). The quality of evidence was upgraded by one level if strong evidence of associations (RR>2.5) or evidence of dose response gradients were found. The following levels of the quality of the evidence were distinguished:

- High quality: Further research is very unlikely to change the level of evidence. There are sufficient data with narrow confidence intervals. There are no known or suspected reporting biases.
- Moderate quality: Further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate.
- Low quality: Further research is very likely to have an important impact on confidence in the estimate of effect and is likely to change it.
- Very low quality: Great uncertainty about the estimate.

For the final level of the quality of evidence disagreements between the authors on grades were solved through discussion.

RESULTS

Study selection

The search strategy identified 4354 unique and potentially relevant records (Figure 1). After screening titles and abstracts, we retrieved 132 full-text papers for more detailed study. Finally, 40 papers met the eligibility criteria and were included in the review.[10-13,17-52]

Study characteristics

Thirty-three of the 40 studies included reported cross-sectional data that were used to study associations between weight status and MSC; seven reported prospective data that were used to study overweight as a risk factor for future MSC. Sixteen papers reported insufficient data to qualify for inclusion in meta-analyses. The authors of these studies were contacted; Five provided the data that were necessary for meta-analyses.[13,17,29,40,45] The study characteristics of the included studies are shown in Table 2.

The 40 studies were conducted in 19 different countries all over the world. Children were recruited in different settings ranging from schools to obesity clinics and emergency departments. The children's age range was 0-19 years. The cross-sectional studies included 1,106,675 children in total; the prospective studies included 2,380. The most reported specific MSC was LBP.

Risk of bias assessment

The reviewers agreed on 87% of the items in the 40 included studies (556 of 640) The inter-rater reliability was high (Cohen's kappa: 0.77).[54] The final risk of bias assessment is shown in Table 3. Eight studies (six cross-sectional, two prospective) had a high risk of bias. As no raw data could be obtained from six of these studies, these studies were not included in meta-analyses.

Nearly all studies measured weight status and complaints in an appropriate matter, and data were clearly presented. Twenty-six of the included studies reported on confounders. The most reported confounder was gender. Twenty-five studies corrected for confounders. Most studies (n=39) failed to describe whether the weight status has been assessed by an independent person who was unaware of the complaint status of the individual.

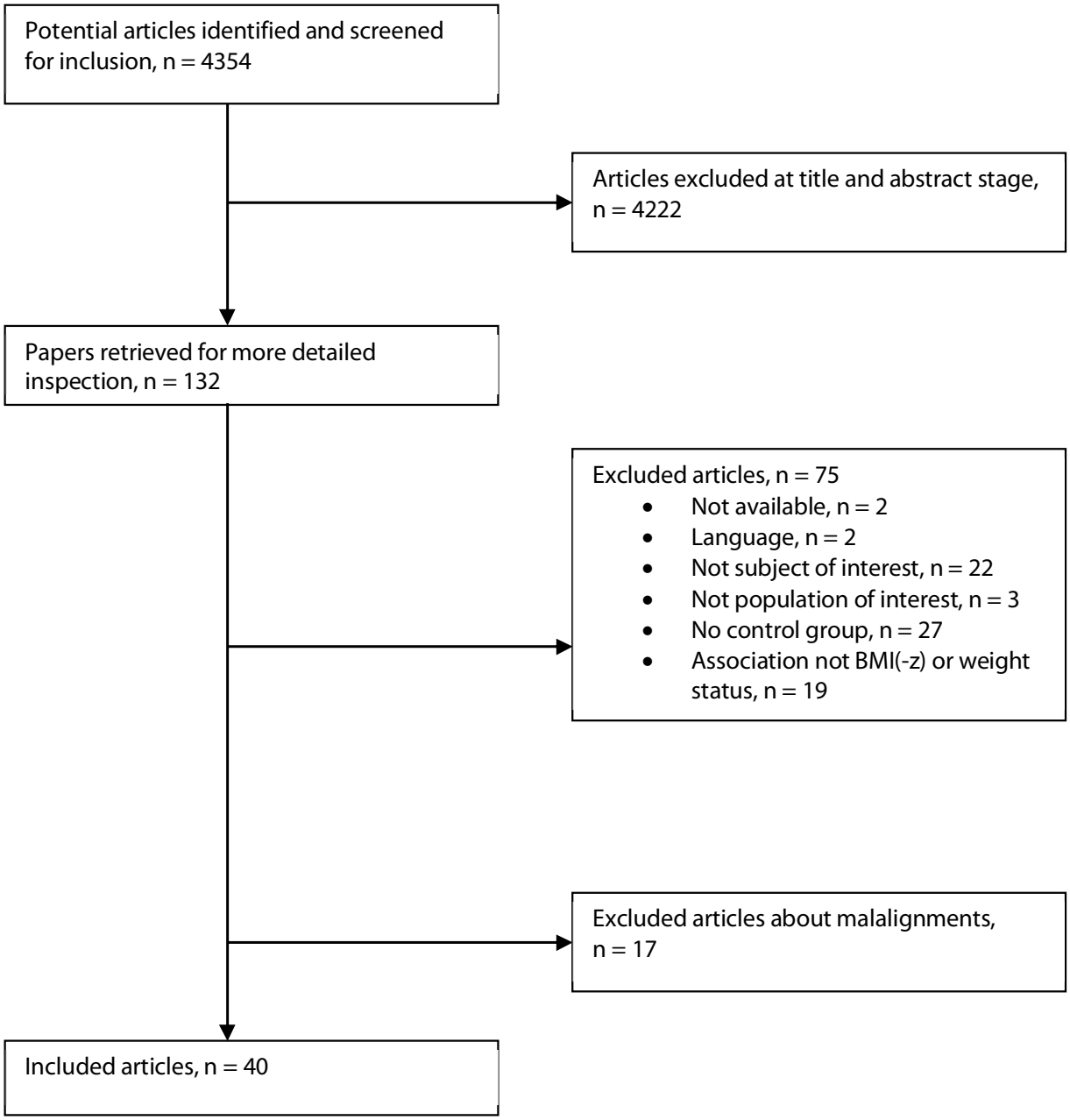

Figure 1. Flowchart of selected papers

Associations

Musculoskeletal Pain

Eighteen of the 34 cross-sectional studies reported on musculoskeletal pai n[11,13,19-21,23,28,29,33,34,37,39,40,43,44,47,49,51] and two reported on both pain and fractures.[17,45] Nine of these 20 articles reported the number of overweight and normal weight individuals in groups with and without pain; these data were pooled (Figure 2a). The risk ratio was 1.26 (95%CI [1.09 to 1.45]), indicating a significant association between being overweight and having musculoskeletal pain. There was significant statistical heterogeneity between the studies (I^2= 93%).

Figure 2b shows the pooled results of five articles that studied associations between BMI (continuous) and musculoskeletal pain. A small significant association is seen between higher BMI and musculoskeletal pain (MD: 0.38, 95%CI [0.20 to 0.55]). Half of the six studies that could not be pooled found a significant positive association between pain and overweight (one study reported an association between BMI-z and MSP[19]; the two other studies reported a higher association for obese children[20,37]). However, the other three studies did not find a significant association between BMI and MSP (MDs not reported in these articles).[33,47,49]

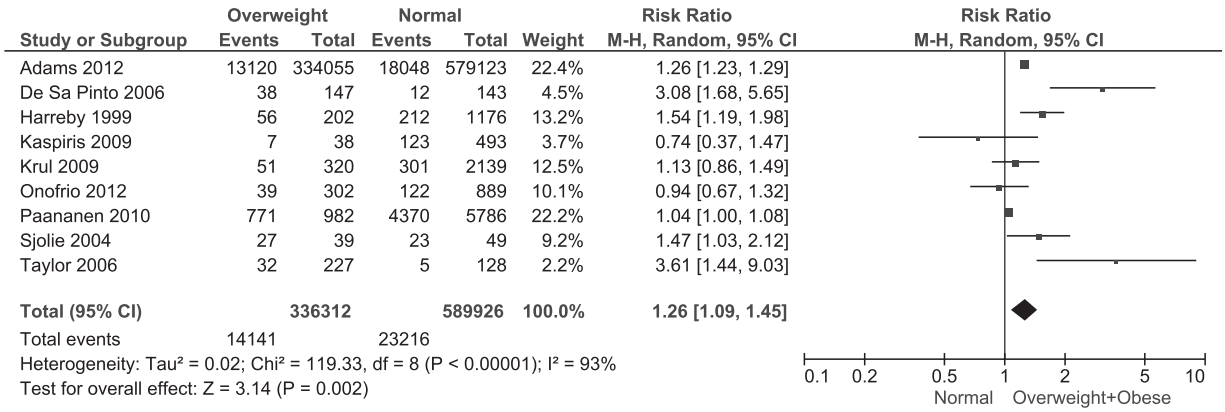

Figure 2a. Pooled results of the studies that reported the number of children with and without MSP (Musculoskeletal Pain) and their weight status; the prevalence of MSP is 26% higher in overweight children.

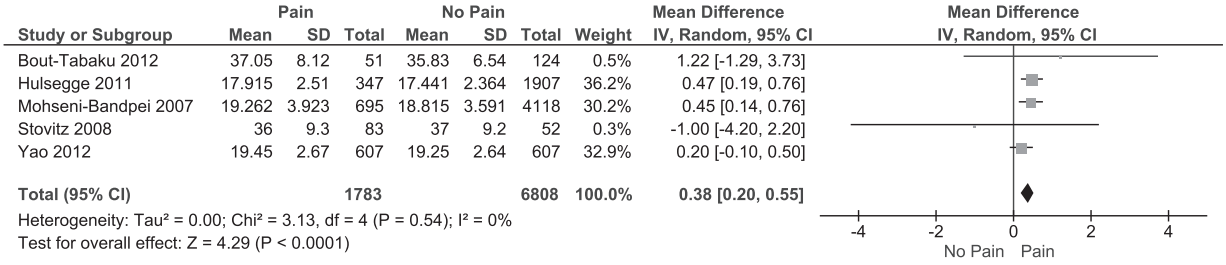

Figure 2b. Pooled results of the studies that reported the BMI of children with and without Musculoskeletal pain (MSP); The mean BMI of children with pain was 0.38 kg/m^2 higher.

Table 2. Study characteristics of included studies.

Study	Country	Design	Setting	N	Age (years)	Gender (%M)	Type of Complaint	Definition	Weight status Assessment	Reported confounders
Cross-sectional studies										
Adams 2004	USA	Cross	Open population	913178	2-19	50,3	Fractures and MSP	Physician visits ICD9 (719-845) recorded	BMI recorded from file, cut-off CDC	Gender, race, age and medi-cal use
Bazelmans 2004	Belgium	Cross	School	2363	9-17	54,5	Injury	Any traumatic event that required care by a health professional	BMI measured, cut-off WHO	Gender and physical activities
Bell 2007	Australia	Cross	Community and hospital	177	6-13	48,5	MSP	In a structured interview by paediatric fellow reported complications like musculoskeletal pain (complications were dichotomized)	BMI measured, cut-off IOTF	Age, gender, SES, mother's and father's ages and parent history of complications
Bell 2011	Australia	Cross	Primary schools	283	6-13	46	MSP	Musculoskeletal pain was reported by parent and child in structured interview	BMI measured, cut-off CDC	Not reported
Bout-Tabaku 2012	USA	Cross	Weight management program	175	9-19	30,9	MSP	Questionnaire by patients and parents on pain in feet, ankles, knees and hips	BMI measured, cut-off CDC	Not reported
Dahlstrom 2012	Sweden	Cross	Youth football players	767	8-18	63,8	Injury	Injury occurred during game or practice, which causes players to miss a practice or game	BMI reported, cut-off Swedish centiles	Not reported
De Sa Pinto 2006	Brazil	Cross	Obesity clinic	96	7-14	55	MSP	Parents and child answered questionnaire. Symptoms only considered if pain was present at least once a week for the last month	BMI measured, cut-off CDC	Not reported

Table 2. Study characteristics of included studies. (continued)

Study	Country	Design	Setting	N	Age (years)	Gender (%M)	Type of Complaint	Definition	Weight status Assessment	Reported confounders
Doan 2010	Canada	Cross	Community health centre	12170	12-17	51,9	Injury	"Not counting repetitive strain injuries, in the past 12 months were you injured?" Injuries were defined as serious enough to limit your normal activities, such as a broken bone, a bad cut or burn, a sprain or a poisoning.	BMI reported, cut-off IOTF	Gender, physical activity, household highest education, health status
Flynn 2007	Tasmania	Cross	Open population	183	Mean 8,2 (sd 0,3)	64	Fractures	Fractures ascertained by self-report with X-ray confirmation	BMI measured, cut-off IOTF	Not reported
Goulding 2000	New-Zealand	Cross	Unclear	170	3-15	0	Fractures	Reported fractures checked in radiology records	BMI measured, no cut-off	Not reported
Harreby 1999	Denmark	Cross	School	1389	13-16	48,3	Low Back Pain (MSP)	Low Back Pain was defined as pain in the lower back and was illustrated by a text and drawing on the front page of the questionnaire.	BMI reported, cut-off BMI>25	Not reported
Hulsegge 2011	Netherlands	Cross	Open population	2638	11 year olds	50,2	MSP	Could you mark for the following diseases or conditions whether you have had it in the past 12 months (¼ last year) and whether you visited your doctor in the past 12 months for that reason?" The questionnaire further specified, "If 'long lasting' is stated, we mean conditions which bothered you in total for more than 1 month," using the following 3 items: "long-lasting back complaints," "long-lasting complaints of the neck, shoulder, elbow, wrist, or hand," and "long-lasting complaints of the hip, knee, ankle, or foot	BMI reported, BMI-z calculated on Dutch growth data	Pubertal stage, mental health, tiredness, physical activity

Table 2. Study characteristics of included studies. (continued)

Study	Country	Design	Setting	N	Age (years)	Gender (%M)	Type of Complaint	Definition	Weight status Assessment	Reported confounders
Jones 2004	New-Zealand	Cross	Open population	968	0-18	51,7	Fractures	Fractures reported between birth and 18 years of age	BMI measured, cut-off CDC	Age and gender
Kaspiris 2009	Greece	Cross	Paediatric clinic	532	7-14	52,3	Growing pains (MSP)	Questionnaire concerning the appearance of growing pains the year before	BMI reported, no cut-off	Not reported
Kaspiris 2010	Greece	Cross	Paediatric clinic	692	4-12	49	Low Back Pain (MSP)	Nonspecific LBP was defined as any pain localized in the area between L1 and L5 and the sacroiliac joints. Children where shown a picture in the questionnaire	BMI reported, no cut-off	Not reported
Kirk 2012	Canada	Cross	Open population	3361	10-11	48	Injury	Physician visits ICD9 (800-999) recorded	BMI measured, cut-off IOTF	Gender, income, education and urban residence
Krul 2009	Netherlands	Cross	Family practice	2459	2-17	not reported	MSP	International Classification of Primary Care codes were used to identify musculoskeletal problems in past twelve months	BMI reported, Dutch cut-off points	Not reported
Lowry 2007	USA	Cross	High schools	28815	Not reported	48,8	Injury	During the past 30 days, did you see a doctor or nurse for an injury that happened while exercising or playing sports?	BMI reported, cut-off CDC	Physical activity, strengthening exercises, PE classes, sports teams, grade and race

Table 2. Study characteristics of included studies. (continued)

Study	Country	Design	Setting	N	Age (years)	Gender (%M)	Type of Complaint	Definition	Weight status Assessment	Reported confounders
Lusky 1996	Israel	Cross	Jewish military service	110000	17 year olds	100	Specific medical conditions (hip, meniscus, ankle and knee) (MSP)	Conditions were considered medically significant if they were of sufficient severity to disqualify the inductee for service in a combat unit	BMI measured, cut-off Israeli centiles: <5 severe underweight 5-15 mild underweight 15-85 normal 85-95 mild overweight >95 severe overweight	Not reported
Manias 2006	UK	Cross	Emergency department (and control buddy)	150	4-16	48	Fractures	Fracture reported at the emergency department	BMI measured, no cut-off	Not reported
Mohseni-Bandpei 2007	Iran	Cross	School	5000	11-14	47,7	Low Back Pain (MSP)	Low back pain was defined as any pain in the lower back between L1-L5 and the sacroiliac joints using anatomical drawing. Pain at the moment, last month, last 6 month and last year were questioned.	BMI measured, no cut-off	Not reported

Table 2. Study characteristics of included studies. (continued)

Study	Country	Design	Setting	N	Age (years)	Gender (%M)	Type of Complaint	Definition	Weight status Assessment	Reported confounders
Onofrio 2012	Brazil	Cross	School	1191	13-19	46,3	Low Back Pain (MSP)	Have you ever had low back pain? When? Within the last 30 days was recorded.	BMI measured, cut-off unclear	Gender, age, skin color, economic status, commute to school, seating position, daily screen time, backpack weight and usage
Paananen 2010	Finland	Cross	Open population	6875	15-16	39,1	MSP	Have you had any chest or pains during the last 6 months in the following areas of the body: Neck, shoulders, low back, elbows, wrists, knees, ankle and foot areas? (also illustrated by a drawing)	BMI reported, cut-off IOTF	Not reported
Richmond 2012	Canada	Cross	High schools	4399	12-19	49,3	Injury	In the past one year did you have at least one sports injury?	BMI reported, cut-off IOTF	Gender, age, hours of sports, place of residence, ethnicity, level of play, parental education
Sjolie 2004	Norway	Cross	School	88	14-16	56,8	Low Back Pain (MSP)	Aching, pain or discomfort in the low back during the preceding year, not related to trauma or menstrual pain	BMI measured, cut-off BMI>20,4 (mean)	Gender, hip flexibility and overall well-being

Table 2. Study characteristics of included studies. (continued)

Study	Country	Design	Setting	N	Age (years)	Gender (%M)	Type of Complaint	Definition	Weight status Assessment	Reported confounders
Stovitz 2008	USA	Cross	Obesity clinic	135	3-18	49,6	MSP	Parents and children completed a written questionnaire that asked whether the child had pain in their back, hip, knee, ankle and foot	BMI measured, no cut-off	Age, gender and ethnicity
Taylor 2006	USA	Cross	Trial and national institute of health	355	6-18	44,2	Fractures and MSP	Medical chart review of fractures and complaints	BMI measured, cut-off >95 overweight 5-95 non-overweight	Not reported
Valerio 2012	Italy	Cross	Children's hospital	579	3-14	65%	Fractures	Admitted for a recent fracture to the outpatient clinic of the Department of Orthopaedics and Traumatology	BMI measured, cut-off IOTF	Gender
Vahasarja 1995	Finland	Cross	School	856	9-10 and 14-15	47,3	Chronic knee pain (MSP)	Symptoms (pain, snapping, effusion luxation or giving away) lasted for more than 3 months and was several times a week	BMI reported, cut-off overweight = BMI mean + 1,5SD	Not reported
Viry 1999	France	Cross	School	123	Mean 14 (sd 0,6)	52,8	Low Back Pain (MSP)	Prevalence of back pain on the study day and during the last year was questioned	BMI reported, cut-off mean BMI 18,35	Gender, schoolbag, travel time and sitting position
Wake 2008	Australia	Cross	Preschool cohort	4934	4-5	50,9	Injury	Number of injuries requiring medical attention over the last 12 months (from interview with caregiver)	BMI measured, cut-off IOTF	Gender, maternal education and SEIFA quintile

Table 2. Study characteristics of included studies. (continued)

Study	Country	Design	Setting	N	Age (years)	Gender (%M)	Type of Complaint	Definition	Weight status Assessment	Reported confounders
Yao 2012	China	Cross	Open population	1214	10-18	39,7	Low Back Pain (MSP)	A pain experience in the lower back, from the 12th rib to the lumbar or lumbosacral area, and not related to tumor, inflammation, injury, spinal deformity, or lumbar disc protrusion at least once during the preceding 3 months. Diagnosed by a professional doctor	BMI measured, no cut-off	Family history, feeling schoolbag uncomfortable, duration of schoolbag carrying, basketball playing and rest position between classes
Zonfrillo 2008	USA	Cross	Emergency department	360	5-19	53,9	Ankle injury	Case = chief complaint of acute ankle injury by any musculoskeletal trauma to the ankle while ambulatory Control = chief complaint of fever, headache or sore throat	BMI measured, cut-off CDC	Age, gender, race, insurance status and month of visit
Longitudinal studies										
Barber-Foss 2012	USA	Long	Female basket ball players	262	Mean 12,8 (sd 1,1)	0	Patel-lofemoral pain (MSP)	Pain around the patella not due to trauma	BMI measured, cut-off CDC	Not reported
Feldman 2002	Canada	Long	High schools	502	Mean 13,8 (sd 0,1)	52,6	Neck/ Upper Limb Pain (MSP)	Pain according to Mikkelson and Brattberg at least once a week in the past six months	BMI measured, no cut-off	Sport activity, musical instrument, work, mental health index, high growth, height, age, gender and smoking

Table 2. Study characteristics of included studies. (continued)

Study	Country	Design	Setting	N	Age (years)	Gender (%M)	Type of Complaint	Definition	Weight status Assessment	Reported confounders
Gomez 1998	USA	Long	High school football teams	215	14-19	100	Injury	Injury rates were calculated for groups with exposure as denominator	BMI measured, no cut-off	Age, playing level, exposure time, body fat, weight, and lean body mass
Jones 2003	UK	Long	School	1046	11-14	not reported	Low Back Pain (MSP)	Questionnaire LBP in past month that lasted for longer than 1 day	BMI measured, no cut-off	Age and gender
Kaplan 1995	USA	Long	High school football teams	98	Mean 16,6 (sd 0,9)	100	Injury	Injury which causes players to miss a practice or game, reported by trainers	BMI measured, cut-off >95%	Not reported
Plisky 2007	USA	Long	School cross-country runners	105	Mean 16 (sd 1)	56,2	Medial Tibial Stress Syndrome (MSP)	MTSS was defined as continuous or intermittent pain in the tibial region, exacerbated with repetitive weight-bearing activity, and localized pain with palpation along the distal two thirds of the posterior-medial tibia.	BMI reported, cut-off Q1 <18,8 18,8-20,1 Q2 20,2-21,6 Q3 >21,6 Q4	Orthotic use and previous injury
Tyler 2006	USA	Long	Football teams	152	Not reported	100	Ankle sprains	A lateral ankle sprain was defined as an ankle injury with an inversion mechanism requiring the player to miss at least one game or practice. Contact injury when athlete was being tackled, all other noncontact. Injury incidence was calculated as injuries per 1000 player exposures, with an exposure defined as a player's participation in a game or practice	BMI recorded, cut-off CDC	Previous ankle sprain

Design: Cross = Cross-sectional study (or data from only one time point used of cohort study), Long = Longitudinal (Prospective cohort)
Type of Complaint: MSP = Musculoskeletal Pain
Weight status Assessment: CDC & WHO-centiles >85% overweight, IOTF has age and gender specific cut-off values[53]
Reported confounders: SES/SEIFA = SocioEconomic Status, PE = Physical Exercise

Because only two studies reported data separately for overweight and obese individuals[17,39] no subgroup analyses were done. Since the overall pooled results show inconsistencies (I^2= 93%), the quality of evidence was downgraded by one level, indicating a moderate quality of evidence for a positive association between being overweight and having musculoskeletal pain in childhood.

Acute Musculoskeletal Complaints

Fifteen studies reported associations between weight status and acute musculoskeletal complaints.[10,12,17,22,25,27,31,35,36,38,42,45,48,50,52] Dichotomous data were available from eleven studies and the results were pooled (Figure 3a). There was a small significant positive association between being overweight and having acute MSC (RR: 1.08, 95%CI [1.03 to 1.14]). Statistically significant heterogeneity (I^2= 77%) was found.

A significant positive association was also found in the two studies that reported on the BMI and acute MSC, which are shown in Figure 3b, (WMD: 1.40, 95%CI [1.00 to 1.80]). Of the two studies that were not pooled, one reported no association between fractures and BMI (RR: 1.01, 95%CI [0.98 to 1.23])[31], while the other reported a positive association between weight and injuries (data not reported).[22]

Since nine studies reported the data separately for obese individuals, and seven reported the data for overweight individuals, these results were pooled. Being overweight was significantly positively associated with having acute MSC in childhood (RR: 1.06, 95%CI [1.02 to 1.11]) and being obese was significantly positively associated with having acute MSC in childhood (RR: 1.10, 95%CI [1.02 to 1.20]).

Since there were some methodological flaws (one study had a high risk of bias) and since the results were inconsistent (I^2= 77%), the quality of evidence was downgraded by two levels. There is therefore low quality of evidence for a small positive association between overweight and injuries and fractures in childhood.

Subgroup Analysis

As ten cross-sectional studies reported on LBP, subgroup analysis was done. Six of these studies reported dichotomous outcomes and were pooled (Figure 4). Overweight was associated with significantly higher rates of low back pain (RR: 1.42, 95%CI [1.03 to 1.97]). There was significant heterogeneity (I^2= 57%). The related funnel plot was skewed to the right, possibly due to publication bias. One of the four studies that reported on LBP but could not be pooled reported a significant association between BMI and LBP[13]; the other three did not.[33,49,51] Of these latter three studies one had a high risk of bias.

Since there was a potential publication bias and the results were inconsistent (I^2= 57%), the grade of evidence decreased two levels. There is therefore low quality of evidence for a significant positive association between being overweight and having LBP in childhood.

Table 3. Quality assessment scores of included studies. Scoring options included positive (1), negative (0), unclear (2) or not applicable (na).

Study	Study groups are clearly defined	Participation ≥ 70%	Number of cases ≥ 50	Overweight definition	Assessment of overweight	Blind for complaint status	Complaint definition	Assessment of complaint	Blind for weight status	Longitudinal design	Inclusion and exclusion criteria	Follow-up period ≥ 1 year	Information completers versus withdrawals	Data presentation	Consideration of confounders	Control for confounding	**Total percentage**
Cross-sectional studies																	
Adams 2012	0	1	1	1	1	2	1	1	2	0	1	na	na	1	1	1	**71,4**
Bazelmans 2004	1	1	1	1	1	2	1	1	2	0	0	na	na	1	1	1	**71,4**
Bell 2007	1	1	1	1	1	2	0	1	2	0	1	na	na	1	1	1	**71,4**
Bell 2011	1	0	1	1	1	2	0	1	2	0	1	na	na	0	0	0	**42,9**
Bout-Tabaku 2012	1	1	1	1	1	2	0	1	2	0	1	na	na	1	0	0	**57,1**
Dahlstrom 2012	0	0	1	1	1	0	1	1	2	0	1	na	na	0	0	0	**42,9**
De Sa Pinto 2006	1	1	0	1	1	2	1	1	2	0	1	na	na	1	0	0	**57,1**
Doan 2010	1	1	1	1	1	2	1	1	2	0	0	na	na	1	1	1	**71,4**
Flynn 2007	1	0	1	1	1	2	1	1	2	0	0	na	na	1	0	0	**50,0**
Goulding 2000	1	1	1	0	1	2	1	1	2	0	0	na	na	1	1	1	**71,4**
Harreby 1999	1	1	1	1	1	2	1	1	2	0	0	na	na	1	1	1	**71,4**
Hulsegge 2011	1	0	1	1	1	2	1	1	2	0	0	na	na	1	1	1	**64,3**
Jones 2004	1	1	1	1	1	2	1	1	2	0	0	na	na	1	1	1	**78,6**
Kaspiris 2009	1	1	1	0	1	2	1	1	2	0	1	na	na	0	0	0	**57,1**
Kaspiris 2010	1	1	1	1	1	0	1	1	0	0	0	na	na	1	0	0	**50,0**
Kirk 2012	0	1	1	1	1	2	1	1	2	0	0	na	na	1	1	1	**64,3**
Krul 2009	0	1	1	1	1	2	1	1	2	0	0	na	na	1	1	1	**64,3**
Lowry 2007	0	1	1	1	1	2	1	1	2	0	1	na	na	1	1	1	**71,4**
Lusky 1996	0	2	1	1	1	2	1	1	2	0	2	na	na	1	0	0	**42,9**
Manias 2006	1	1	1	1	1	2	1	1	2	0	0	na	na	1	1	1	**71,4**
Mohseni-Bandpei 2007	0	1	1	1	2	2	1	1	2	0	1	na	na	1	1	0	**57,1**
Onofrio 2012	1	1	1	0	0	2	1	1	2	0	1	na	na	1	1	1	**64,3**
Paananen 2010	1	1	1	1	1	2	1	1	0	0	1	na	na	1	1	1	**78,6**
Richmond 2012	1	1	1	1	1	0	1	0	2	0	1	na	na	1	1	1	**71,4**
Sjolie 2004	1	1	1	1	1	2	1	1	2	0	1	na	na	1	1	1	**78,6**
Stovitz 2008	1	2	1	1	1	2	1	1	2	0	1	na	na	1	1	1	**71,4**
Taylor 2006	1	2	1	1	1	2	1	1	1	0	2	na	na	1	0	0	**57,1**

Table 3. Quality assessment scores of included studies. Scoring options included positive (1), negative (0), unclear (2) or not applicable (na). (continued)

Study	Study groups are clearly defined	Participation ≥ 70%	Number of cases ≥ 50	Overweight definition	Assessment of overweight	Blind for complaint status	Complaint definition	Assessment of complaint	Blind for weight status	Longitudinal design	Inclusion and exclusion criteria	Follow-up period ≥ 1 year	Information completers versus withdrawals	Data presentation	Consideration of confounders	Control for confounding	**Total percentage**
Vahasarja 1995	0	1	1	1	1	0	1	1	0	0	0	na	na	1	0	0	**50,0**
Valerio 2012	1	1	1	1	1	2	1	0	2	0	1	na	na	1	1	1	**71,4**
Viry 1999	0	1	1	1	1	0	1	1	0	0	0	na	na	1	1	1	**64,3**
Wake 2008	1	1	1	1	1	2	1	1	2	0	1	na	na	1	1	1	**78,6**
Yao 2012	1	1	1	1	1	2	1	0	2	0	1	na	na	1	1	1	**71,4**
Zonfrillo 2008	1	0	1	1	1	2	1	1	2	0	1	na	na	1	1	1	**71,4**
Longitudinal studies																	
Barber-Foss 2012	1	1	0	1	1	1	0	1	2	1	1	1	0	0	0	0	**56,3**
Feldman 2002	1	0	1	1	1	2	1	1	2	1	0	1	1	1	1	1	**75,0**
Gomez 1998	0	1	1	1	1	2	0	1	2	1	0	0	1	0	0	0	**43,8**
Jones 2003	0	1	1	1	1	2	1	1	2	1	0	1	1	0	1	1	**68,8**
Kaplan 1995	1	1	0	1	1	2	1	1	1	1	0	0	0	1	0	0	**56,3**
Plisky 2007	1	1	0	1	1	1	1	1	2	1	1	0	1	1	1	1	**81,3**
Tyler 2006	0	2	0	1	0	1	1	1	2	1	1	1	0	1	0	0	**50,0**

Four cross-sectional studies on acute MSC reported fractures and seven reported injuries. Separate pooling showed that overweight is positively associated with fractures (RR 1.12, 95%CI [1,00 to 1,25]) and injuries (RR 1.07, 95%CI [1,00 to 1,14]).

No other subgroup analyses could be performed for different pain locations, age groups or gender differences, since not enough studies reported data for these groups separately.

Risk Factors

Although four longitudinal studies reported on musculoskeletal pain, not enough prospective data were reported for pooling. Nevertheless, all four studies report no association between BMI at baseline and pain at follow-up.[18,24,30,41]

Data from two prospective studies reporting football injuries were pooled for acute complaints. Overweight in the beginning of the season was significantly associated with a higher risk of injuries later in the season (RR: 2.41, 95%CI [1.42 to 4.10]). The funnel

plot did not include RR=1, possibly due to publication bias. The third study reported no significant differences in overall injury rates between different BMI groups. However, it does report that lower extremity injury rates were significantly higher in groups with a high BMI.

Since a study with high risk of bias was included, the number of participants was small (which led to uncertainties), and because there was a potential publication bias, the quality of evidence was downgraded by three levels. There is therefore very low quality of evidence of an increased risk of football injuries in young overweight people.

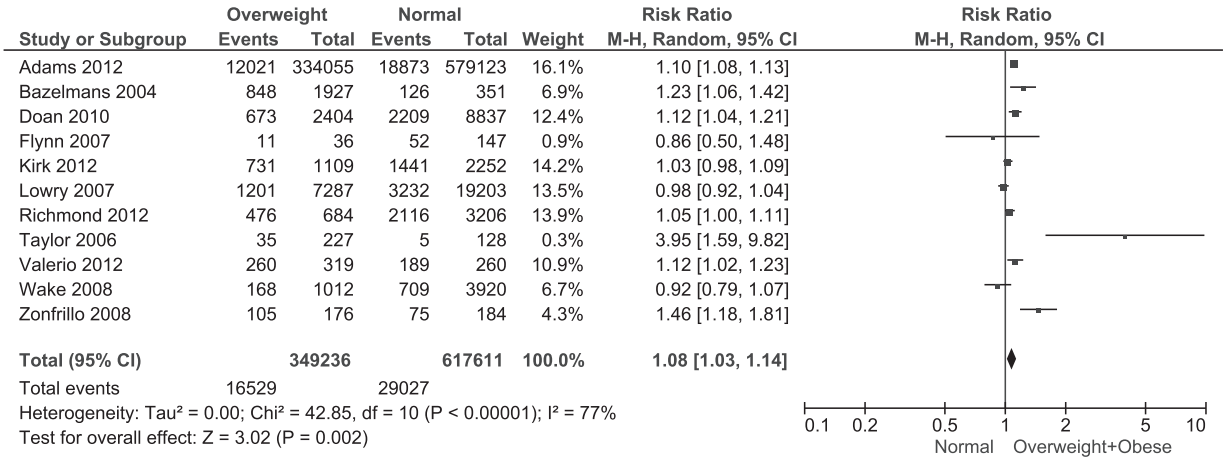

Figure 3a. Pooled results of the studies that reported the number of children with and without acute complaints (injuries and fractures) and their weight status; the prevalence of injuries and fractures is 8% higher in overweight children.

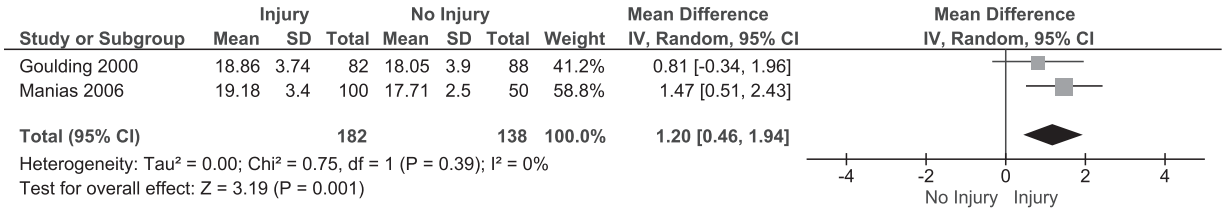

Figure 3b. Pooled results of the studies that reported the BMI of children with and without acute complaints (injuries and fractures); The mean BMI of children with injuries and fractures was 1.20 kg/m^2 higher.

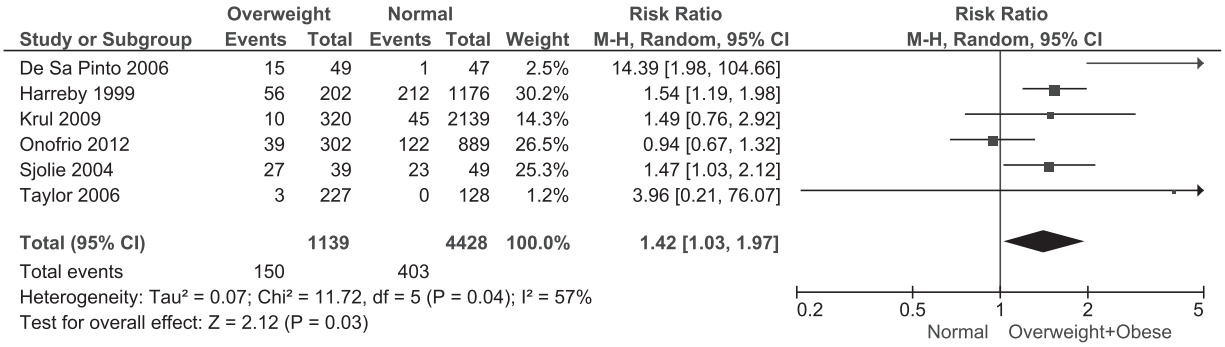

Figure 4. Pooled results of the studies that reported the number of children with and without LBP (Low Back Pain) and their weight status; the prevalence of LBP is 42% higher in overweight children.

DISCUSSION

This is the first systematic review that studied the relationship between overweight and various musculoskeletal complaints in children. It shows that there is moderate quality of evidence for a positive association between overweight in childhood and musculoskeletal pain. There is low-quality evidence for positive associations between overweight and low back pain and between overweight and injuries and fractures. Finally, there is very low quality of evidence to suggest that the risk of developing injuries during a football season is significantly higher for young people who are overweight.

We found an association between overweight and MSP of RR 1.26; this implies that the prevalence of MSP is 26% higher in overweight children than in normal weight children. For low back pain, the prevalence was 42% higher in overweight children. As Mikkelsson et al. found that 32% of all schoolchildren report to have MSP at least once a week[55], MSP is a frequent complaint in children in general. Our review suggests that this is even more the case in overweight children.

As well as this association with musculoskeletal pain, we also found a small association between overweight and acute complaints such as injuries and fractures. As already shown for asthma[56] and cardiovascular disease risk[4], excessive weight is also associated with various MSC as early as childhood.

Because most of the studies included are cross-sectional, and because the only prospective data that could be pooled focused on football players, no statements can be made about the causal links between overweight and MSC in childhood. The literature suggests that various mechanisms underlie the relationship between overweight and the various complaints. For example, reduced physical activity, disturbed sleep, psychological factors and dysfunctional hormone regulation are all suggested to play roles in the association of pain with overweight.[57] Other explanations are suggested for acute complaints like injuries and fractures. A previous study reports that obesity is associated with clumsiness[58], which might lead to injuries. Similarly, low bone-mineral density is associated with high fat mass and a higher risk of fractures.[59] However, there is no good evidence that the suggested mechanisms do indeed cause the various MSC in children with excessive weight. Better prospective studies are needed to study the nature of this relationship.

The link between overweight and MSC might induce a vicious circle in which being overweight, musculoskeletal problems, and low fitness level reinforce each other. The literature shows that weight reduction in adults reduces MSC.[60] Although it is unclear whether the same is true for children, the importance of effective weight-loss interventions for overweight children is evident if one wants to break this vicious circle. Previous literature shows that low physical activity levels at baseline increase one's risk of injury from physical activity[61], and even though the evidence is of very low quality our review

shows a higher risk of injuries in overweight children. As when offering physical activity training, weight-loss interventions should therefore keep injury prevention in mind.

Strengths and Limitations

This is the first systematic review that studied the associations between overweight and MSC in children. It involved extensive literature search, and data extraction and risk-of-bias assessment were done by two independent reviewers. Because the authors of original papers were contacted for raw data, data could be pooled for various subgroups.

Different studies used different outcomes for weight. Because continuous variable BMI was included as well as dichotomous outcomes for weight, the true nature of exposure and outcome could be studied.[62] An even better variable would be BMI-z, as BMI cut-offs for overweight in children are age and gender specific. However, only two studies reported on this variable.[18,29] When studying the association for obese and overweight individuals separately, we also studied a dose-response effect. No evidence for a dose-response effect was found; although the pooled risk ratio for an association with acute MSC for obese individuals was slightly higher than for overweight individuals, the association was already apparent in overweight individuals.

Statistical heterogeneity was found in most pooled analyses and is probably explained largely by clinical and methodological differences between studies; statistical heterogeneity was 93% for MSP in general, but decreased to 57% for LBP. The latter might be explained by the different settings in which patients were recruited and the different definitions used for LBP. To correct for statistical heterogeneity, a random effects model was used in all analyses. Besides, to grade the evidence, the quality was reduced by one level to interpret the findings with caution.

While most studies included in the present review scored a low risk of bias, the score was very low in only one study (above 80%)[41]. There is therefore a risk that the results of all studies are biased. Sixteen of the 40 authors were contacted because their original studies presented insufficient data; only five provided the data needed. Therefore this review included studies from which data could not be used in pooling, with a low risk-of-bias score, and from which it is unclear whether the person who measured weight status was unaware if the individual did have any musculoskeletal complaints. One can argue whether the risk-of-bias assessment method was sufficient to study risk of bias in the present review.

Most of the studies included reported on possible confounders such as gender. Studies that corrected for these confounders found that this correction influenced the strength of the association, but not the direction. In the present study, data were not corrected for confounders; since few studies reported the data separately for boys and girls, no subgroup analysis was done. Future studies should focus on investigating the relationship between overweight and MSC in specific subgroups.

One must be aware of publication bias, especially in articles studying associations. Nevertheless, since we have included articles in which BMI was one of the many factors studied for MSC, we also included no associations or negative associations. The funnel plots for cross-sectional studies of MSP and acute complaints show no indication of publication bias.

Implications

The relationship between overweight and MSC in children might induce a vicious circle in which overweight, musculoskeletal complaints, and low fitness level reinforce each other. These results underline the importance of preventing overweight. If overweight does occur, effective weight loss interventions are needed that take pain and injury prevention into account.

Conclusion

Overweight and obesity are related with various MSC as early as childhood. More high quality prospective cohort studies are needed to study the nature of this relationship and if this relationship is more apparent in specific subgroups.

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APPENDIX A1 SEARCH STRING FOR MEDLINE, EMBASE, WEB OF SCIENCE AND COCHRANE

Medline

(child[tw] OR children[tw] OR teen*[tw] OR toddler*[tw] OR preschool*[tw] OR infant*[tw] OR childhood[tw] OR juvenile[tw] OR ((adolescen*[tw]) NOT adult[mesh]) OR pediatric*[tw] OR paediatric*[tw])
AND
(Overweight[tw] OR Obes*[tw] OR weight gain*[tw] OR increased weight*[tw] OR increased bmi[tw] OR high bmi[tw] OR higher bmi[tw])
AND
(Musculoskeletal Diseases/etiology[Mesh] OR Musculoskeletal Diseases/epidemiology[Mesh] OR Musculoskeletal Pain[Mesh] OR Musculoskeletal Pain*[tw] OR"low back pain" [tw] OR orthopaedic[tw] OR orthopedic[tw] OR injur*[tw] OR biomechanic*[tw] OR ((pain[tw] OR lesion*[tw] OR trauma*[tw] OR fracture*[tw]) AND (bone*[tw] OR foot [tw] OR feet [tw] OR ankle*[tw] OR knee*[tw] OR hip[tw] OR hips[tw] OR joint*[tw])))
NOT (animals[mesh] NOT humans[mesh])
NOT (editorial[pt] OR letter[pt] OR case reports[pt])

Embase

((child OR children OR teen* OR toddler* OR preschool* OR infant* OR childhood OR juvenile OR pediatric* OR paediatric*):de,ab,ti OR ((adolescen*):de,ab,ti NOT [adult]/lim)) AND (Overweight*:de,ab,ti OR Obes*:de,ab,ti OR ((gain OR increase* OR high OR higher) NEAR/3 ('body mass index' OR bmi OR weight*)):de,ab,ti) AND ('Musculoskeletal Disease'/exp/dm_ep,dm_et OR ((Musculoskeletal NEXT/1 Pain*) OR (Low NEXT/1 Back) OR orthopaedic OR arthropath* OR orthopedic OR injur* OR biomechanic*):de,ab,ti OR ((pain OR lesion* OR trauma* OR fracture*) NEAR/5 (bone* OR foot OR feet OR ankle* OR knee* OR hip OR hips OR joint*)):de,ab,ti) NOT ([animals]/lim NOT [humans]/lim) NOT ([editorial]/lim OR [letter]/lim OR 'case report':ti)

Web of Science and Cochrane

(child OR children OR teen* OR toddler* OR preschool* OR infant* OR childhood OR juvenile OR ((adolescen*) NOT adult) OR pediatric* OR paediatric*) AND (Overweight OR Obes* OR ((gain OR increase* OR high OR higher) AND ('body mass index' OR bmi OR weight*))) AND (Musculoskeletal Diseases OR Musculoskeletal Pain OR Musculoskeletal Pain* OR 'low back pain' OR orthopaedic OR orthopaedic OR biomechanic* OR ((injur* OR pain OR lesion* OR trauma* OR fracture*) AND (bone* OR foot OR feet OR ankle* OR knee* OR hip OR hips OR joint*))) NOT (animals NOT humans) AND (letter* OR editorial* OR case report*)

PART II

Awareness

Chapter 6

Difference between parental perception and actual weight status of children: a systematic review

M Rietmeijer-Mentink, WD Paulis, M van Middelkoop, PJE Bindels & JC van der Wouden

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ABSTRACT

An increasing number of children worldwide are overweight, and the first step in treating obesity is to identify overweight. However, do parents recognise overweight in their child and which factors influence parental perception? The aim of the present review is to systematically study differences between parental perception and the actual weight status of children.

Medline, EMbase, CINAHL and PsychINFO were searched. After screening 2497 abstracts and 106 full texts, two reviewers independently scored the methodological quality of 51 articles (covering 35 103 children), which fulfilled the inclusion criteria. The primary outcome parameters were sensitivity and specificity of parental perception for actual weight status of their child.

The methodological quality of the studies ranged from poor to excellent. Pooled results showed that according to objective criteria 11 530 children were overweight; of these 7191 (62.4%) were incorrectly perceived as having normal weight by their parents. The misperception of overweight children is higher in parents with children aged 2-6 years compared to parents of older children.

Sensitivity (correct perception of overweight) of the studies ranged from 0.04-0.89, whilst specificity (correct perception of normal weight) ranged from 0.86-1.00. There were no significant differences in sensitivity or specificity for different cut-off points for overweight, or between newer and older studies.

Therefore, we can conclude that parents are likely to misperceive the weight status of their overweight child, especially in children aged 2-6 years. Since appropriate treatment starts with the correct perception of overweight, healthcare professionals should be aware of the frequent parental misperception of the overweight status of their children.

Key messages

- 63.4% of the parents of overweight children fail to recognise overweight of their child.
- 86% of the parents of children aged 2-6 years fail to recognise overweight of their child.
- Although different studies used different cut-off points for the definition of overweight, the misperception of overweight seems to be universal.
- There are no significant differences in sensitivity of parental perception between the studies included in earlier reviews and the more recent studies.
- Health care professionals should be aware of the frequent parental misperception of the overweight status of their children.

INTRODUCTION

Worldwide an increasing number of children are overweight.[1] For example, in preschool children the worldwide prevalence of overweight increased from 4.2% in 1990 to 6.7% in 2010.[2]

Obesity in adults is related to metabolic disorders such as impaired glucose tolerance, diabetes, dyslipidemia, cardiovascular diseases and certain types of cancer.[3,4] Overweight and obesity in childhood can lead to diabetes and cardiovascular diseases at a younger age.[4-6] Overweight that begins before 8 years of age and persists into adulthood is associated with a mean body mass index (BMI) of 41 in adulthood, as compared with 35 for adult-onset obesity.[7,8] Therefore, the high proportion of overweight in children is alarming.

Although prevention of childhood overweight is the most desirable scenario[4], because prevention of childhood obesity has not yet been very successful[9], the treatment of obesity remains an important item. The first step in treating obesity is to identify overweight.[10,11] This applies to healthcare professionals and to parents, who often initiate treatment. Parents' concerns about their child's health depend on their awareness of their child's overweight and, consequently, whether they are willing to take action against overweight.[12-14] Therefore, the perception of overweight of parents is an important initial step. However, previous reviews show that ≥ 50% of parents fail to accurately perceive the overweight of their child.[15-17] These reviews included studies published up to August 2007. Since then, in the wake of considerable focus on the prevention and treatment of overweight in children, it is unclear whether there has been an improvement in parental perception.

However, because studies often use different BMI cut-off criteria to define overweight, this can influence the data and might contribute to the parental misperception that was that is found in other studies. Also, societal factors (e.g. child's age and gender of parent that filled out questionnaires) might influence parents' perception of overweight. It is therefore important to study factors that might influence differences between parental perception and actual weight status of children. This might reveal possible subgroups that need more attention by health care professionals to help them become aware about their child's weight status. Therefore, this systematic review investigates differences between parental perception and the actual weight status of children and explores possible determinants for these differences.

MATERIAL AND METHODS

Study selection

The inclusion criteria for this review were the study investigated the perception of parents/caregivers, the children were aged 2-18 years, and the outcome was the difference between measured weight status (classified by BMI) and weight status as observed by parents on the child level. Exclusion criteria were Diagnostic and Statistical Manual of Mental Disorders (DSM) classified eating disorders, medical conditions affecting the weight (e.g. Down syndrome, Prader Willi syndrome), and qualitative studies.

Data sources and search strategy

The PubMed, EMbase, CINAHL and PsychINFO databases were searched up to January 2011. Search terms were combined into four groups: child, body weight, parent, and perception. Articles identified by the search strategy contained at least one term from each group. The search terms were adapted to the different databases to facilitate a comprehensive search (for details on search strings, see Appendix A). In addition, the reference lists of the retrieved articles were reviewed for promising titles, in order to recover articles not included in the major databases. There were no restrictions regarding date of publication (prior to January 2011) or language. Two reviewers (MR, WP) independently selected citations based on titles and abstracts, or on retrieved articles. Full articles were obtained for those citations thought to fulfill the inclusion criteria. Eligibility was independently assessed by the same two reviewers. Any discrepancies were resolved through discussion.

Quality assessment

Since there was no existing quality assessment tool for the observational and cross-sectional studies, a quality assessment tool for diagnostic studies based on the Cochrane criteria[18] was selected and adapted for our purpose (Table 1). The methodological quality of articles using a verbal description of the perception of the weight status was based on six items and categorized into poor quality (0-2 items scored positive), moderate quality (3-4 items positive), good quality (5 items positive), and excellent quality (6 items positive). The quality of articles using image scales was based on seven items (good quality = 5-6 items positive; excellent quality = 7 items positive).

Data extraction

Study characteristics were extracted by the same two reviewers and included country; setting; number of children included; male to female ratio; age of children; type of caregiver (mother, father, other) who provided the data; and details on which classification for overweight was used (Table 2).

Table 1. Results of the quality assessment.

	Selection bias		Blinding	Method and data collection			Non-responders
	Inclusion did not take place based on weight	Characteristics were described, representative sample	Parent did not know weight status before answering	Type of equipment mentioned, all children same equipment	In case of image scale a validated scale was used	Description of weight status classification was mentioned	Non-responders were mentioned
Verbal description							
Abbot et al. 2010	+	+	+	+	n.a.	+	+
Al-Quaoud et al. 2010	–	–	–	+	n.a.	+	+
Anderson et al. 2006	+	+	+	_	n.a.	+	+
Baughcum et al. 2000	+	?	?	+	n.a.	+	+
BoaSorte et al. 2007	+	+	+	+	n.a.	+	+
Boutelle et al. 2004	+	+	?	–	n.a.	+	+
Bracho et al. 2007	+	+	?	?	n.a.	+	+
Carnell et al. 2005	+	?	?	–	n.a.	+	+
Crawford et al. 2005	+	+	?	–	n.a.	+	+
DeLa et al. 2009	+	+	?	+	n.a.	+	+
Eckstein et al. 2006	+	+	?	–	–	+	+
Flowers et al. 2008	+	?	?	–	n.a.	+	+
Garret et al. 2008	+	+	?	–	n.a.	+	+
Goodman et al. 2000	+	?	?	–	n.a.	+	+
Gray et al. 2007	+	–	?	+	n.a.	+	+
Hackie et al. 2007	–	–	?	–	n.a.	+	+
Harnack et al. 2009	+	+	?	+	n.a.	+	+
Hearst et al. 2011	+	+	?	+	n.a.	+	+
Hernandez et al. 2010	+	+	?	–	–	+	+
Hirschler et al. 2006	+	+	?	–	n.a.	+	+
Hirschler et al. 2008	+	+	?	–	n.a.	+	+
Huang et al. 2007	+	+	?	–	n.a	+	+
Hudson et al. 2009	+	+	?	+	n.a.	+	+
Jackson et al. 1990	+	+	+	+	n.a.	+	+
Jansen et al. 2006	+	+	?	+	n.a.	+	+
Jeffery et al. 2005	+	+	+	–	n.a.	+	+
Juliusson et al. 2011	+	+	?	+	n.a.	+	+
Kasemsup et al. 2006	+	?	?	–	n.a.	+	+

Table 1. Results of the quality assessment. (continued)

	Selection bias		Blinding	Method and data collection			Non-responders
	Inclusion did not take place based on weight	Characteristics were described, representative sample	Parent did not know weight status before answering	Type of equipment mentioned, all children same equipment	In case of image scale a validated scale was used	Description of weight status classification was mentioned	Non-responders were mentioned
Kroke et al. 2006	+	+	?	–	n.a.	+	+
Lampard et al. 2008	–	–	–	+	n.a.	+	+
Lazzeri et al. 2006	+	+	?	–	n.a.	+	+
Mamum et al. 2008	+	+	?	–	n.a.	+	+
Manios et al. 2009	+	+	?	+	n.a.	+	+
Mathieu et al. 2010	+	+	?	–	n.a.	+	+
May et al. 2007	+	+	?	?	n.a.	+	+
Maynard et al. 2003	+	+	?	–	n.a.	+	+
Molina et al. 2009	+	+	?	–	n.a.	+	+
Myers et al. 2000	–	–	?	–	n.a.	+	+
Neumark et al. 2008	–	–	?	–	n.a.	+	+
Perrin et al. 2010	+	+	?	+	n.a.	+	+
Rudolph et al. 2010	–	–	–	–	n.a.	+	?
Skelton et al. 2006	+	?	?	–	n.a.	+	?
Tschamler et al. 2010	+	+	?	–	n.a.	+	+
Valdes et al. 2009	+	+	?	–	n.a.	+	+
Vuorela et al. 2010	+	+	?	–	n.a.	+	+
Wald et al. 2007	+	+	?	–	n.a.	+	?
Young et al. 2000	–	–	?	–	n.a.	+	+
Ratio +/-/? (%)	85/15/0	70/17/13	11/6/83	32/64/4	n.a.	100/0/0	94/0/6
Image scales							
Beatty et al. 2009	+	+	?	–	?	–	+
Eckstein et al. 2006	+	+	?	–	–	+	+
Hernandez et al. 2010	+	+	?	–	–	+	+
Reifsnider et al. 2006	+	+	+	+	–	+	+
Warschburger et al. 2009	–	–	?	+	+	+	–
Zonana et al. 2010	+	+	+	–	–	+	+
ratio +/-/? (%)	87/13/0	87/13/0	25/0/75	38/62/0	25/62/13	87/13/0	87/13/0

+ = yes; - = no; ? = unclear; n.a.= not applicable

Data extracted included: true positives (actual overweight, perceived overweight); false positives (actual normal weight, perceived overweight); true negatives (actual normal weight, perceived normal weight); and false negatives (actual overweight, perceived normal weight). In some studies not all participants were suitable for analyses. For example, at two different moments (T1 and T2) parents were asked to give their perception about their child's weight status, but only at T2 were the child's weight and height measured. In this case, only data of T2 were extracted. In most studies (*n*=47), parents were asked to choose the best verbal description for their child's weight status (e.g underweight, normal weight, overweight). In some studies (*n*=6), from a series of images, parents had to choose the one that best represented their child.

Authors were contacted when insufficient data were provided.

Definition of overweight

A variety of definitions are applied to identify overweight in children (Table 2; Appendix B). The cut-off points for BMI used to classify overweight by the International Obesity Task Force (IOTF) are adopted from Cole et al.[19] These centile curves for children and adolescents aged 2-17 years are similar to the widely used cut-off points of a BMI of 25 kg/m^2 (overweight) and 30 kg/m^2 (obesity) for adults from age 18 years onwards.

The cut-off points which the World Health Organisation (WHO) applies are BMI >85% on their centiles for overweight and BMI >95% for obesity. On their centiles, until 2010 the Centre for Disease Control and Prevention (CDC) defined BMI >85% as at risk of overweight and BMI >95% as overweight. After 2010 they changed the definition to BMI >85% as overweight and BMI >95% as obesity.[20] From studies that referred to CDC centiles measured BMI >85% are included as actual overweight. When articles used definitions other than those described above, this is indicated in the tables.

Definition of sensitivity and specificity

Sensitivity was defined as the correct perception of overweight (true positives/all overweight children). Specificity was defined as correct perception of normal weight (true negatives/ all normal weight children).

Subgroup analyses

Three subgroup analyses were defined to further explore differences in perception and actual weight status. The first analysis compared studies that included only young children (≤ 6 years) versus studies that included older children, or a broader age range. The second subgroup analysis compared studies with different cut-off points used for the definition of overweight (IOTF, WHO BMI >85% and CDC BMI >85%). The third subgroup analysis compared relatively older studies (included in the reviews published up to 2007) with more recent studies.

Table 2. Characteristics of the included studies.

Author, year of publication	Country	Setting	No. of participants suitable for this analysis (n)	Male (%)	Range of age, or mean (years)	Caregiver	Definition of weight status
Verbal description[a]							
Abbot et al. 2010[d]	Australia	school[i]	2148	49	5-12	n.a.	IOTF Cole[19]
AlQuaoud et al. 2010[c]	Kuwait	sample Kuwait Nutrition Surveillance System study	482	45	3-6	mother	WHO[l]
Anderson et al. 2006[c]	USA	sample Head Start program	82	45	3-5	55% female, 45% male	CDC[m]
Baughcum et al. 2000[d]	USA	health care facility[j]	304	n.a.	2-5	mother	BMI >90th overweight
BoaSorte et al. 2007[d]	Brazil	school	827	46	6-19	mother	CDC
Boutelle et al. 2004[d]	USA	school	742	53	mean 14.6	91% mother	CDC
Bracho et al. 2007[d]	Chili	school + health care facility	270	51	2-6	mother	WHO
Carnell et al. 2005[e]	UK	school	564	n.a.	3-5	94.5% mother; 5.5% other	IOTF Cole
Crawford et al. 2005[c]	Australia	school	1116	48[k]	5-6 and 10-12	84.4% female, 15.6% male	IOTF Cole
DeLa et al. 2009[f]	USA	school	576	49	5-12	n.a.	WHO
Eckstein et al. 2006[d]	USA	health care facility	223	42	2-17	n.a.	CDC
Flowers et al. 2008[e]	USA	health care facility	57	49	8-12	n.a.	WHO
Garret et al. 2008[d]	USA	health care facility	120	53	2-5	92% mothers, 8% fathers	BMI >95th overweight
Goodman et al. 2000[c]	USA	sample National Longiitudinal Study of Adolescent Health	564	51	teens	n.a.	BMI >95th obese
Gray et al. 2007[e]	USA	school	169	n.a	second-grade students	90% mothers, 6.5% father, 2.5% grandmother, 1% other	CDC
Hackie et al. 2007[c]	USA	health care facility	38	53	2-5	mother	BMI >95th overweight
Harnack et al. 2009[f]	USA	school	593	54	2-5	90.5% mother, 9,5% father	CDC
Hearst et al. 2011[c]	USA	sample Etiology Childhood Obesity study	358	48	mean 14	80% female	WHO

Table 2. Characteristics of the included studies. (continued)

Author, year of publication	Country	Setting	No. of participants suitable for this analysis (n)	Male (%)	Range of age, or mean (years)	Caregiver	Definition of weight status
Hernandez et al. 2010[d]	USA	health care facility	49	57[k]	2-5	n.a.	WHO
Hirschler et al. 2006[c]	Argentina	school	321	50	2-6	mother	CDC
Hirschler et al. 2008[e]	Argentina	school	620	48	5-13	mother	WHO
Huang et al. 2007[c]	USA	health care facility	429	45[k]	0-18	87% female, 13% male	CDC
Hudson et al. 2009[e]	USA	sample Head Start program	96	45	3-5	75% mother, 25% father or mother	CDC
Jackson et al. 1990[d]	USA	school	107	51	3-6	mother	BMI >90th overweight
Jansen et al. 2006[c]	The Netherlands	sample Rotterdam Youth Health Monitor study	524	50	9-11	75% mothers, 15% fathers, 10% other	IOTF Cole
Jeffery et al. 2005[c]	UK	sample Early Bird Study	272	56	mean 7.4	can be mother or father	BMI >91th overweight, BMI >98th obese
Juliusson et al. 2011[g]	Norway	Sample Bergen Growth study	3770	51	2-19	n.a.	IOTF Cole
Kasemsup et al. 2006[c]	USA	school	80	n.a.	3-5	mother	BMI >95th overweight
Kroke et al. 2006[c]	Germany	sample Dortmund Nutritional and Anthropometric Longitudinally Designed study	253	49	6 months to 4 years	mother	CDC
Lampard et al. 2008[e]	Australia	health care facility + school	329	n.a.	6-13	n.a.	IOTF Cole
Lazzeri et al. 2006[c]	Italy	school	2835	51[k]	8-9	mother	IOTF Cole
Mamum et al. 2008[d]	Australia	sample Mater-University Study of Pregnancy	2650	52	14	mother	IOTF Cole
Manios et al. 2009[f]	Greece	sample Growth, Exercise and Nutrition Epidemiological Study in preSchoolers	1759	54	2-5	mother	CDC
Mathieu et al. 2010[d]	Canada	birth cohort follow-up	1128	48	mean 6.2	can be mother or father	WHO

Table 2. Characteristics of the included studies. (continued)

Author, year of publication	Country	Setting	No. of participants suitable for this analysis (n)	Male (%)	Range of age, or mean (years)	Caregiver	Definition of weight status
May et al. 2007[c]	USA	previous research	228	49[k]	2-5	mother	CDC
Maynard et al. 2003[d]	USA	sample Third National Health and Nutrition Examination Survey	5500	50	2-11	mother	CDC
Molina et al. 2009[f]	Brazil	school	1272	42	7-10	mother	Must et al. 23,24
Myers et al. 2000[c]	USA	health care facility	200	n.a.	2-5	can be mother or father	BMI >90th overweight
Neumark et al. 2008[b]	USA	school + sample Project EAT study	307	48	mean 14.4	92% mother	WHO
Perrin et al. 2010[c]	USA	health care facility	96	50[k]	4-12	92.2% female	WHO
Rudolph et al. 2010[c]	Germany	health care facility	150	54[k]	7-17	can be mother or father	WHO
Skelton et al. 2006[c]	USA	fair	37	n.a.	4-20	can be mother or father	CDC
Tschamler et al. 2010[c]	USA	health care facility	193	50	1-9	89% mother, 11% father	CDC
Valdes et al. 2009[c]	USA	health care facility	141	50[k]	2-18	can be mother or father	BMI >75th (at risk for) overweight, BMI >95th obese
Vuorela et al. 2010[c]	Finland	school	606	50	5 and 11	can be mother or father	IOTF Cole
Wald et al. 2007[c]	USA	health care facility	612	55	3-12	can be mother or father	CDC
Young et al. 2000[c]	USA	health care facility	111	43	5-11	n.a.	BMI >95th overweight
Image scales[h]							
Beatty et al. 2009[f]	USA	health care facility	130	45	8-11	mother	unknown
Eckstein et al. 2006[d,e]	USA	health care facility	223	42	3-17	78% mother	CDC
Hernandez et al. 2010[d]	USA	health care facility	150	57	2-5	n.a.	WHO
Reifsnider et al. 2006[c]	USA	health care facility	25	64	3	mother	WHO
Warschburger et al. 2009	Germany	health care facility + child care	141	58[k]	3-6	mother	IOTF Cole

Table 2. Characteristics of the included studies. (continued)

Author, year of publication	Country	Setting	No. of participants suitable for this analysis (n)	Male (%)	Range of age, or mean (years)	Caregiver	Definition of weight status
Zonana et al. 2010	Mexico	health care facility	525	48	2-13	mother	WHO

[a] Parents were asked to describe their child with words like 'very underweight, underweight, about right, overweight, very overweight'.
[b] Did parents recognise overweight?
[c] Did parents recognise normal weight and overweight?
[d] Did parents recognise underweight, normal weight and overweight?
[e] Did parents recognise normal weight, a little overweight and very overweight?
[f] Did parents recognise underweight, normal weight, a little overweight and very overweight?
[g] Did parents recognise very underweight, a little underweight, normal weight, a little overweight and very overweight?
[h] Parents were asked to compare their child with different images and say which most resembles their child.
[i] Selection of participants took place at school
[j] Selection of participants took place at well child visits or outpatient clinics
[k] percentage male in original sample
[l] weight status by WHO: BMI >85th overweight, BMI >95th obese
[m] weight status by CDC: >85th overweight, BMI >95th obese
n.a. = not available

Statistical analysis

For studies using verbal descriptions for recognition of both normal weight and overweight, plots for sensitivity and specificity (including 95% confidence intervals and a summary ROC curve) were constructed using RevMan software version 5.1, (Rigshospitalet, Copenhagen, Denmark).[21] Sensitivity plots were constructed for all studies addressing recognition of overweight. For subgroup analyses, sensitivity and specificity of the different studies were pooled using STATA 12 (StataCorp, Texas, USA) weighing for study size.

RESULTS

Study selection and characteristics

The electronic search resulted in 2497 hits. Screening the titles and abstracts resulted in 106 articles for which the full text was assessed. Finally, 51 articles were included in this systematic review (Figure 1).[22-72] These 51 studies were conducted in 18 different countries (Table 2). In two studies parents had to give both a verbal description of their child's actual weight status and choose the image that best represented their child[33,41]; therefore, these two articles are reported twice in the study characteristics and results.

Studies were published between 1990 and 2011. In total, the studies included over 35 000 child-parent couples; of these, by far the most were child-mother couples. The age of the children ranged from 2-18 years, with the largest group aged 2-6 years. Most families were recruited from schools or health care facilities.

Methodological quality

Studies using verbal descriptions had poor (6 articles), moderate (30 articles), good (8 articles) or excellent (3 articles) methodological quality. The quality of studies using image scales ranged from moderate (4 articles) to good (2 articles) (Table 1).

Combining all types of studies showed that it was unclear in most studies whether parents were unaware of the results of the weight measurement of their children before answering the question (this item scored unclear in 81% of the studies). The classification used for weight status and the number of non-responders were mentioned in most articles. The item that was not mentioned in most articles was related to which equipment was used and whether that same equipment was used for all children (64% unknown).

Perception of weight status

Of the 35 103 children enrolled (i.e. the total number of children in studies using verbal descriptions and image scales), according to objective criteria 11 530 were overweight

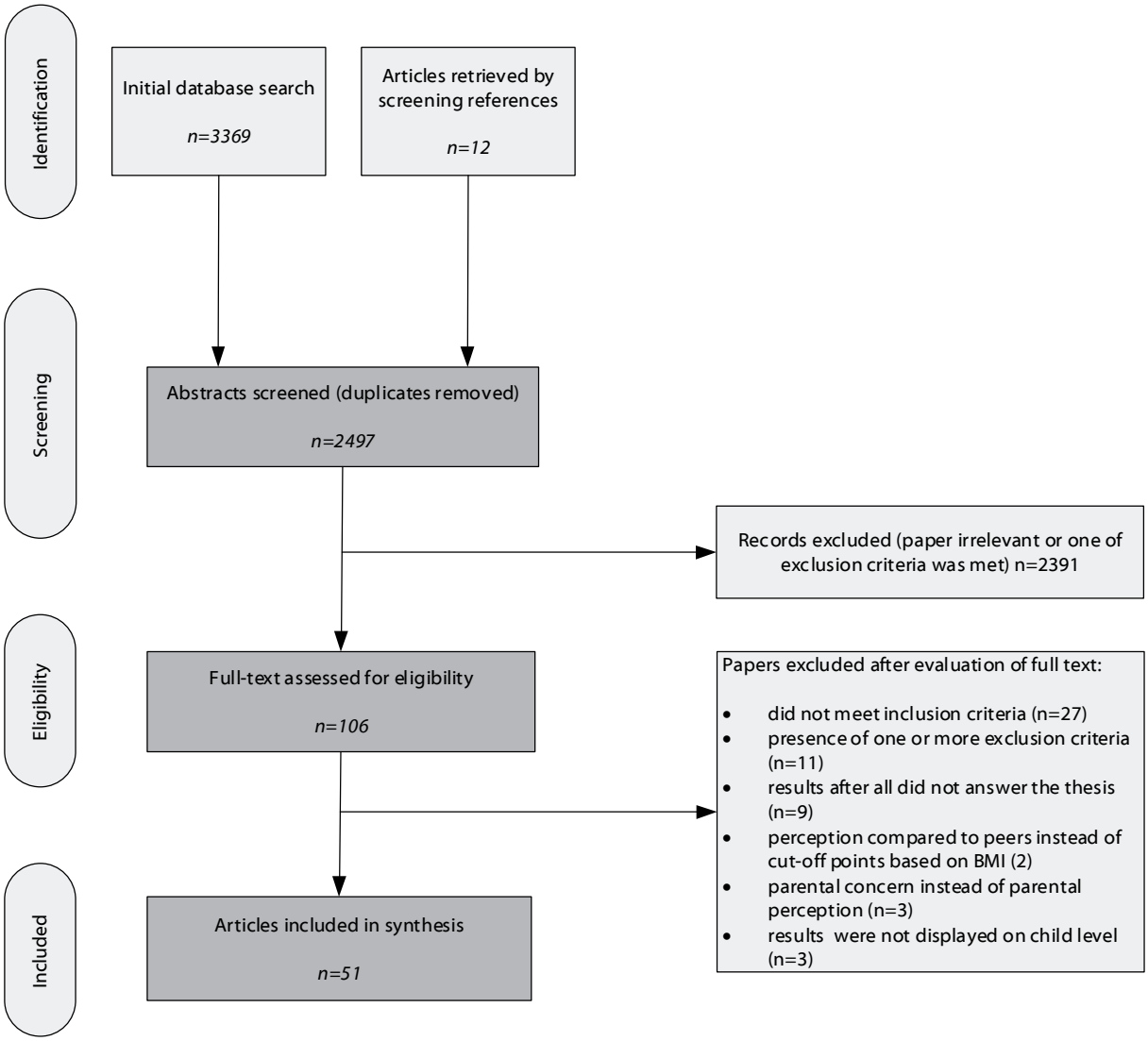

Figure 1. Flowchart of the screening and selection process of the study articles.

(32.9%). Of these overweight children, 4339 (37.6%) were correctly perceived as overweight by their parents, and the remaining 7191 (62.4%) were incorrectly perceived as normal weight. According to objective criteria 23 573 (67.1%) children had a normal weight. For 21 410 of these children information was available on the percentage perceived to be correct or incorrect: Of these normal weight children, 664 (3.1%) were incorrectly perceived as overweight by their parents.

The six studies using image scales enrolled 1195 children. According to objective criteria, 392 of them were overweight (32.8%). Of these 392 overweight children, 52.3% were indeed perceived as overweight by their parents and 47.7% were incorrectly perceived as normal weight by their parents. According to objective criteria, 803 (67.2%) children had a normal weight. Parental perception was recorded for 688 of them, and 40 (5.8%) of these children were incorrectly perceived as overweight.

A total of 32 studies using verbal descriptions quantitatively reported on both overweight and normal weight perception. Figure 2 shows a forest plot of these studies

reporting the percentages of parents who correctly assigned the overweight or normal weight status to their children. Specificity (correct perception of normal weight) ranged from 0.86-1.00. Figure 3 shows the ROC curves of these 32 studies.

In total, 15 studies using verbal descriptions quantitatively reported on perception of only overweight children. Therefore, sensitivity (correct perception of overweight) was calculated for 47 (32 + 15) studies and ranged from 0.04 to 0.89. Figure 4 shows a forest plot of these studies. Again, it is shown that about 37% of the overweight children were perceived correctly by their parents.

Study	TP	FP	FN	TN	Cut-off	Sensitivity (95% CI)	Specificity (95% CI)
Bracho 2007 (31)	28	4	89	149	BMI>85%	0.24 [0.17, 0.33]	0.97 [0.93, 0.99]
DeLa 2009 (34)	41	5	50	481	BMI>85%	0.45 [0.35, 0.56]	0.99 [0.98, 1.00]
Flowers 2008 (35)	17	2	10	28	BMI>85%	0.63 [0.42, 0.81]	0.93 [0.78, 0.99]
Hearst 2011 (41)	51	0	65	242	BMI>85%	0.44 [0.35, 0.53]	1.00 [0.98, 1.00]
Hirschler 2008 (43)	97	9	106	409	BMI>85%	0.48 [0.41, 0.55]	0.98 [0.96, 0.99]
Mathieu 2010 (56)	46	135	156	791	BMI>85%	0.23 [0.17, 0.29]	0.85 [0.83, 0.88]
Molina 2009 (59)	149	16	148	959	BMI>85%	0.50 [0.44, 0.56]	0.98 [0.97, 0.99]
Perrin 2010 (62)	25	0	20	51	BMI>85%	0.56 [0.40, 0.70]	1.00 [0.93, 1.00]
Rudolph 2010 (63)	48	7	6	88	BMI>85%	0.89 [0.77, 0.96]	0.93 [0.85, 0.97]
Baughcum 2000 (28)	21	3	78	202	BMI>90%	0.21 [0.14, 0.31]	0.99 [0.96, 1.00]
Jackson 1990 (46)	1	0	16	90	BMI>90%	0.06 [0.00, 0.29]	1.00 [0.96, 1.00]
Jeffery 2005 (48)	25	31	27	189	BMI>91%	0.48 [0.34, 0.62]	0.86 [0.81, 0.90]
BoaSorte 2007 (29)	83	41	69	634	CDC BMI>95%	0.55 [0.46, 0.63]	0.94 [0.92, 0.96]
Boutelle 2004 (30)	61	30	209	442	CDC BMI>95%	0.23 [0.18, 0.28]	0.94 [0.91, 0.96]
Eckstein 2006 (21)	32	3	56	132	CDC BMI>95%	0.36 [0.26, 0.47]	0.98 [0.94, 1.00]
Garret 2008 (36)	6	1	40	73	CDC BMI>95%	0.13 [0.05, 0.26]	0.99 [0.93, 1.00]
Harnack 2009 (40)	9	1	217	366	CDC BMI>95%	0.04 [0.02, 0.07]	1.00 [0.98, 1.00]
Hudson 2009 (45)	11	2	22	61	CDC BMI>95%	0.33 [0.18, 0.52]	0.97 [0.89, 1.00]
Kasemsup 2006 (50)	8	5	27	40	CDC BMI>95%	0.23 [0.10, 0.40]	0.89 [0.76, 0.96]
Kroke 2006 (51)	24	0	9	220	CDC BMI>95%	0.73 [0.54, 0.87]	1.00 [0.98, 1.00]
Manios 2009 (55)	165	22	472	1100	CDC BMI>95%	0.26 [0.23, 0.29]	0.98 [0.97, 0.99]
Maynard 2003 (58)	527	75	725	4173	CDC BMI>95%	0.42 [0.39, 0.45]	0.98 [0.98, 0.99]
Tschamler 2010 (65)	32	3	27	131	CDC BMI>95%	0.54 [0.41, 0.67]	0.98 [0.94, 1.00]
Wald 2007 (68)	123	2	128	359	CDC BMI>95%	0.49 [0.43, 0.55]	0.99 [0.98, 1.00]
Young 2000 (69)	79	1	21	10	CDC BMI>95%	0.79 [0.70, 0.87]	0.91 [0.59, 1.00]
Abbott 2010 (25)	111	6	330	1701	IOTF Cole	0.25 [0.21, 0.29]	1.00 [0.99, 1.00]
Carnell 2005 (32)	9	3	136	416	IOTF Cole	0.06 [0.03, 0.11]	0.99 [0.98, 1.00]
Crawford 2005 (33)	97	35	209	778	IOTF Cole	0.32 [0.27, 0.37]	0.96 [0.94, 0.97]
Juliusson 2011 (49)	139	71	343	3217	IOTF Cole	0.29 [0.25, 0.33]	0.98 [0.97, 0.98]
Lampard 2008 (52)	88	10	40	191	IOTF Cole	0.69 [0.60, 0.77]	0.95 [0.91, 0.98]
Mamum 2008 (54)	343	98	319	1890	IOTF Cole	0.52 [0.48, 0.56]	0.95 [0.94, 0.96]
Vuorela 2010 (67)	39	3	79	485	IOTF Cole	0.33 [0.25, 0.42]	0.99 [0.98, 1.00]

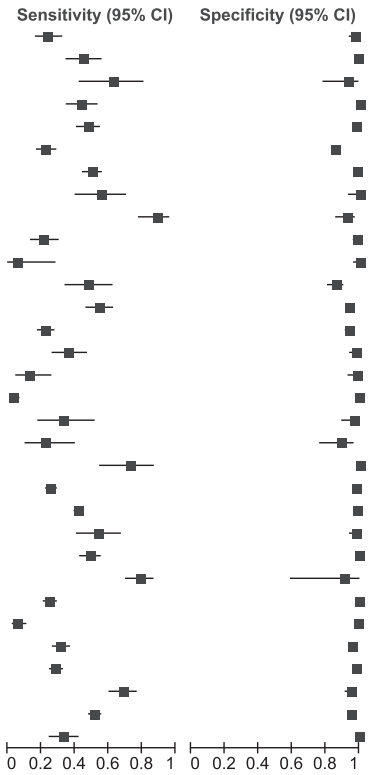

Figure 2. Forest plot of studies using verbal descriptions (n=32) reporting sensitivity and specificity of parental perception.

Subgroup analyses

The pooled sensitivity and specificity for each subgroup are shown in Table 3. Based on the 95% confidence intervals, there is a significant difference in sensitivity between the different age groups. The percentage of parents who misperceive the overweight of their children is higher in parents of children aged 2-6 years compared to parents of older children. However, there was no significant difference in specificity between the subgroups.

No significant difference in sensitivity or specificity was found between the different cut-off points used to define overweight, or between the more recent and older studies. However, there is a positive trend towards a higher sensitivity in the later studies.

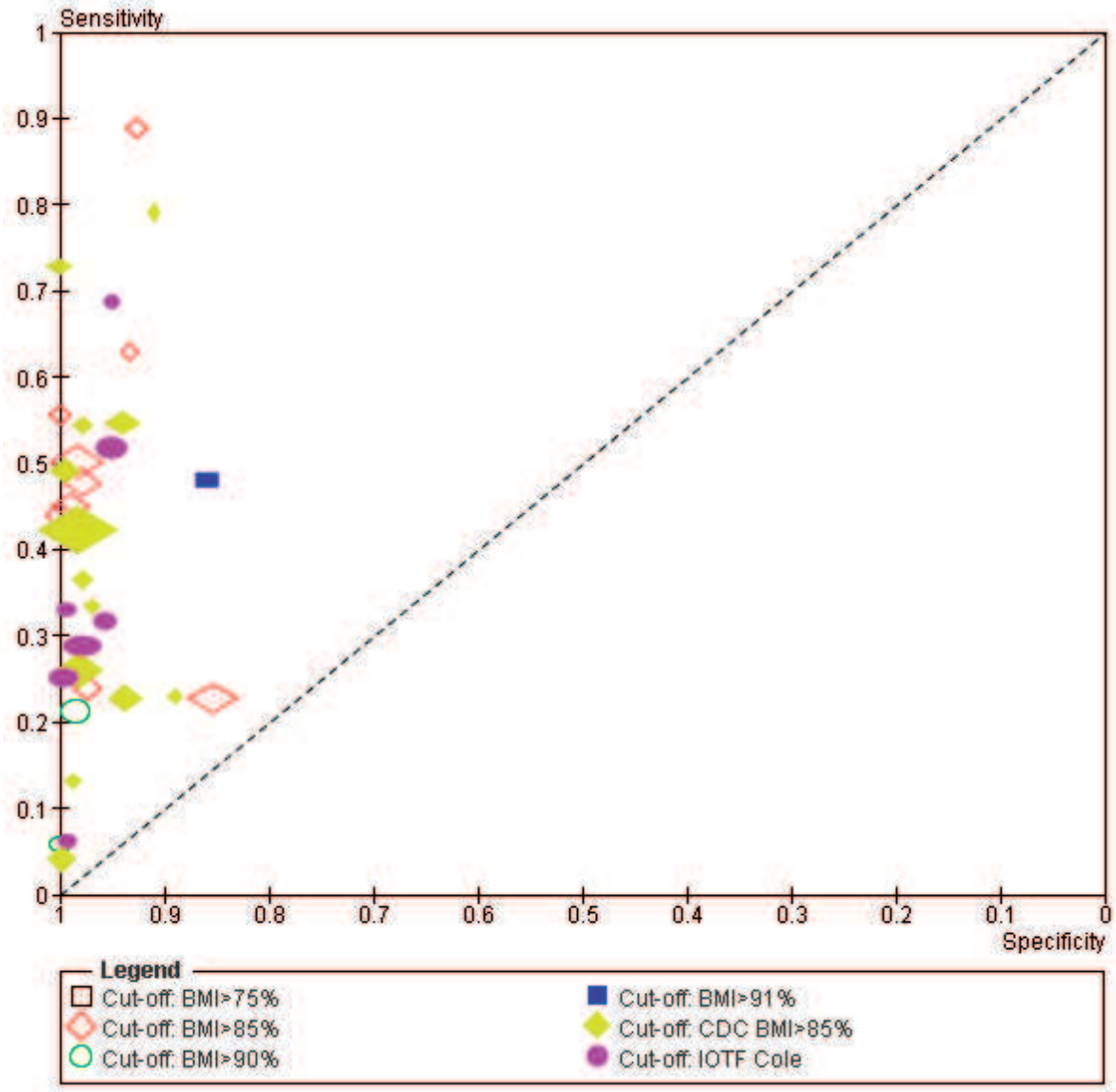

Figure 3. ROC curve based on the 32 studies using verbal descriptions reporting sensitivity and specificity of parental perception.

Table 3. Pooled sensitivity and specificity for subgroup analyses (n=number of studies).

Subgroup	Sensitivity	Specificity
Based on child's age		
Young children (2-6 years) n=8	0.14 (95%CI: 0.08-0.23)	0.99 (95%CI: 0.97-0.99)
Older children n=24	0.47 (95%CI: 0.40-0.55)	0.98 (95%CI: 0.96-0.99)
Based on cut-off for overweight		
BMI>85% (WHO) n=9	0.49 (95%CI: 0.35-0.63)	0.98 (95%CI: 0.95-0.99)
BMI>95% (CDC) n=13	0.36 (95%CI: 0.23-0.51)	0.98 (95%CI: 0.96-0.99)
IOTF Cole[19] n=7	0.32 (95%CI: 0.19-0.49)	0.98 (95%CI: 0.96-0.99)
Based on year of publication		
Older studies (<2007) n=10	0.29 (95% CI: 0.16-0.45)	0.97 (95% CI: 0.93-0.98)
Newer studies n=22	0.41 (95% CI: 0.31-0.52)	0.98 (95% CI: 0.97-0.99)

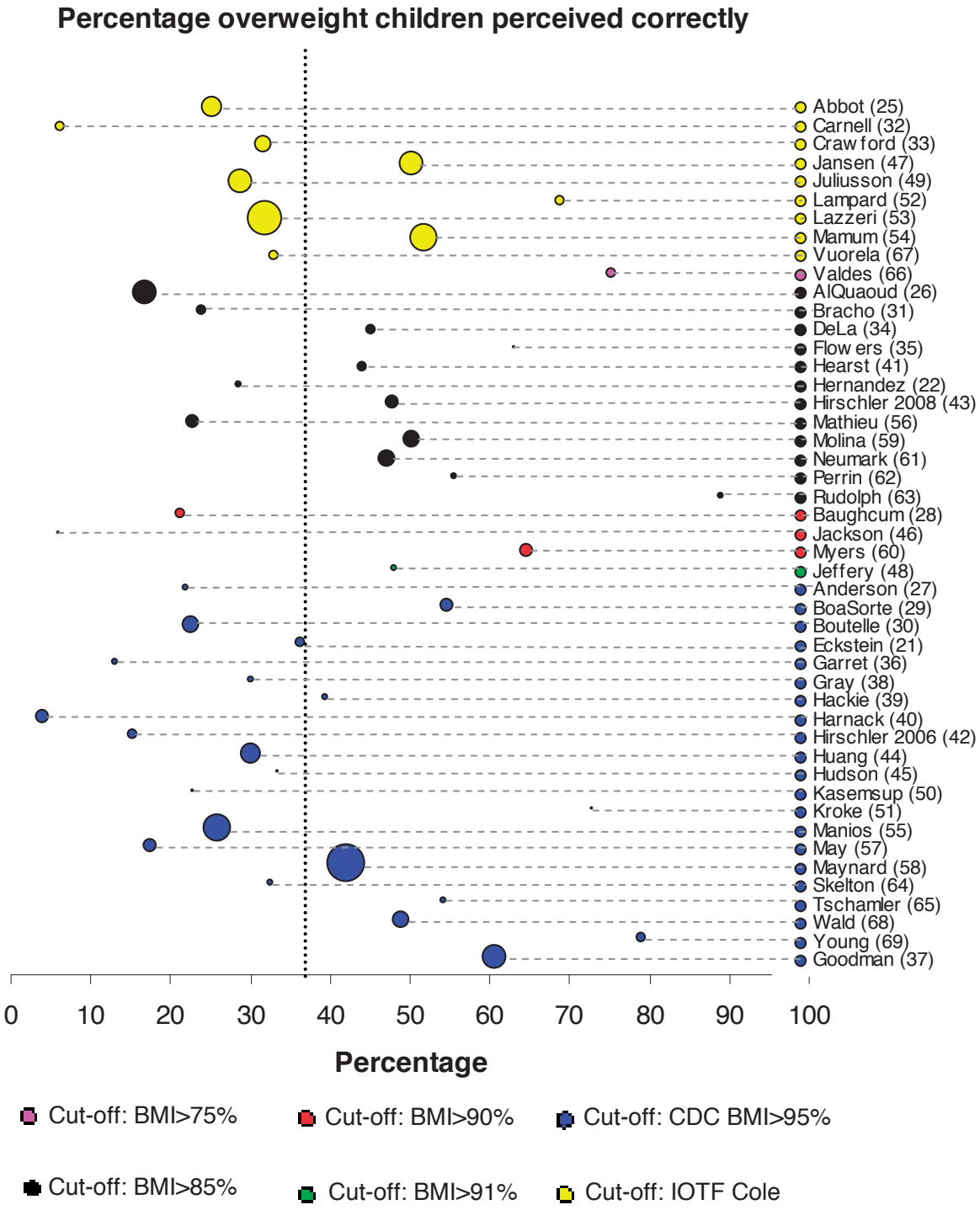

Figure 4. Forest plot of studies using verbal descriptions reporting the percentage of parents who perceived their overweight children correctly (47 studies). The balls are proportional to study size, the dotted line is the pooled result adjusted for study size.

DISCUSSION

The purpose of the present systematic review was to identify differences between parental perception and the actual weight status of children. Of the 35 103 children enrolled 11 530 were overweight (32.9%). Of these, 4339 (37.6%) children were correctly perceived as overweight by their parents, while 7191 (62.4%) were misperceived as normal weight. This implies that there is a large proportion of parents that fail to recognise the overweight weight status of their child. This is especially true for parents of young children. Subgroup analysis revealed that 86% of the parents of children aged 2-6 years fail to recognise overweight of their child.

Figure 4 shows that especially the larger studies (using verbal descriptions) lay close to the pooled result, with the exception of two studies.[23,36] In terms of results, the smaller studies are often both positive and negative outliers. Of the 9 relatively large studies with results close to the pooled results, the methodological quality is relatively high (moderate: 5 articles; good: 3 articles; excellent: 1 article) (Figure 4, Table 1). Therefore, the pooled results seem to give a reliable estimate of the available data on this subject.

Studies using image scales for the perception of parents, show a higher percentage of overweight children perceived correctly by parents compared to studies using verbal descriptions (52.3% vs 37.6%). This suggests that parents do acknowledge the weight status of their overweight child, but do not verbally label it as overweight. The reason for this reluctance might be a negative association with the word overweight because of stigmatization of obese people in our society, as previous proposed by Neumark-Sztainer et al.[61] However, there are too few studies using image scales in the present review to draw firm conclusions about this.

It is noteworthy that children with a normal weight status are almost never seen as being overweight, while children with overweight are often perceived as normal weight children. This indicates that parents often label their children as normal weight, irrespective of the child's actual weight status. This implies that parental perception of the weight status of a child is an inadequate diagnostic tool for overweight. Weight status of children should therefore not be asked to parents, but height and weight should be measured instead.

Besides stigmatization, another possible explanation for the poor sensitivity (misperception of overweight status by parent) could be the change in reference frame. Given the current high percentage of overweight children (and parents), the overweight status may be seen as being average and therefore perceived as 'normal'.[73] However, one might expect a difference between sensitivity in the older and newer studies and this was not found.

Although different studies used different cut-off points for the definition of overweight, the misperception of overweight seems to be universal. This is shown by our

pooled results, where no significant differences were found between sensitivity and specificity scores of the different cut-off points used by IOTF, CDC or WHO.

Strengths and Limitations

The most recent reviews[15-17] searched electronic databases up to August 2007. The present review included 51 studies of which 32 were not included in the previous reviews and were published after August 2007. This illustrates the topicality of the subject. Our review revealed no significant differences in sensitivity between the studies included in the earlier reviews and the more recent studies.

Our subgroup analyses revealed that misperception of overweight is even worse for parents of young children. Furthermore, the use of different definitions of actual overweight in terms of accurate perception of overweight, did not affect the sensitivity and specificity.

Because by far most studies included child-mother and no child-father couples no differences in misperception between genders of parents could be tested. It seems obvious to assume that overweight parents are less likely to perceive their child as being overweight.[74] Taking the weight status of the parents into account may help to elucidate whether there is a difference in perception between overweight and normal-weight parents; however, because too few studies reported parents' weight status, no subgroup analyses could be performed on this.

Finally, cultural differences in terms of a healthy weight perception are likely to affect the perception of parents. In the present review, because most studies were conducted in western countries, no comparison could be made with non-western countries.

Implications

Health care professionals should be aware of the frequent misperception of the overweight status of a child, especially in young children. This is particularly important in view of the consequences of overweight at early age, i.e. a rapid increase in bodyweight during the first year of life is significantly associated with overweight at age 12 years.[75] Moreover, childhood-onset overweight accounts for 25% of adult obesity and persists into a higher BMI in adulthood, as compared with adult-onset obesity.[7,8]

Also, parental awareness of their child's overweight implies concern about the child's health and willingness to take appropriate action.[12-14] Therefore, as a first step to counteract overweight, health care professionals should aim to make parents recognise the overweight of their child. For example, physicians could measure height and weight, calculate and interpret BMI and discuss the weight status of a child during a consultation, irrespective of the reason for consultation.

Conclusion

The 51 studies (covering 35 103 children) show that parents are likely to misperceive the weight status of their overweight child, especially in young children. Despite the recent focus on the prevention and treatment of overweight in children, only 37.6% of the overweight children were perceived as being overweight by their parents. The most important implication of these results is that health care professionals should be aware of this frequent misperception and help make parents aware of the overweight of their child so that treatment options can be discussed.

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APPENDIX A SEARCH STRING AND HITS

Publication date to 2011/01/17

PubMed: **1958**

(Child*[tw] OR (adolescent[MeSH] NOT adult[mesh]))
AND
(Parent*[tw] OR father*[tw] OR mother*[tw] OR matern*[tw] OR patern*[tw])
AND
(body mass index*[tw] OR overweight[tw] OR obes*[tw] OR BMI [tw] OR Quetelet*[tw] OR weight status*[tw] OR weight gain[tw] OR weight concern*[tw] OR weight control*[tw])
AND
(percepti*[tw] OR view*[tw] OR perceiv*[tw] OR aware*[tw] OR recogni*[tw] OR notion[tw] OR judg*[tw] OR classif*[tw] OR concern*[tw] OR reported weight[tw])

APPENDIX B STUDY RESULTS

	Definition of weight status	Number of participants suitable for this analysis (n)	true negative[a]	false positive[b]	false negative[c]	true positive[d]
Verbal description						
Weight status IOTF based on Cole et al.						
Abbot et al. 2010	IOTF Cole	2148	1701	6	330	111
Carnell et al. 2005	IOTF Cole	564	416	3	136	9
Crawford et al. 2005	IOTF Cole	1116	778	35	209	97
Jansen et al. 2006	IOTF Cole	524	n.a.	n.a.	261	263
Juliusson et al. 2011	IOTF Cole	3770	3217	71	343	139
Lampard et al. 2008	IOTF Cole	329	191	10	40	88
Lazzeri et al. 2006	IOTF Cole	2835	n.a.	n.a.	656	306
Mamum et al. 2008	IOTF Cole	2650	1890	98	319	343
Vuorela et al. 2010	IOTF Cole	606	485	3	79	39
Weight status by WHO						
AlQuaoud et al. 2010	BMI>85th overweight	482	n.a.	n.a.	401	81
Bracho et al. 2007	BMI>85th overweight	270	149	4	89	28
DeLa et al. 2009	BMI>85th overweight	576	481	5	50	41
Flowers et al. 2008	BMI>85th overweight	57	28	2	10	17
Hearst et al. 2011	BMI>85th overweight	358	242	0	217	9
Hernandez et al. 2010	BMI>85th overweight	49	n.a.	n.a.	35	14
Hirschler et al. 2008	BMI>85th overweight	620	409	9	106	97
Mathieu et al. 2010	BMI>85th overweight	1128	791	135	156	46
Neumark et al. 2008	BMI>85th overweight	307	n.a.	n.a.	162	145
Perrin et al. 2010	BMI>85th overweight	96	51	0	20	25
Rudolph et al. 2010	BMI>85th overweight	150	88	7	6	48
Weight status by CDC						
Anderson et al. 2006	BMI>85th overweight	82	n.a.	n.a.	64	18
BoaSorte et al. 2007	BMI>85th overweight	827	634	41	69	83
Boutelle et al. 2004	BMI>85th overweight	742	442	30	209	61
Eckstein et al. 2006	BMI>85th overweight	223	132	3	56	32
Gray et al. 2007	BMI>85th overweight	169	n.a.	n.a.	49	21
Harnack et al. 2009	BMI>85th overweight	593	366	1	217	9
Hirschler et al. 2006	BMI>85th overweight	321	n.a	n.a.	111	20
Huang et al. 2007	BMI>85th overweight	429	n.a.	n.a.	300	129
Hudson et al. 2009	BMI>85th overweight	96	61	2	22	11
Kroke et al. 2006	BMI>85th overweight	253	220	0	9	24
Manios et al. 2009	BMI>85th overweight	1759	1100	22	472	165

APPENDIX B STUDY RESULTS (CONTINUED)

	Definition of weight status	Number of participants suitable for this analysis (n)	true negative[a]	false positive[b]	false negative[c]	true positive[d]
May et al. 2007	BMI>85th overweight	228	n.a.	n.a.	188	40
Maynard et al. 2003	BMI>85th overweight	5500	4173	75	725	527
Skelton et al. 2006	BMI>85th overweight	37	n.a.	n.a.	25	12
Tschamler et al. 2010	BMI>85th overweight	193	131	3	27	32
Wald et al. 2007	BMI>85th overweight	612	359	2	128	123
Weight status other						
Baughcum et al. 2000	BMI>90th overweight	304	202	3	78	21
Garret et al. 2008	BMI>95th overweight	120	73	1	40	6
Goodman et al. 2000	BMI>95th obese	564	n.a.	n.a.	222	342
Hackie et al. 2007	BMI>95th overweight	38	n.a.	n.a.	23	15
Jackson et al. 1990	BMI>90th overweight	107	90	0	16	1
Jeffery et al. 2005	BMI>91th overweight, BMI>98th obese	272	189	31	27	25
Kasemsup et al. 2006	BMI>95th overweight	80	40	5	27	8
Molina et al. 2009	Must et al.[19,20]	1272	959	16	148	149
Myers et al. 2000	BMI>90th overweight	200	n.a.	n.a.	71	129
Valdes et al. 2009	BMI>75th (at risk for) overweight, BMI>95th obese	141	n.a.	n.a.	35	106
Young et al. 2000	BMI>95th overweight	111	10	1	21	79
Images scales						
Weight status IOTF based on Cole et al.						
Warschburger et al. 2009	IOTF Cole	142	n.a.	n.a.	10	17
Weight status by WHO						
Hernandez et al. 2010	BMI>85th overweight	150	90	11	33	16
Reifsnider et al. 2006	BMI>85th overweight	25	4	9	7	5
Zonana et al. 2010	BMI>85th overweight	525	351	12	64	98
Weight status by CDC						
Eckstein et al. 2006	BMI>85th overweight	223	127	8	52	36
Weight status other						
Beatty et al. 2009	Unknown	130	76	0	21	33

[a] actual weight status normal weight, perception normal weight
[b] actual weight status normal weight, perception overweight
[c] actual weight status overweight, perception normal weight
[d] actual weight status overweight, perception overweight
n.a. = not available

PART III

Attitudes

Chapter 7

General practitioners' attitudes, daily practice and experienced barriers in managing childhood obesity

A shorter version was published in Dutch
*(*Kinderen met obesitas in de huisartsenpraktijk
een online onderzoek onder huisartsen)

WD Paulis, A de Jong, M van Avendonk,
F Boukes & JC van der Wouden

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ABSTRACT

Background General Practitioners (GPs) might play a significant role in preventing childhood obesity.

Aims 1) To investigate attitudes and daily practice of Dutch GPs regarding the management of childhood obesity, and 2) To identify barriers GPs experience in diagnosing and referring obese children.

Design Two cross-sectional studies.

Methods An online survey was sent to a random sample of 1500 Dutch GPs. The survey consisted of 25 multiple choice questions on attitudes and daily practices regarding the management of childhood obesity. To identify barriers GPs experience in diagnosing and referring obese children, a random sample of 104 GPs were telephonically approached and interviewed about their beliefs, behaviour and experienced barriers in obesity management.

Results The response rate of the survey and telephonic interviews was 23% and 53%, respectively. Over 90% of the GPs feel they should play a role in diagnosing obesity in children. However, they think it is hard to raise the issue of obesity to children and parents, especially if children consult them for non-weight related complaints. Only 4% of GPs always refer children with obesity to intervention programs. Barriers GPs experience in referring obese children are lack of efficacy of existing interventions and the feeling that children and parents do not want to be referred.

Conclusion GPs feel they should play a role in the management of childhood obesity, but they experience barriers in both diagnosing and referring obese children. Additional training and guidance seem required for GPs in order to successfully manage childhood obesity in primary care.

INTRODUCTION

Almost half of the adult Dutch population is currently overweight and the prevalence of overweight children is rising at alarming rates as well.[1,2] This is in accordance with a worldwide trend. Childhood obesity is associated with serious health risks of almost every system of the body later on in life.[3] Furthermore, overweight children are known to become victims of bullying[4,5] and report lower health related quality of life compared to normal weight children.[6,7]

While there is no universal agreement in how to prevent childhood obesity best, it is recognised that primary healthcare professionals can play a significant role in the management.[8] To support this new role, several countries have developed clinical practice guidelines for the management of overweight and obesity.[9,10] In the Netherlands every resident is registered in one general practice and when patients seek health care one of the 11.732 general practitioners (GPs)[11], also referred to as family doctor, is the first doctor to visit.

The Dutch College of General Practitioners (NHG) introduced an obesity guideline in November 2010 to assist Dutch GPs with the assessment and management of obesity.[12] This guideline states that GPs should examine all presenting children who appear to be obese, regardless of reason for consultation; i.e. measure the BMI, compare it with gender and age specific international cut-off values and if a child is obese raise this issue. Furthermore, GPs need to treat or refer all obese children who ask for help in weight reduction, who are referred by a youth health care physician for obesity, or in case they have risk factors or clinical symptoms associated with obesity.

Since the theory of planned behaviour states that attitudes influence behaviour[13], a deeper understanding of professionals' perceptions can help to improve the implementation process of guidelines, by revealing areas that need more attention during implementation.

Previous research revealed the perceptions of American family doctors.[14,15] However, since both the prevalence of childhood obesity and the role of the family doctor are different in western European countries such as the Netherlands, UK and Sweden, but also Australia, these perceptions of American doctors cannot be extrapolated to other countries. Little is known about the attitudes and daily practice of Dutch GPs regarding the management of childhood obesity, therefore the aims of the present study were twofold:

1) To investigate attitudes and daily practice of Dutch GPs regarding the management of childhood obesity prior to the obesity guideline was launched.
2) To identify barriers Dutch GPs experience in diagnosing and referring obese children.

Attitudes and daily practices were investigated with a web survey and experienced barriers were further revealed in a second study by means of structured telephone interviews.

MATERIALS AND METHODS

Survey (part I)

Participants and study design

In a cross-sectional study, a random sample of 1500 practising GPs (situated all over the Netherlands) was approached by the Dutch College of General Practitioners.

Procedure

In August 2010 (before the new Dutch obesity guideline for GPs was launched) GPs were approached by e-mail and asked to participate in the study. The e-mail contained a hyperlink to the web survey they had to fill out. After two weeks a reminder was sent to all non-respondents.

Measures

Demographics (gender, age, BMI) of all respondents were collected. We asked whether the practice was situated in deprived area and to estimate the number of obese children seen per month. From non-respondents age and gender were available as well.

Based on literature and the new obesity guideline[14-18] a survey was developed with the elements of the theory of planned behaviour.[13] The survey informed on knowledge, attitudes, competence and daily practice of GPs regarding the management of childhood obesity. A pilot version was tested for face validity with five GPs. The final version of the survey contained 25 items (Appendix A):

- One question on knowledge of BMI cut-off points
- Two questions on attitude towards aetiology and consequences of obesity in childhood
- Ten statements on attitudes regarding diagnosing and referring children with obesity and the role GPs think they should fulfil (5-point Likert Scale)
- Six statements and one question about daily practice and referrals (5-point Likert Scale)
- Five questions on competence and need for education and guidance

Data Analysis

Only questionnaires with more than 80% of questions answered were analysed. Respondents and non-respondents were compared for gender and age using independent sample t-tests. Differences with a p-value < 0.05 were considered statistically significant. Descriptive statistics were used to describe the frequencies of answers of the respondents to the questions and statements.

Structured telephone interviews (part II)

Participants and study design

To further explore experienced barriers, a new random sample of 122 GPs, who were not approached for the first study, situated in the south-west of the Netherlands were interviewed by telephone and asked about experienced barriers in diagnostics and referral of obese children. Interviews were taken March 2011.

Procedure

One researcher performed all standardized interviews by telephone. A list of 581 GPs was used to select the GPs. The sequence of GPs on the list was randomized using Microsoft Excel. Every GP that could not directly be reached was called an average of four times, before calling the next GP on the list. The aim was to interview 50 GPs. After completing 50 interviews, no new GPs were called. However, GPs who called back after this period were still interviewed.

Measures

Demographics of GPs were registered; age, gender and whether their practice was situated in a deprived area (self-estimation by GP). The structured interview was developed based on the questionnaire of the first study and the NHG obesity guideline[12] (Appendix B). Some questions from the first study were repeated to specify attitudes and practices in this new sample and other questions further explored experienced barriers. Questions were categorized into two clusters:

1. Diagnostics: measuring BMI; raising the issue of obesity; factors that influence GP's choices in diagnosing obesity.
2. Referral: the role of the GP in the treatment of obese children; factors that influence GP's choices of referral.

A pilot was taken among the first five interviewed GPs to test for face validity. All five GPs noted to understand the questions and minor changes were made to the answer categories.

Analysis

Descriptive statistics were applied to describe the response of GPs to multiple choice questions. All data were analysed using SPSS Inc. Statistics 17.

RESULTS

Survey (part I)

From the 1500 sent e-mails 83 were immediately returned because of a mail delivery failure. It was assumed that the 1417 other e-mail addresses were correct. A total of 344 GPs returned the questionnaire, 333 questionnaires were filled out for at least 80% and were therefore included in the analyses (response 23%).

Characteristics of participating GPs are shown in Table 1. The mean age of the survey respondents was 46 years and non-response analyses revealed that age did not significantly differ between respondents and non-respondents. However, significantly more women returned the questionnaire compared to men. From the respondents 69% had a self-reported BMI in the normal weight range, 22% was overweight and 3% was obese.

Table 1. Demographics of respondents in both studies

Demographics	Survey I (N=333)	Interviews II (N=55)
Gender (% male)	45%	64%
Mean age in years (sd)	46,1 (9,5)	49,5 (9,2)
Practice in deprived area (%)	15%	31%

Knowledge

A total of 66% of the GPs were aware of the gender and age specific BMI cut-off values for children. GPs reported the medical consequences of obesity in childhood as severe (average 81.3 on a 0 (not severe) to 100 (extremely severe) scale); however psychological and social consequences were reported as important as well (average 77 and 76, respectively).

Attitudes

The degree of agreement with the attitude statements scored on a Likert-scale is shown in Figure 1. A large majority (91%) of the respondents reported they agree that GPs should play a role in diagnosing obesity in children. However, 78% reported that the role of the youth health care physician is even more important. More than half of the respondents agree that raising the issue of obesity is not too time-consuming. However, raising the issue seems hard, especially to their parents (50%).

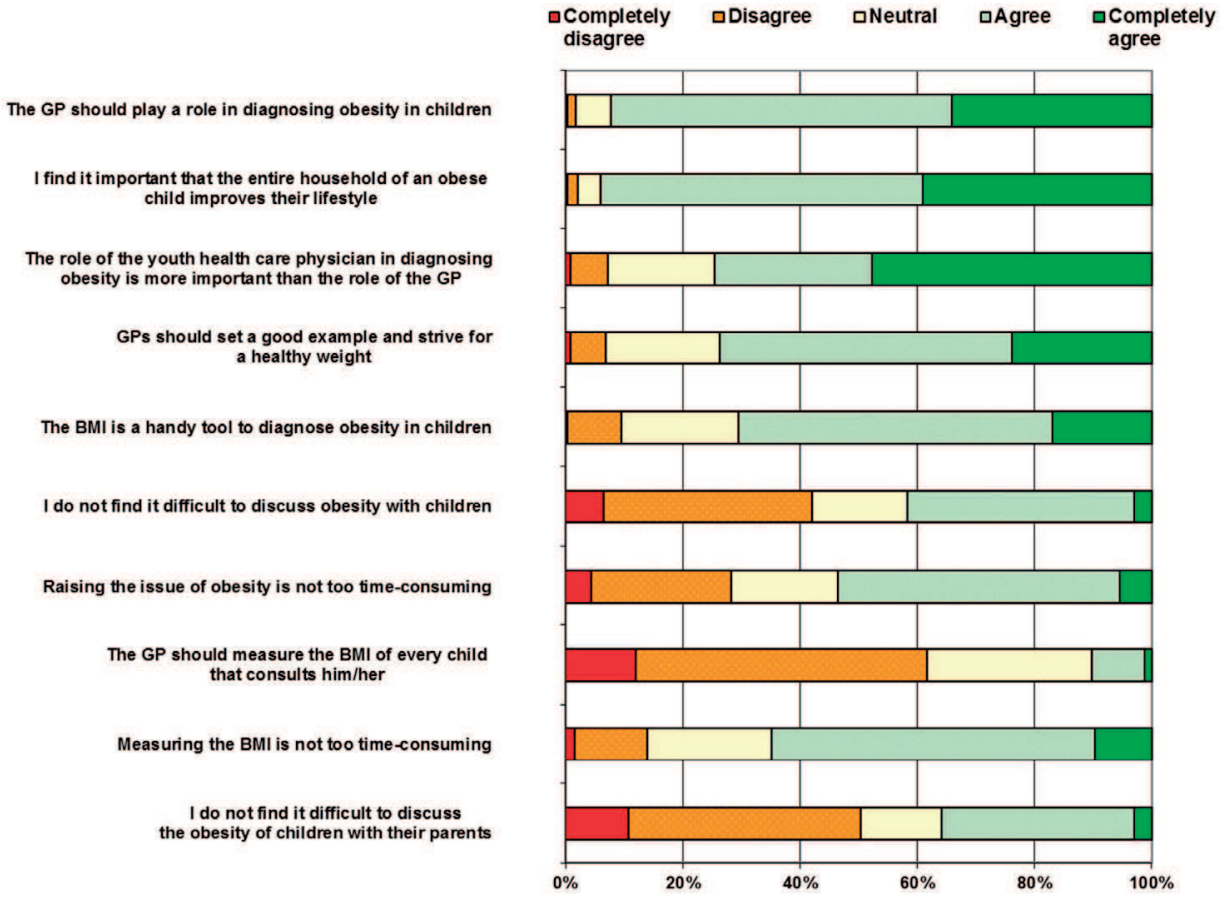

Figure 1. Frequencies of answers of the 333 respondents of study part I to the attitude statements. Each color represents the total percentage of GPs that answered that category. Missing data (maximum one or two respondents) were excluded. Some statements are negatively framed for the graph in order to make the graph colors corresponding to green 'positive' and red 'negative' attitude.

Daily Practice

Of the respondents, only 24% report to measure the BMI (often or always) when they expect a child to be obese (Figure 2). When it comes to referral 38% of the respondents refer obese children often or always and 44% sometimes. GPs refer to dieticians (81%), paediatricians (66%), physical therapists (27%) and psychologists (14%). Less than 4% of the GPs report to refer to multidisciplinary programs.

Competence

GPs feel more competent in diagnosing children (80%) compared to treating overweight children (50%). However, 74% of respondents reported they preferred to be educated in diagnosing obese children and 86% in treating obese children.

Structured telephone interviews (part II)

A total number of 122 GPs were approached for the structured telephone interviews; 18 were excluded because they retired, stopped working or were away for a longer

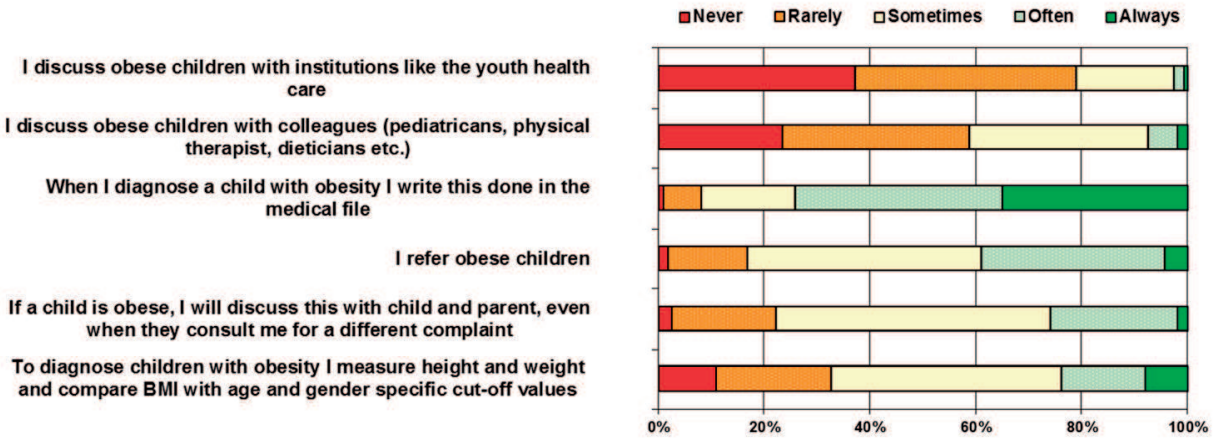

Figure 2. Frequencies of answers of the 333 respondents of study part I to the questions on daily practice. Each color represents the total percentage of GPs that answered that category. Missing data (maximum one or two respondents) were excluded.

period of time and 49 GPs refused to participate in this study. Most important reasons for refusing were lack of time (n=15) or systematic refusal of all telephonic surveys (n=8). Therefore, 55 GPs participated and completed the entire interview (Table 1).

Diagnostics

Reasons that were most frequently reported for not calculating BMI in all consultations of children GPs expect to be obese are: children present themselves with non-weight-related problems (42%), not enough time per consultation (40%) and I think it is unnecessary (33%).

Referral

Most GPs indicate that they should play an active role in the treatment of obese children (76%). Half of the GPs reported, apart from referring patients, to stay actively involved themselves.

Often reported barriers for both referral and treatment were 'There is not enough time for diagnostics and treatment' (26%) and 'Existing interventions are not effective enough' (29%). The majority of GPs assume that overweight children and/or their parents do not want to be referred for this problem (56%).

The preference of children and parents has the largest influence on the decision of the GP where to refer an overweight child to (63%). Lack of information about available interventions is another frequently reported factor of influence (47%).

DISCUSSION

Barriers GPs experience in diagnosing and treating obese children in general practice have not been investigated before in the Netherlands. It is important to highlight these barriers, since GPs can play a key role in tackling this health problem and barriers might restrain GPs from acting accurately.

The Dutch obesity guideline for GPs advises that every child that appears to be obese, regardless of the reason for consultation, should be examined by the GP to diagnose obesity. The web survey in the present study shows that a large majority, 91% of the respondents, agree the GP should play a role in diagnosing obesity in children. However, only 24% of the respondents often or always measure the BMI to diagnose obesity. This is in accordance with results from different studies from the USA among paediatricians.[19-21] One of the main reasons for not calculating BMI in all of those consultations is that GPs consider it to be unnecessary, since they feel confident about their visual diagnosis. Rivara et al. found that GPs believe they can easily recognize an obese child or adolescent without measuring.[22] However, it is shown that this results in under-recognition of overweight and obesity.[23] Therefore it is recommended for GPs to always calculate the BMI and to compare this BMI with age and gender specific cut-off points to diagnose obesity.

In addition the present study shows that only 26% of the GPs raise the issue of obesity when obese children consult them for any type of complaint. Half of the GPs (51%) reports to find it difficult to discuss the subject with children and their parents. King et al. suggest that GPs are afraid to disturb their relationship with their patients as a factor for not raising the issue of obesity.[24]

The obesity guideline states that all children who need assistance in weight reduction should be treated or referred. Most GPs indicate in the telephone interview that they agree with their active role in the treatment of obese children (76%). GPs indicate that they refer most frequently to nutritionists, paediatricians and only a few GPs indicate to refer to multidisciplinary programs. This is noteworthy since a Cochrane review showed that multidisciplinary interventions are the most effective in treating childhood obesity.[25] Moreover, Sargent et al. have demonstrated that multidisciplinary interventions in primary care may be effective.[26] Unfortunately, the authors of this review used a variety of different outcome measures to indicate effectiveness and studies with a significant result in only one of these different outcome domains were considered to be effective. Therefore, the available evidence on effective interventions in primary care is still marginal and the magnitude of the effect is hard to interpret. Additionally, various interventions to which a GP can refer children have not yet been studied. This is in accordance with the response of the GPs in our study. They indicated that the effectiveness of existing interventions is still unclear which is in line with the results of several other

studies.[15,27] Further research on the effectiveness of childhood obesity interventions in primary care is therefore necessary.

The most important barrier reported in referring an overweight or obese child is that GPs assume children and parents do not want to be referred. This is in accordance with research findings from the USA, where GPs reported a lack of parent involvement and patient motivation to be barriers of major importance.[27,28] However, a recent study from Turner et al.[29] showed that parents do see primary care as an appropriate setting in which to treat childhood obesity. However, they were reluctant to consult the GP for this problem. Reasons for this reluctance were the fear of being blamed for their child's weight, concern about their child's mental well-being. Moreover, parents questioned whether practitioners had the knowledge, time and resources to effectively manage childhood obesity.

Strengths and limitations of the study

Limitation of both studies is that the questionnaires are not validated; however it was used as an exploring tool to collect more information on this topic and GPs confirmed to understand all questions. Another limitation is a possible response bias. The response rate of the web survey is low and non-response analysis of the first study shows that significantly more women filled out the questionnaire. Respondents might have special interest in the subject; they may have a more positive attitude towards or are more actively involved in the management of childhood obesity compared to the non-responders. Therefore results might give a positive overestimation of the attitude and daily practice of the average GP.

Moreover, the number of interviewed general practitioners in the telephone survey is small and this sample was taken from GPs in an urban area. Therefore, the sample does not resemble all GPs in the Netherlands. Besides, the second population is different from the first population and contains more men. However, these two different populations both reported to experience difficulties in diagnosing and referring obese children. Therefore, it seems plausible that reported barriers are experienced by the majority of Dutch GPs.

Implications for future research and clinical practice

Primary healthcare professionals can play a significant role in the management of childhood obesity. To support this role, several countries have developed clinical practice guidelines for the management of overweight. The results of the present studies show that current GP handling in the Netherlands does not correspond with their guideline. GPs experience barriers in both diagnosing and referring obese children. It can be of additive value to offer GPs extra courses, making them more comfortable discussing the problem of childhood overweight. Besides, further research into the effectiveness of

intervention programs in primary care is necessary. When there are effective intervention programs available in primary care the need to diagnose obesity might be more apparent to GPs and they will feel more confident to refer children.

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APPENDIX A SURVEY (PART I)

1. Which factors contribute how much to obesity in childhood?
   (0 = no contribution, 100 = contributes a lot)?

   a. Biological factors .....

   b. Psychological factors .....

   c. Behavioural factors .....

   d. Parents .....

   e. Social factors .....

2. How would you describe the severity of the next consequences of obesity
   (0 = not at all severe, 100 = extremely severe)?

   a. Medical consequences .....

   b. Psychological consequences .....

   c. Social consequences .....

3. The cut-off value for obesity in children (2-17 years) is a BMI of 30

   a. True

   b. False

   c. Don't know

Find your appropriate answer for each of the statements below

	Completely disagree	Disagree	Neutral	Agree	Completely agree
4. I find it difficult to discuss the obesity of children with their parents	○	○	○	○	○
5. Measuring the BMI is too time-consuming	○	○	○	○	○
6. The GP should measure the BMI of every child that consults him/her	○	○	○	○	○
7. Raising the issue of obesity is too time-consuming	○	○	○	○	○
8. I find it difficult to discuss obesity with children	○	○	○	○	○
9. The BMI is a handy tool to diagnose obesity in children	○	○	○	○	○
10. GPs should set a good example and strive for a healthy weight	○	○	○	○	○
11. The role of the youth health care physician in diagnosing obesity is more important than the role of the GP	○	○	○	○	○
12. I find it important that the entire household of an obese child improves their lifestyle	○	○	○	○	○
13. The GP should play a role in diagnosing obesity in children	○	○	○	○	○

Find your appropriate answer for each of the statements below

	Never	Rarely	Sometimes	Often	Always
14. To diagnose children with obesity I measure height and weight and compare BMI with age and gender specific cut-off values	○	○	○	○	○
15. If a child is obese, I will discuss this with child and parent, even when they consult me for a different complaint	○	○	○	○	○
16. I refer obese children	○	○	○	○	○
17. When I diagnose a child with obesity I write this down in the medical file	○	○	○	○	○
18. I discuss obese children with colleagues (pediatricans, physical therapist, dieticians etc.)	○	○	○	○	○
19. I discuss obese children with institutions like the youth health care	○	○	○	○	○

20. If you do refer children, to whom do you refer (more options allowed)

    a. Physical Therapist

    b. Dietician

    c. Psychologist

    d. Pediatrician

    e. Other (fill in) .....

Find your appropriate answer for the two questions below

	Not at all competent	Not competent	Neutral	Competent	Very competent
21. How competent do you consider yourself in diagnosing obesity?	○	○	○	○	○
22. How competent do you conside r yourself in treating obesity?	○	○	○	○	○

23. Do you feel need for education on how to diagnose obesity in children?

    a. A lot

    b. A little

    c. None

24. Do you feel need for education on how to treat obesity in children?

    a. A lot

    b. A little

    c. None

25. Do you think you could use the National Guidance Obesity?

    a. Yes

    b. No

    c. Maybe

APPENDIX B INTERVIEW (PART II)

1. In what percentage of the children you suspect to be obese, do you calculate BMI?

☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
0	10	20	30	40	50	60	70	80	90	100

2. In case question no. 1 was answered with less than 100%: Why don't you calculate BMI in every case of suspected overweight? Multiple answers are possible.

   a. The reasons children consult me are not weight-related.

   b. I have not enough time per consultation

   c. I think this is a task of the youth health care physician

   d. I find it hard to bring up the issue of overweight to these children and their parents

   e. I think it is unnecessary

   f. Other

      ……

3. To what level do you agree with the following statement: if an overweight or obese child consults me, I undertake action.

   a. Always

   b. Often

   c. Sometimes

   d. Occasionally

   e. Never

4. In case you answered question three positively, in which way do you undertake action?

   a. I refer these children to another physician or paramedical professional

   b. I stay actively involved myself

   c. I refer, buy stay also actively involved myself

5. In case you refer children, where do you refer them?
    a. Physiotherapist
    b. Nutritionist
    c. Psychologist
    d. Paediatrician
    e. Multidisciplinary program running in our own health centre or somewhere else in the region

6. What barriers do you experience in referring overweight and obese children? Multiple answers are possible.
    a. I do not have enough time for diagnostics and treatment
    b. There are no (or not enough) options to refer to
    c. I prefer to see these children back myself
    d. I feel that existing interventions do not have enough effect as needed
    e. I think this not my task
    f. Children or their parents don't want to be referred for this problem

7. How is your overall picture of existing overweight/obesity interventions you can refer to in your region? Rate on a scale from zero (no knowledge) through 10 (=complete knowledge)

☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
0	1	2	3	4	5	6	7	8	9	10

8. Which factors have influence on the chosen option to refer an overweight child to? Multiple answers are possible
    a. Lack of information of other interventions
    b. Positive experiences with children I referred before
    c. Positive experiences from colleagues
    d. Distance to patients' houses
    e. Preference of children and their parents
    f. Waiting list
    g. Costs
    h. Severity of overweight

PART IV

Treatment

Chapter 8

An overview of national clinical guidelines for the management of childhood obesity in primary care

L Richardson, WD Paulis, M van Middelkoop & BW Koes

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ABSTRACT

Study design Review of clinical guidelines.

Background Most national clinical guidelines for the management of childhood obesity in primary care were published since 2003. It is unknown whether there is international consensus concerning the diagnosis and management of childhood obesity.

Objective To present an overview of available guidelines for the management of childhood obesity in primary care.

Methods Guidelines were included if they met the following criteria: (1) the guideline makes recommendations concerning the management of childhood obesity, (2) the target group consists of primary care health practitioners, (3) the guideline is available in English or Dutch.

Results Clinical guidelines from six different countries published from 2003 until 2010 met the selection criteria and were included in this review. The recommendations of the guidelines regarding the management of childhood obesity appeared to be quite similar. A consistent feature was the recommended combined intervention, with diet, physical activity and counselling being the three most important elements. There were discrepancies between the guidelines for recommendations regarding diagnostic classification criteria for childhood obesity.

Conclusion The present review shows that there is international consensus regarding the recommendations for management of childhood obesity. There is less international consensus regarding the diagnostic classification of childhood obesity.

INTRODUCTION

Worldwide, there were nearly 43 million overweight children under the age of five in 2010.[1] These overweight children are more likely to become overweight adults.[2,3] Therefore, childhood obesity is a major risk factor for the development of a large amount of disorders in adulthood.[4] Already, obese children have been identified with hyperlipidaemia, hypertension, impaired glucose tolerance and even with type II diabetes.[5,6] Beside the physical effects, obesity in childhood and adolescents is also associated with psychosocial problems.[4] Primary care could play an important role in managing childhood obesity, since obese children are frequently seen by general practitioners.[7-9] A 2009 Cochrane systematic review assessed the efficacy of a range of interventions designed to treat obesity in children and adolescents and identified several strategies as being potentially useful.[10] The targets of effective interventions in primary care vary from incorporating healthy diet to decreasing sedentary behaviour, restricting calorie intake and becoming physical more active.[8,11] Several countries recognized the opportunity for health care practitioners in primary care to manage childhood obesity and have developed and issued clinical guidelines in order to optimize weight management.

Since childhood obesity only became pandemic in the last decades, the clinical guidelines for the management in the primary care setting were published since 2003. It is at present unknown whether or not there is international consensus concerning the diagnosis and management of childhood obesity. Therefore, the aim of the present study is to present an overview of available guidelines for the management of childhood obesity in primary care. These guidelines are compared regarding the target group, recommendations for diagnosing, treatment and referring, and the extent to which these recommendations are based on scientific evidence.

METHODS

Search strategy

Clinical guidelines were searched up to May 2nd 2012 by two independent researchers using the following methods. First of all, electronic databases and search engines Pubmed (Mesh terms: Obesity/therapy and Practice Guideline as Topic), National Guideline Clearinghouse (key words: National Clinical Guideline Management Obesity) and www.g-i-n.net (key word: obesity) were used. The World Wide Web was also searched via Google for clinical guidelines that were not published in journals or if we were unable to obtain (a direct link to) the document. Secondly, references of reviews about relevant clinical guidelines and references of relevant clinical guidelines were checked. Thirdly,

experts in the field were contacted and were asked to provide the latest updates of their clinical guidelines.

Selection

Guidelines were included if they met the following criteria: (1) the guideline is a national clinical guideline which makes recommendations concerning the management of childhood obesity, (2) the target group consists of primary care health practitioners, (3) the guideline is available in English or Dutch because documents in these languages could be read by the reviewers.

If in one country more than one guideline was available, a multidisciplinary guideline was preferred above a monodisciplinary guideline.

Data-extraction

To compare the manner in which guidelines were composed we assessed which organisation composed the guideline, for whom the guideline is meant and how the guideline was published.

For guideline recommendations regarding diagnosis, information about the target population, the diagnostic classification and possible additional testing was extracted.

Finally, the guidelines' recommendations regarding management of childhood obesity were compared. Information regarding the target group and the goal of management, and recommendations concerning the content of non-drug therapy (such as diet, physical activity and counselling), drug therapy and referral was extracted from these guidelines.

Quality assessment

The quality of each guideline was assessed by one assessor with the Appraisal of Guidelines for Research and Evaluation (AGREE) instrument, which consists of 23 items divided into six domains (scope and purpose, stakeholder involvement, rigor of development, clarity and presentation, applicability, and editorial independence).[12] Each item was rated on a 7-point Likert scale measuring the extent to which an item has been fulfilled with 7 being the highest reward for that item and 1 being the lowest. Scores were standardized across domains (dividing the difference between the obtained score and the minimum possible score by the difference between the maximum and minimum possible scores) and expressed in percentages. Domain scores under 50% were considered low. Scores were compared both per guideline and per domain.

Comparison of recommendations

The recommendations of the national clinical guidelines on diagnosis and management of childhood obesity in primary care are compared with the recommendations of the

"European Association for the Study of Obesity" (EASO)[11] and with the recommendations of an expert committee composed of members of the American Medical association, Health Resources and Service Administration and the CDC[13]. The recommendations of these expert committees are displayed in Table 1.

Table 1. Expert Committees Recommendations

Item	American Expert Committee	European Association for the Study of Obesity
Diagnosis		
Measure	Height and Weight	Height, Weight and Waist Circumference (WC)
Determine Weight Status	Plot BMI on standard growth charts; ≥95% is obese; ≥85% is overweight	Plot BMI on local BMI centile charts and plot WC with appropriate centiles too
Additional	Blood pressure Investigate family history Laboratory tests (including alanine transaminase (ALT), fasting lipid and fasting glucose)	Blood pressure Investigate family history Laboratory tests (including alanine transaminase (ALT), fasting lipid and fasting glucose)
Management		
Nutrition	Consume ≥ 5 servings of fruits and vegetables a day Minimize sugar-sweetened beverages Eating daily breakfast Limit meals outside home Eating family meals at least 5 times a week	Promote consumption of fruit and vegetables Avoid all sweetened beverages. Water is best for children Attempt to establish a steady schedule of meals Eat in the kitchen/dining room, never in front of television Family meals are strongly recommended. Promote consumption of complex carbohydrates instead of simple carbohydrates Encourage low fat and non-fried foods
Physical Activity	Engage in ≥ 1 hour of daily physical activity	Minimum level of activity 1 hour each day Promote walking or cycling to school Suggest activities that involve parents or friends Promote even small amounts of moderate to vigorous activities Promote enjoyable and fun activities
Sedentary Behaviour	Limit screen time ≤ 2 hours a day No television in child's bedroom	Maximum of 2 hours a day of 'media time'
Parental Involvement	Allow children to self-regulate meals Avoid overly restrictive behaviours Counsel patient and family for eating behaviours	Repeatedly emphasise the parental role Parents are responsible for grocery shopping and meal preparation Parents serve as a role model Parents should encourage their child and give positive feedback Lifestyle tips are aimed at the entire household
Drugs	None in primary care	None in primary care
Referral to secondary care	When no improvement in BMI after treatment in primary care for 3 to 6 months the patient should be referred to a multidisciplinary obesity care team	Those suspected of having a syndrome Those with suspected complications of overweight or obesity Those with predisposing genetic background

RESULTS

Guidelines

In total, nineteen clinical practice guidelines were found. Nine were excluded because they were not written in English or Dutch. The remaining ten clinical practice guidelines were screened after which another four guidelines were excluded; two focussed on adults only, one was monodisciplinary while there was a multidisciplinary available in the same country and a Malaysian guideline was excluded because their national official portal of the ministry of health stated that their clinical practice guideline for the diagnosis and management of (childhood) obesity needs to be updated[14]. Guidelines from the following agencies and countries (year of publication) were included:

- Scottish Intercollegiate Guidelines Network (SIGN), Scotland (2010)[15]
- Ministry of Health (MoH), New Zealand (2009)[16]
- Dutch Institute for Healthcare Improvement (CBO), Netherlands (2008)[17]
- National Institute for Health and Clinical Excellence (NICE), UK (2006)[18]
- Obesity Canada, Canada (2006)[19]
- National Health and Medical Research Council (NHMRC), Australia (2003)[20]

Quality assessment

The quality assessment scores are shown in Table 2. All guidelines scored an overall-score of more than 50%. Both the oldest and the second oldest published guidelines (Australia and Canada, respectively) had the lowest overall agree-score. The three lowest scoring guidelines scored particularly low on items to assess whether or not the views and preferences of the target population have been sought and whether or not a procedure for updating the guideline is available.

All guidelines, except the New Zealand and the Canadian, scored less than 50% on the domain of editorial independence. The NICE-guideline from the UK was the highest scoring guideline with scores over 90% in four out of six domains (domains 'scope and purpose', 'stakeholder involvement', 'rigour of development' and 'clarity of presentation'). The Scottish guideline was the second highest scoring guideline with a score over 90% in one of six domains (domain 'scope and purpose'). No other guideline scored over 90% in any domain.

Composition of the guideline

The composition of the guideline is shown in Table 3. All guidelines formulated their target users and mentioned health practitioners in primary care as part of their target users. All guidelines are based on a comprehensive literature search, including Medline, Embase, Cochrane Library and Cinahl. Still, there was only little uniformity in the description of their literature searches. For example, some guidelines did not mention

Table 2. Quality of clinical practice guidelines on childhood obesity in primary care. Measured with the AGREE-II instrument.

AGREE items	Scotland	New Zealand	Netherlands	UK	Canada	Australia
Domain 1. Scope and purpose						
1. The overall objective(s) of the guideline is (are) specifically described.	7	7	7	7	7	5
2. The health question(s) covered by the guideline is (are) specifically described.	7	4	5	7	4	2
3. The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.	6	7	6	7	7	7
Score (%)*	**94,4**	**83,3**	**83,3**	**100,0**	**83,3**	**61,1**
Domain 2. Stakeholder involvement						
4. The guideline development group includes individuals from all relevant professional groups.	6	6	6	7	6	6
5. The views and preferences of the target population (patients, public, etc.) have been sought.	7	1	5	7	1	2
6. The target users of the guideline are clearly defined.	6	5	6	7	4	6
Score (%)*	**88,9**	**50,0**	**77,8**	**100,0**	**44,4**	**61,1**
Domain 3. Rigour of development						
7. Systematic methods were used to search for evidence.	7	7	6	5	5	6
8. The criteria for selecting the evidence are clearly described.	6	6	5	7	5	6
9. The strengths and limitations of the body of evidence are clearly described.	7	3	6	6	6	6
10. The methods for formulating the recommendations are clearly described.	5	4	6	7	7	3
11. The health benefits, side effects, and risks have been considered in formulating the recommendations.	7	6	6	7	6	6
12. There is an explicit link between the recommendations and the supporting evidence.	7	6	7	7	5	7
13. The guideline has been externally reviewed by experts prior to its publication.	6	3	6	6	6	6
14. A procedure for updating the guideline is provided.	6	1	7	7	2	1
Score (%)*	**89,6**	**58,3**	**85,4**	**91,7**	**70,8**	**68,8**
Domain 4. Clarity of presentation						
15. The recommendations are specific and unambiguous.	6	6	5	7	4	4
16. The different options for management of the condition or health issue are clearly presented.	6	7	6	6	7	6
17. Key recommendations are easily identifiable.	5	6	7	7	4	3
Score (%)*	**77,8**	**88,9**	**83,3**	**94,4**	**66,7**	**55,6**
Domain 5. Applicability						

Table 2. Quality of clinical practice guidelines on childhood obesity in primary care. Measured with the AGREE-II instrument. (continued)

AGREE items	Scotland	New Zealand	Netherlands	UK	Canada	Australia
18. The guideline describes facilitators and barriers to its application.	5	3	6	5	5	2
19. The guideline provides advice and/or tools on how the recommendations can be put into practice.	6	7	6	7	5	4
20. The potential resource implications of applying the recommendations have been considered.	4	4	4	4	4	4
21. The guideline presents monitoring and/or auditing criteria.	5	6	5	7	5	6
Score (%)*	**66,7**	**66,7**	**70,8**	**79,2**	**62,5**	**50,0**
Domain 6. Editorial independence						
22. The views of the funding body have not influenced the content of the guideline.	1	5	1	1	6	1
23. Competing interests of guideline development group members have been recorded and addressed.	4	5	5	4	7	1
Score (%)*	**25,0**	**66,7**	**33,3**	**25,0**	**91,7**	**0,0**
Overall score (%)	**79,0**	**66,7**	**76,8**	**86,2**	**68,8**	**55,8**

1= lowest quality score possible, 4= intermediate, 7= highest quality score possible

*Percentages were calculated by dividing the difference between the obtained score and the minimum possible score by the difference between the maximum and minimum possible scores.

the used keywords or gave the inclusion criteria for articles to be selected. A similarity between guidelines was that every guideline published after the NICE-guideline – i.e. the Scottish, New Zealand and Dutch guidelines – mentioned the NICE-guideline as one of their main sources.

Except the New Zealand guideline, every guideline gives a grade to their recommendations and/or makes statements about the level of evidence. In addition, all guidelines give direct links between their recommendations and the evidence, mostly via specific references.

The guidelines were all free available online.

Recommendations for diagnosis

The recommendations for diagnosis are shown in Table 4. Although not all guidelines explicitly described their target population, every guideline covered the diagnostic classification for childhood obesity.

Guidelines show differences between their recommendations concerning the diagnostic classification. All guidelines recommended measuring height and weight,

Table 3. Composition of the guideline.

Country (date): issued by*	Target users	Evidence base	AGREE-score	Dissemination channel
Scotland (2010): SIGN	Primary care, secondary and tertiary national health service weight management services	NICE-guideline Medline, Embase, Cinahl, PsycINFO and The Cochrane Library, New Zealand Guidelines Programme, NELH Guidelines Finder, and the US National Guideline Clearinghouse.	**1.** 79,0%	Free available online at http://www.sign.ac.uk/guidelines/fulltext/115/index.html No data concerning the used dissemination strategy was found
New Zealand (2009): Ministry of Health	Principally in primary care and community-based initiatives	Evidence from the *NICE guideline* was updated by a literature search to July 2008 in Medline, Embase, Cinahl, psycInfo, Cochrane database and AMED.	**2.** 66,7%	Free available online at http://www.health.govt.nz/publication/clinical-guidelines-weight-management-new-zealand-children-and-young-people No data concerning the used dissemination strategy was found
Netherlands (2008): CBO	All professions presented in the development group, such as GP's.	Based on *NICE-guideline*. Cochrane, Medline and Cinahl were searched, reference check.	**3.** 76,8%	Free available online at http://www.cbo.nl/thema/Richtlijnen/Overzicht-richtlijnen/Richtlijnen-O-t-m-R/?p=295 The guideline is spread among all relevant professions and hospitals. A summary of the guideline has been published in the Dutch Journal of Medicine (NTvG)
UK (2006): NICE	(areas that require collaboration between) primary, secondary and, where appropriate, tertiary care.	Systematic literature searches were done. Methodology is described per chapter, not in general. Search strategies included searching databases such as Medline.	**4.** 86,2 %	Free available online at http://www.nice.org.uk/CG43 No data concerning the used dissemination strategy was found
Canada (2006): Obesity Canada	Health care practitioners in everyday clinical practice	MEDLINE, EMBASE, Cochrane, and HealthSTAR were searched, from time of inception until the end of the review period. Recommendations were assessed by an independent evidence-based Review Committee.	**5.** 68,8%	Free available online at http://www.cmaj.ca/content/176/8/S1.full The guideline provides recommendations about the dissemination of guidelines in general but no data concerning the used dissemination strategy of this guideline was found.
Australia (2003): National Health and Medical Research Council	General practitioners and allied health professionals when providing advice to patients in the clinical setting	The guidelines are based on a systematic review of the scientific literature published in Medline, using PubMed.	**6.** 55,8%	Free available online http://www.health.gov.au/internet/main/publishing.nsf/Content/obesityguidelines-guidelines-children.htm No data concerning the used dissemination strategy was found

* Ranked according to publication date

calculate the BMI and determine the weight status of children. However, the definition of overweight differed among guidelines and three different sets of cut-off criteria were recommended. The first was defined by the Centre for Disease Control and prevention (Overweight: = ≥85th, obese = ≥95th)[21] and was used by Australia, Canada and New Zealand. The second set of criteria recommended other cut-offs for clinical use (obese = ≥98th, overweight = ≥91st), and these were used by both the NICE-guideline from the UK and the Scottish guideline. The third set of criteria was defined by the IOTF[22] and was recommended by the Dutch guideline.

The guidelines are also not unanimous about the recommendations for additional testing. For example, the UK, Scottish and Dutch guideline do not recommend any additional testing in primary care at all. On the other hand, the New Zealand, Australian and Canadian guideline recommend testing fasting glucose and lipid levels in specific conditions.

Table 4. Recommendations of the national clinical guidelines for diagnosis.

Country (date)*	Target population	Diagnostic classification	Additional testing
Scotland (2010)	Not clearly described	BMI centiles with national centile cut-offs; For clinical use: severely obese = ≥99,6th, obese = ≥98th, overweight = ≥91st; For public health use: obese = ≥95th, overweight = ≥85th	None advised
New Zealand (2009)	Maori and Pacific children and young people	Overweight (≥ 85th to < 95th percentile) and obesity (≥ 95th percentile), with US Centres for Disease Control and Prevention growth charts as reference	fasting lipid profile, fasting glucose, an overnight sleep study using pulse oximetry only in specific conditions
Netherlands (2008)	Children age 0-19 who appear to be overweight or obese.	IOTF + clinical view on physique, pubertal stage, ethnicity and fat distribution	None advised
UK (2006)	Children aged 2 years or older, either healthy weight, overweight or obese	BMI (interpreted with caution) centiles with the UK 1990 BMI charts as reference; obese = ≥98th, overweight = ≥91st	Only advised in secondary care.
Canada (2006)	Children and adolescents who are overweight or obese, or with an increased waist circumference.	Overweight (≥ 85th to < 95th percentile) and obesity (≥ 95th percentile), with US Centres for Disease Control and Prevention growth charts as reference	Fasting plasma glucose level and determining lipid profile in children aged 10 years and older
Australia (2003)	Children and adolescents in the clinical setting	Overweight (≥ 85th to < 95th percentile) and obesity (≥ 95th percentile), with US Centres for Disease Control and Prevention growth charts as reference	Fasting lipid, fasting glucose in obese children and adolescents, particularly those with additional risk factors.

* Ranked according to publication date

As advised by the expert committees all guidelines recommend to measure height and weight and determine the weight status with based on standard growth charts. In contrast to what the expert committees advise none of the national guidelines recommend to measure blood pressure or to test for alanine transaminase (ALT). In addition, none recommend measuring waist circumference, which is recommended by the EASO, but not by the American expert committee.

Recommendations for management

The recommendations made for the management of childhood obesity are shown in Table 5. The guidelines describe their treatment goals differently, but the focus of all guidelines seems to be on either weight maintenance – because children can still lower their body mass index by maintaining their weight but increasing their height – or weight loss depending on the specific situation.

Guidelines make different statements about the duration of therapy. Some guidelines make explicit recommendations about the follow up, while others do not, but all guidelines seem to consider the management as long-lasting and state that there should be on-going contact for at least three months. Concerning the non-drug treatment all guidelines recommend a combined strategy of diet, activity and counselling. They recommend healthier eating and some guidelines refer to other dietary guidelines for children. The Dutch and UK guideline explicitly state that dietary changes should be sustainable. All guidelines recommend that children should be encouraged to increase their activity. The UK, Scottish and Dutch guideline advise a minimum of 60 minutes per day of at least moderate activity. The guidelines also recommend less sedentary behaviour or a limited amount of screen-time (time spent in front of a computer, TV or game console). All guidelines recommend that parent and/or family should play a role in the treatment of the overweight or obese child. The Dutch guidelines recommend that overweight or obese parents should lose weight as well.

None of the guidelines advise drug use as one of the basic elements in the treatment of childhood obesity. Drug use is recommended only in specific conditions, varying between the several countries. In 2010 the NICE-guideline provided an update stating that their initial recommendations for the use of sibutramine were withdrawn. None of the more recently published guidelines made recommendations about the use of sibutramine. The NICE-guideline from the UK stated that the use of medication should only be started in secondary care, while the other guidelines which advise drug treatment in specific situations were less clear about this.

Recommendations concerning the referral to secondary care vary extremely between countries. The Canadian and Australian guidelines recommend to refer children with marked obesity of early onset and associated abnormalities to a clinical geneticist, while the other guidelines do not recommend this. The NICE-guideline from the UK remains

Table 5. Recommendations of the national clinical guidelines for management.

Country (date)*	Goal	Follow-up	Non drug treatment**			Drug	Referral to secondary care	
			Diet	Activity	Counselling and parental involvement		Who?	To Whom?
Scotland (2010)	Weight maintenance (≥98th) with annual monitoring (≥91st), weight loss max: 0.5-1 kg per month (≥99,6th)	Interventions both intensive and long-lasting (≥ 6 months)	Healthier eating and decreasing energy intake.	In healthy children, 60 min/day of moderate-vigorous activity), no more than 14 hours screen time per week	Treatment programmes should incorporate behaviour change components, be family based, involving at least one parent/carer and aim to change the whole family's lifestyle.	Orlistat; only for severely obese patients with co-morbidities or extreme obese patients (>3.5 SD above average)	Obesity-related morbidity that requires weight loss, suspected underlying cause for obesity (including all children under 24 month of age who are severely obese)	Paediatrician
New Zealand (2009)	Slowing down weight gain and weight loss in some young people	Ongoing contact and support is an essential element in the management of obesity.	A nutrionally balanced diet to ensure growth and development are maintained.	Encourage parent support for children to be active and families to exercise together.	Comprehensive lifestyle approaches involving family and remember parent may be better agents of change than the child.	Consider in BMI > 95th percentile and no weight control. Orlistat is contra-indicated under 12 years and sibutramine*** is contra-indicated under 18 years.	Physiological matured persons with BMI above 50 or BMI above 40 plus other significant disease with no BMI reduction after lifestyle intervention	Surgeon
Netherlands (2008)	Optimal growth in height combined with decrease in BMI (by weight loss or weight maintenance)	At least 1 year, followed by long-lasting monitoring and support	Dietary changes should be sustainable and consistent with healthy eating advice	At least 60 min/day of moderate-vigorous activity), less sedentary behaviour	Behavioural therapy by professional. Parents should be encouraged to function as a role model.	Additional drug use is generally not recommended (only in exceptional cases).	Children treated for obesity	Paediatrician; further research for co-morbidity and management plan (both along with GP)

Table 5. Recommendations of the national clinical guidelines for management. (continued)

Country (date)*	Goal	Follow-up	Non drug treatment**			Drug	Referral to secondary care	
			Diet	Activity	Counselling and parental involvement		Who?	To Whom?
UK (2006****):	Creating a supportive environment that helps making lifestyle changes. Weight is managed by either weight maintenance or weight loss	Regular long-term follow-up by a trained professional	Dietary changes should be individualised, sustainable, age appropriate and consistent with healthy eating advice.	At least 60 min/day of at least moderate activity in session lasting 10 min or more, less sedentary behaviour.	Overweight parents of overweight children should lose weight. Behavioural interventions should include strategies such as stimulus control, self monitoring, goal setting, rewards for reaching goals and problem solving.	Prescribers should not issue any new prescriptions for sibutramine***. Drug use, such as orlistat, is only continued in primary care (if circumstances and licenses allow) after it is started in specialist paediatric settings	Overweight children with significant co-morbidity or complex needs (for example, learning or educational difficulties).	An appropriate specialist, not further described.
Canada (2006)	No treatment goal described.	Follow-up for a minimum of three months	Energy-reduced diet, developed by qualified and experienced health care professional (preferably a registered dietician)	Regular physical, fun, and/or recreational activity, reduction of screen-time	Family based behaviour therapy	Orlistat; added to a regimen of lifestyle intervention. Prepubertal children can only be treated within the context of a supervised clinical trial.	Marked obesity of early onset and associated abnormalities	Geneticist

Table 5. Recommendations of the national clinical guidelines for management. (continued)

Country (date)*	Goal	Follow-up	Non drug treatment**			Drug	Referral to secondary care	
			Diet	Activity	Counselling and parental involvement		Who?	To Whom?
Australia (2003)	A BMI percentile below the 85th, in young children weight maintenance suffices	No explicit recommendation is made, but health care providers should be aware that obesity management is a medium- to long-term intervention.	Follow the Dietary Guidelines for Children and Adolescents in Australia and the Australian Guide to Healthy Eating. VLED***** therapy in adolescents only by specialist obesity-management teams	Age-appropriate activity and reducing screen-time.	Involve parents, especially for children of primary school age, always incorporate simple age-appropriate behaviour modification	Orlistat or sibutramine*** in obese adolescents with co-morbidity only in a specialist centre	Severe and early onset obesity, obesity in association with intellectual disability and multiple physical abnormalities, height-growth failure	Paediatrician, Endocrinologist and geneticist

* Ranked according to publication date

**All guideline recommend combinations

*** No update of neither the Australian nor the New Zealand guideline provided updated information about the usage of sibutramine.

**** A 2010 update of the NICE-guideline provided information about the usage of sibutramine. It stated that prescribers should not issue any new prescriptions for sibutramine and that they should review the treatment of patients taking the drug and discuss alternative matters.

***** VLED = Very Low Energy Diet

unclear, by recommending referral to an appropriate specialist, not further defined. The Dutch and Scottish guidelines recommend referral to a paediatrician in some cases, for example for children with obesity related morbidity that requires weight loss. The New Zealand guideline is the only guideline that explicitly mentions a surgeon as a possibility for referral.

As advised by the expert committees all guidelines recommend a no drug treatment with the components nutrition, physical activity and counselling. National guidelines advise to eat healthy and reduce energy intake and sedentary behaviour. The expert committees have more specific recommendations to avoid sweetened beverages, promote fruits and vegetables, eat with the family and limit screen time to less than two hours a day. Both the guidelines and the expert committees varied in their recommendations on referral to secondary care.

DISCUSSION

Most important findings

The aim of this study was to present an overview of available guidelines for the management of childhood obesity in primary care. Six clinical practice guidelines were found. A summary of common recommendations is shown in Table 6.

First of all, the comparison of the guidelines shows that there is no clear consensus regarding the diagnostic classification. All guidelines recommend to measure weight and height and determine the weight status. However, the six guidelines used three different classifications for obesity. This lack of consensus is consistent with findings from a previous paper.[23] In recent years, several other studies have tried to come up with the best way to measure and define childhood obesity[24-26], but international consensus has yet to be reached. The expert committees recommend to measure height and weight and determine the weight status by comparing the BMI with standard growth charts. They do not note which classification for childhood obesity gives the best definition. This underlines the lack of consensus on the diagnostic classification.

National guidelines do not recommend measuring waist circumference. This is in accordance with the American expert committee. However, the EASO does recommend to measure waist circumference and compare values with appropriate reference data.[27] They note that a waist circumference greater than the 90th percentile increases the risk for the presence of cardio-vascular risk factors and insulin resistance.

The guidelines made various recommendations about additional diagnostic testing. The three guidelines with the highest overall AGREE-score did not recommend additional testing in primary care. Recommendations regarding additional testing seem to have decreased since the NICE-guideline only advised additional testing in secondary

care, and two out of the three more recently published guidelines did not recommend additional testing. However, both expert committees do recommend to measure blood pressure. The difference between recommendations regarding additional testing can be explained because the value of additional tests for childhood obesity in primary care is unknown.

Broad consensus was found regarding the management of childhood obesity. The treatment goal in all guidelines is weight management or weight reduction, depending on the BMI and the remaining growth potential. The treatment is always recommended to be a combined intervention with parental or family involvement, dietary changes, increase in physical activity and counselling being the most essentials elements. Lifestyle changes, focussing on diet, physical activity and/or behaviour changes are also recommended by both expert committees and the 2009 Cochrane review[10]. The important role of parental involvement is also underscored by recent studies.[28,29] Three out of the latest four guidelines did make specific recommendations concerning physical activity; more than 60 minutes a day of moderate to vigorous physical activity, which is in line with both expert committees and the recommendation of the World Health Organization.[30] However, the content of the treatment recommendations in the guidelines lack clarity when it comes to both diet and counselling. In general the guidelines fail to inform about specific diet plans or an approach for counselling. Both the EASO and an American expert committee published practical tips for the primary health care provider (see Table 1). These tips include nutritional and behavioural recommendations (e.g. promote eating in the kitchen with the family, drink water instead of sweetened beverages and limit screen time to less than two hours a day), that might be useful to a lot of primary health care providers.

All guidelines are reticent about the use of medication in the management of obesity in children. Orlisat is only recommended in certain conditions. The NICE-guideline provided an update stating that their initial recommendations for the use of sibutramine are withdrawn, because the marketing authorization was suspended by the Medicines and Healthcare products Regulatory Agency (MHRA)[31]. This followed a review by the European Medicines Agency which found that the cardiovascular risks of sibutramine outweigh its benefits.[32] The Australian guideline initially also made recommendations for the use of sibutramine, but an update stating that these recommendations are withdrawn was not found.

Strengths and limitations

This was the first study presenting an overview of the available guidelines for the management of childhood obesity in primary care. An extensive search was done and clinical practice guidelines from over fifteen countries were found.

Table 6. Summary of common recommendations in national guidelines

Summary of common recommendations in national guidelines
Diagnosis
• Measuring weight and height
• Determine weight status
Management
• Combined intervention:
1. Dietary changes (sustainable and consistent with healthy eating advice)
2. Increase physical activity (less sedentary behaviour and at least 60 min/day of at least moderate activity)
3. Family-based counseling
• Consider medication (e.g. Orlistat) only in exceptional cases

The AGREE II-tool was used to assess the quality of the guidelines. It is an international tool for the assessment of practice guidelines. The AGREE II is both valid and reliable and the overall-score gives a reliable indication of the quality of the guideline. Still, some items are less relevant for the assessment of the guidelines but do have a major influence on their domain score or even on the overall score. For instance, the domain 'editorial independence' had a negative influence on the overall-score of the best scoring guidelines. These guidelines failed to give information about the editorial independence and therefore had the lowest possible score for these items. Still, this does not necessarily mean the editors had conflicts of interest.

A limitation of this study might be that all guidelines were reviewed by a single reviewer. To overcome this limitation another reviewer checked the data-extraction and quality assessment of one randomly chosen guideline. There were no differences in the extracted data and only slight differences in AGREE-scores.

Another limitation to this study might be that only Dutch and English guidelines were included. Nine guidelines were excluded based on language. The result of this inclusion criterion might have been that the guidelines we found show more similarities than guidelines from for example non-western cultures. However, only two guidelines of non-western countries (Malaysia and Brazil) were initially found. We chose for only Dutch and English guidelines, because we wanted to be certain we were able to completely understand the content of guidelines and the nuances in the text. Nevertheless, since obesity is a worldwide concern, it would be interesting to compare western with non-western guidelines in the future.

Recommendations

Although it might be hard to create one diagnostic classification system that suites all countries, future research could focus on creating such a classification system. In addition clinicians could try to obtain more practical knowledge to make more explicit

recommendations concerning the treatment of childhood obesity. For instance, present guidelines do not always inform primary health care practitioners about the duration of the therapy, the frequency of consultations and the content of these consultations. For developing or updating guidelines, we recommend considering the practical tips of the expert committees.[11,13]

Conclusion

The present study shows that there is broad consensus in the management of childhood obesity in the primary care setting. All guidelines recommend a combined intervention, with diet, activity and counseling being the three most important elements. However, exact recommendations for these interventions often lack clarity. In addition, this study shows that there is consensus regarding the non-prescription of medicine, since medicine is only prescribed in exceptional cases. However, there is no clear international consensus about the diagnostic classification for childhood obesity. Most countries use their own preference for the classification systems.

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Chapter 9

Addressing healthy eating and exercise in young people presenting to primary care: secondary findings from a cluster randomized trial of training clinicians in health risk screening and motivational interviewing principles

WD Paulis, M van Middelkoop, S Kauer,
P Chondros, G Patton & LA Sanci

Submitted

ABSTRACT

We evaluated whether training primary care clinicians in preventive health care for young people had benefits on 1) how often healthy eating and exercise were discussed, and 2) young people's self-reported Body Mass Index (BMI), amount of physical activity and satisfaction with their eating behavior. In addition, we explored whether healthy eating and exercise were discussed particularly in overweight and obese young people and whether they report willingness to change.

These are secondary analyses from a cluster randomized controlled trial. Forty-two general practices from Victoria, Australia were recruited (2007-2011). Intervention clinicians received training on general health risk assessment and motivational interviewing. Young people (14-24 years) were recruited when consulting their general practice and 901 young people were included. Clinicians in intervention practices discussed eating (OR 1.71, 95%CI [1.09, 2.68]) and exercise behavior (OR 2.04, 95%CI [1.29, 3.23]) more often post-consultation (28% of consultations) than clinicians in comparison practices (22%). There were no differences between the two arms on self-reported BMI or behavior of youth at three and 12 month follow-up. Half of the overweight and obese youth reported willingness to change eating or exercise behavior, however most had not discussed these behaviors with the GP.

Training clinicians in general health risk assessments increases the number of consultations in which healthy eating and exercise are discussed, however this alone does not appear to improve BMI or behavior. Since half of the overweight and obese young people are willing to change behavior there are opportunities to increase GPs engagement in weight management.

INTRODUCTION

One quarter of Australian adolescents are currently overweight or obese[1] in common with adolescents in other developed countries.[2, 3] Excess weight at a young age is associated with chronic obesity in adulthood, which increases the risk of weight-related morbidities.[4]

If energy intake increases above energy expenditure the excess is used to build new fat tissue and weight gain results, a continuation of this imbalance may lead to obesity.[5] Risk-factors for obesity are therefore the intake of energy dense foods, too little physical activity, and too much sedentary behavior. These risk-factors are prevalent among Australian adolescents: 95% of the boys and 91% of the girls have at least one of these risk-factors.[6] It has been shown that levels of physical activity linearly decline with age.[7] Therefore effective weight management strategies at a young age are needed.

Since overweight and obese children and adolescents are frequently seen by primary care professionals this setting can play an important role in managing weight in children and adolescents.[8, 9] Targets of interventions in primary care include incorporating a healthy diet and decreasing sedentary behavior.[8, 10] Several countries have recognized primary care as a good setting for obesity management and have developed clinical guidelines.[11] General practitioners (GPs) acknowledge their important role in the management of childhood obesity.[12] However, the majority of GPs do not address weight in regular consultations and report several barriers including the limited evidence base for effective management strategies[13] and the feeling that parents and children lack motivation to change.[14] Moreover, GPs emphasize the need for additional training in the management of childhood obesity.[12]

Overweight and obese young people visit the GP more often than normal-weight youth[15] hence offering greater opportunities for GPs to initiate discussions about weight, eating and exercise behavior. Adolescents perceive healthcare professionals as credible sources of health information and trust their advice.[16] Body shape, eating and exercise together with acne are the most common health topics adolescents report wanting to discuss with their primary health care provider.[17] Accordingly, GPs discussing eating and exercise behavior with young people could be a starting point for effective weight management.

The Prevention Access and Risk Taking in Young people (PARTY) study is a cluster randomized controlled trial assessing the effectiveness and acceptability of an intervention training primary care clinicians (GPs and practice nurses) to address risk-taking behavior in youth presenting to general practice.[18] Primary care clinicians were trained in motivational interviewing strategies to address primarily the risk-taking behaviors of tobacco, alcohol, illicit substance use, road risks, and unprotected sex. The primary outcomes of the trial were focused on the effects of the intervention on these specific health risks. It was shown that intervention clinicians discussed more health risks per young person than comparison clinicians and young people in intervention practices reported less

illicit drug use and unprotected sex at three months, and less unplanned pregnancies at 12 months post-consultation.[19]

An additional main component of the intervention was training clinicians in discussing a broad range of psychosocial health risks with young people using the HEADSS approach (Home; Education, employment, eating, exercise; Activities and peers; Drugs, cigarettes, alcohol; Sex and sexuality; Suicidality and other mental health symptoms and Safety), which includes the themes of healthy eating and exercise.[20] Possible effects of the intervention on discussing eating and exercise behavior with young people during regular consultations were not investigated yet.

In this paper we present secondary analyses of the PARTY study exploring whether the generic training on screening young people for psychosocial health risks and motivating change in young people's risk taking behaviors provided to the clinicians had any benefits on 1) the number of consultations in which healthy eating and exercise were discussed, and 2) young people's self-reported Body Mass Index (BMI), physical activity patterns and satisfaction with their eating habits. Our secondary aims were to explore whether healthy eating and exercise were discussed particularly with overweight and obese young people and whether these young people reported willingness to change.

METHODS

Study design, intervention and recruitment of participants

We used data from the PARTY study, a stratified cluster randomized trial that recruited general practices and their patients in Victoria, Australia (2007-2011), following CONSORT guidelines (see Appendix A1).[21, 22] The general practice was the unit of randomisation. Practices were eligible for participation if they had at least one GP or practice nurse (PN) interested in the study. The study protocol and main outcome paper, with a detailed description of the intervention, have been published.[18, 19]

Briefly, intervention clinicians received nine hours of training in interactive workshops using role play in youth friendly care, health risk screening using the HEADSS approach and responding to identified risk-taking behaviors with motivational interviewing techniques. Practice support staff also received training in youth friendly practices. The workshops were followed by two practice visits to a) support the use of a screening tool designed to prompt a discussion of health risks using the HEADSS framework, and b) present clinicians data from a small sample of their young patients recruited from each practice prior to randomisation. This data displayed the specific health risks under target from the study and the frequency that clinicians had discussed these with the young people. By contrast, comparison clinicians only received one three hour didactic seminar on youth friendly care, including a brief description of the HEADSS approach.

Young people were recruited from all practices approximately three months post intervention, directly after their consultation. Clinicians provided a brief explanation and requested permission to pass contact details to the study researchers who later phoned each young person and provided a detailed explanation of the study and obtained informed consent. Since clinicians were inconsistent with approaching eligible youth, research assistants were placed in clinic waiting rooms to systematically recruit all eligible young people entering the practice, following the same procedure as clinicians.[18] All young people were given the option to enter a draw for an iPod valued at A$200 as an incentive for participating. Researchers conducted a computer assisted telephone interview (CATI) with young people as soon as possible after the consultation, on average within one week after consultation (median 4 days; mean 6.41 days; std 7.98) lasting approximately 50 minutes: 'the exit interview'. An exit interview with young people has been shown to be a valid method of capturing discussions of health risks up to two months after consultation.[23] Follow-up CATIs (twenty minutes) were conducted with all participants at three and 12 months (Figure 1).

All young people aged between 14 to 24 years were eligible for participation if they consulted the practice for any clinical reason. Youth were excluded if they were very unwell (vomiting, febrile, weak, psychotic or cognitively impaired), could not speak English or if they were less than 18 years of age and judged by the clinician to be too immature to consent on their own behalf and unable to get parental consent.

Measures

The CATI contained self-reported measures of the young person's engagement in risky behaviors, willingness to change health behaviors, basic demographics and experience with the clinic and clinicians. For the present analyses we used the following data:

- basic demographics at exit interview: age, gender, birth country, education (student yes/no) and employment (employed yes/no)
- billing type (private, national health care funded or community health centres) and socioeconomic status of the geographical location of the general practice (based on Socio-Economic Indexes for Areas (SEIFA)[24]
- self-reported height and weight at exit interview, three and 12 month follow-up
- self-reported physical activity level at exit interview, three and 12 month up
- self-reported satisfaction with eating behavior at exit interview, three and 12 month up
- willingness to change eating or exercise behavior at exit interview
- whether the clinician discussed eating or exercise behavior at the recruitment consultation or previously in their relationship with the young person

Details on the data and exact formulation of the questions can be found in Appendix A2.

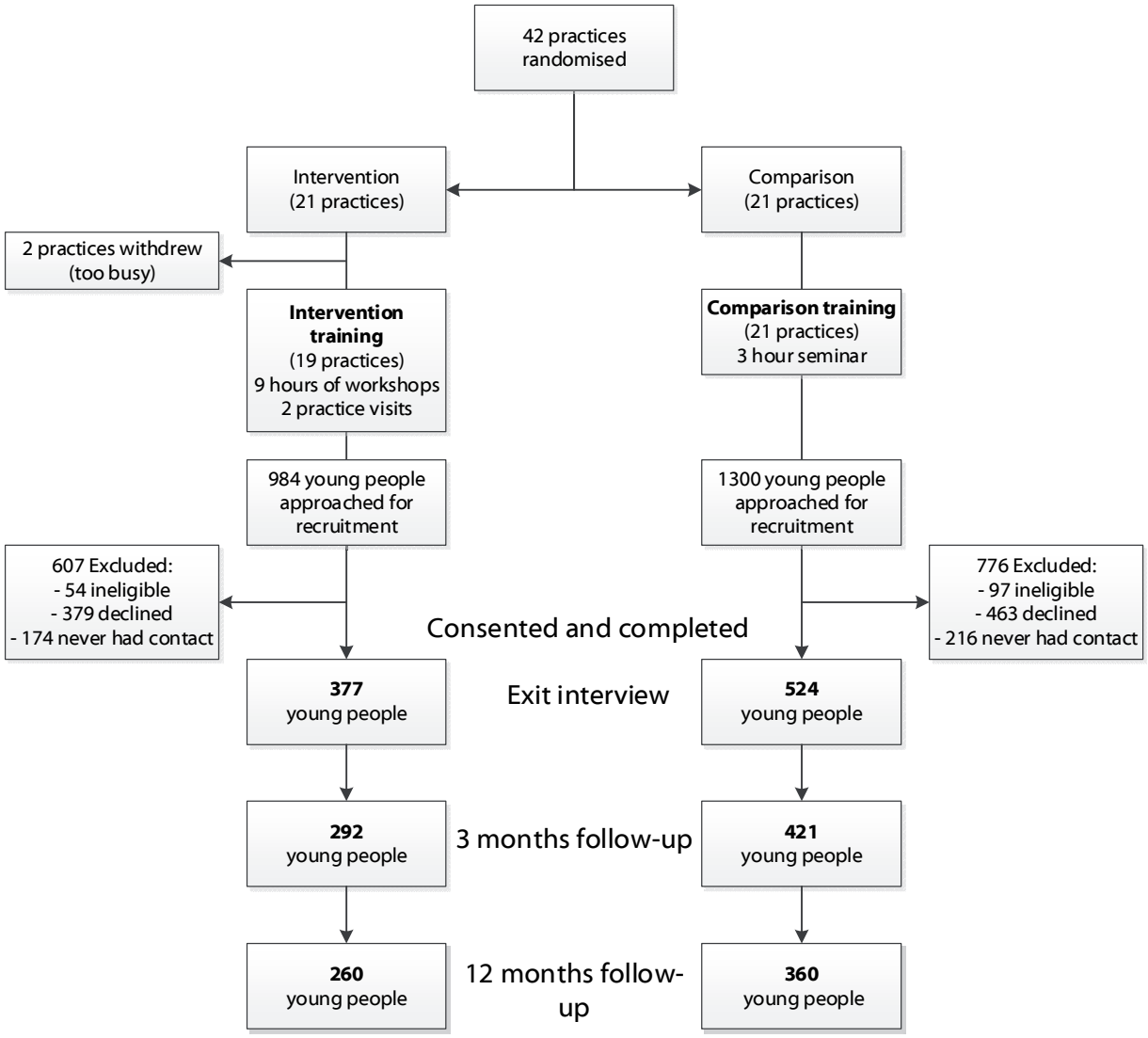

Figure 1. Outline of study, inclusion flow and number of young people used in analyses (Victoria, Australia 2007-2011) modified from main outcome paper[25]

Sequence generation, allocation concealment and blinding

Random allocation was stratified based on socioeconomic advantage-disadvantage scores (SEIFA tertiles dichotomised as middle/high versus low) and billing type (private, national health care funded or community health centres), forming six strata. An independent statistician computer-generated the allocation sequence in block sizes of two within each stratum. The research assistants recruiting young people into the trial and conducting the CATIs were blind to the study arm status of the practices. Young people were not informed on the intervention status of their practice.

Data management and analyses

The sample size needed was 720 youth (18 per practice) from 40 practices to detect a 12.5% difference between the intervention and comparison clinicians in the proportion of young people detected with at least one of the six health risk behaviors (tobacco,

alcohol, illicit drug use, risks for sexually transmitted infection, unplanned pregnancy, and road risks), a assuming an intra-cluster correlation (ICC) of 0.04, 80% power and 5% alpha for 2-sided test. This sample size was inflated by 40% to allow attrition in youth over 12 months and loss of two practices. Details are published elsewhere.[18, 19] All statistical analyses were conducted using STATA/SE 12.0 (Statacorp, College Station, Texas USA). Body Mass Index (BMI) and BMI-z were calculated using self-reported height and weight data.[26] Young people were categorized as underweight, normal weight, overweight or obese using international gender and age specific cut-off values.[27, 28]

All participants who completed the exit interview were analysed in the arms to which their practice was allocated. The intervention effects on whether the behavior was discussed, physical activity patterns and satisfaction with eating behavior were estimated using logistic regression models and the intervention effect on BMI was estimated using a linear regression model. For all models, generalised estimating equations with robust standard errors were used to adjust for clustering effect of the general practice, and where applicable for repeated outcome measures over time. Complete case analyses that included all available data were conducted for the 3 and 12 month outcomes. Multivariable regression was used to adjust for age, gender, BMI category at the exit interview; variables used to stratify randomisation (SEIFA level of the practice location and billing type) and recruitment method of the young people in the trial (clinician versus research assistant). We also conducted separate regression analyses for whether clinicians discussed health behavior by BMI category to identify whether the magnitude of the intervention effect differed depending on the BMI category. ICC values for outcomes were estimated using one-way analysis of variance. Estimates of the intervention effect were reported as odds ratios (OR) for binary outcomes and difference in the mean outcome between the two study arms for continuous outcomes, with respective 95% confidence intervals (CI) and p-values.

Exploratory analyses addressed the secondary aims using descriptive statistics to examine the percentage of young people for each BMI category at exit interview that reported discussing healthy eating and exercise with their clinician, and the proportion of young people within each BMI category that reported willingness to change eating and exercise behavior.

RESULTS

Forty-two practices were randomized, two intervention practices withdrew post-randomisation, pre-intervention, leaving 19 intervention (53 clinicians, 377 patients) and 21 comparison (79 clinicians, 524 patients) practices (Figure 1). Overall, Table 1 shows that the young people in the two study arms were similar at the exit interview, except more

comparison youth were born in Australia (90%) compared to intervention youth (75%). Most participants were female (75.7%) and the mean age was 19.6 (2.9) years.

Effectiveness of GP training program on discussing healthy eating and exercise at recruitment consultation

Table 2 shows that clinicians in the intervention practices were more likely to discuss both eating (OR 1.71, 95%CI [1.09 to 2.68]) and exercise behavior at recruitment consultation (OR 2.04, 95%CI [1.29 to 3.23]) than clinicians in comparison practices. Eating behavior was discussed in 22% of the consultations in the comparison practices and 29% of the consultations in the intervention practices. Comparable percentages were found for exercise behavior. Stratified analyses by BMI category shows that there was effect modification, where the odds ratio of discussing eating or exercise behaviors with

Table 1. Baseline characteristics of young people in the intervention and comparison practices (Victoria, Australia 2007-2011)

Characteristics at the exit interview	Intervention N= 377		Comparison N= 524	
	Mean (s.d.)		**Mean (s.d.)**	
Age in years (N=901)	19.8 (2.8)		19.4 (2.9)	
	n (%)		**n (%)**	
Advantaged Socioeconomic status (N=901)	314 (83.3)		437 (83.4)	
Student (N=900)	268 (71.1)		343 (65.6)	
Employed (N=898)	245 (65.2)		350 (67.1)	
Born in Australia (N=899)	284 (75.3)		472 (90.1)	
Willing to change eating behavior (N=898)	177 (47.2)		232 (44.4)	
Willing to change exercise behavior (N=898)	169 (45.0)		215 (41.2)	
		ICC		**ICC**
Satisfied with eating behavior (N=900)	246 (65.3)	0.014	376 (71.9)	0.024
Moderate activity every day* (N=898)	147 (39.1)	0.056	184 (35.3)	0.002
Vigorous activity at least twice a week* (N=900)	229 (60.7)	0.005	351 (67.1)	0.025
BMI categories (N=683)				
Underweight	28 (8.6)		33 (9.2)	
Normal weight	230 (70.8)		226 (63.1)	
Overweight	49 (15.1)		73 (20.4)	
Obese	18 (5.5)		26 (7.3)	
BMI (N=683)	**Mean (s.d.)**	**ICC**	**Mean (s.d.)**	**ICC**
BMI-z (if age <18) (n=161)	0.48 (0.89)	-	0.32 (1.09)	0.045
BMI (if age >=18) (n=522)	22.7 (4.1)	0.023	23.6 (4.4)	0.038

* activity which lasts at least 20 minutes; s.d. = standard deviation

† Intra-cluster correlation (ICC) estimated at exit interview for each arm using one way analysis of variance; ICC values not shown were truncated at zero.

Table 2. Eating and exercise behaviour discussed by clinician in intervention and comparison practices (exit interview data, 2007-2011)

	Intervention N=372	Comparison N=516	Unadjusted		Adjusted	
Eating behaviour discussed at recruitment consultation	**n(%)**	**n(%)**	**OR (95% CI)**	**p-value**	**OR (95% CI)***	**p-value***
All young people at the exit interview	107 (28.8)	115 (22.3)	1.37 (0.90, 2.09)	0.14	1.71 (1.09, 2.68)	0.02
Stratified by BMI category^						
Underweight	10 (35.7)	10 (31.3)	1.11 (0.34, 3.67)	0.87	1.10 (0.26, 4.70)	0.89
Normal weight	58 (25.6)	43 (19.3)	1.41 (0.81, 2.47)	0.23	1.49 (0.90, 2.47)	0.12
Overweight	16 (32.7)	13 (18.3)	2.43 (1.09, 5.45)	0.03	3.37 (1.55, 7.29)	0.002
Obese	9 (50.0)	6 (24.0)	2.80 (1.22, 6.44)	0.02	3.78 (1.09, 13.1)	0.04
Exercise behaviour discussed at recruitment consultation	**n(%)**	**n(%)**	**OR (95% CI)**	**p-value**	**OR (95% CI)***	**p-value***
All young people at the exit interview	106 (28.5)	112 (21.7)	1.51 (0.98, 2.32)	0.06	2.04 (1.29, 3.23)	0.002
Stratified by BMI category^						
Underweight	7 (25.0)	10 (31.3)	0.83 (0.23, 2.91)	0.77	1.00 (0.27, 3.67)	0.99
Normal weight	64 (28.2)	36 (16.1)	2.16 (1.26, 3.69)	0.005	2.32 (1.36, 3.97)	0.002
Overweight	17 (34.7)	15 (21.1)	2.35 (0.96, 5.75)	0.06	2.52 (0.96, 6.64)	0.06
Obese	10 (55.6)	8 (32.0)	4.35 (2.11, 8.96)	0.000	3.57 (1.50, 8.49)	0.004

All confidence intervals and p-values adjusted for clustering by general practice

* Adjusted for: BMI categories at exit interview, age, gender, socioeconomic status and billing type of practice, recruiter

^ Discrepancies in totals is due to missing BMI values

young people at recruitment consultation was higher in the young people who were classified as being overweight or obese.

Effectiveness of intervention on young people's behaviour and BMI

There was no evidence to support differences in self-reported physical activity patterns, satisfaction with eating behavior or BMI between the intervention and comparison arms at three and 12 months follow-up (see Table 3). BMI(-z), physical activity patterns and satisfaction with eating behavior at follow-up were not significantly different from baseline values.

Healthy eating and exercise discussed according to weight status and willingness to change

Figure 2 shows, young people's willingness to change and whether or not healthy eating and exercise were discussed by the clinician at the recruitment consultation for each BMI category. Within the entire cohort, 24.3% of the young people were classified as overweight or obese. Almost 60% (58.4%, 95%CI 50.8 to 65.7) reported willingness to change their eating behavior and 41.6% (95%CI 34.4 to 49.2) reported willingness to change their exercise behavior. Of those who were willing to change eating behavior 29.7% (95%CI 21.7 to 39.6) reported that the clinician discussed healthy eating with them during the consultation and for willingness to change exercise behavior 29.2% (95%CI 19.6 to 40.6) reported discussing exercise with their clinician.

Eating behavior was never discussed (neither at recruitment consultation nor previously) with 53.3% (95%CI 44.5 to 61.9) of overweight and 39.5% (95%CI 25.7 to 53.3) of obese young people. Similarly, exercise behavior was never discussed with 47.5% (95%CI 38.9 to 56.3) of overweight and 25.6% (95%CI 14.6 to 39.4) of obese young people. Forty percent of overweight and 23.3% of obese young people reported that neither eating nor exercise behavior were ever discussed with them by a clinician in their general practice.

DISCUSSION

Summary of main findings

The present study showed that in practices in which the clinicians had broad training to screen and diagnose health risk behaviors, eating and exercise behavior were discussed more often during regular consultations with young people, especially with overweight and obese young people. However, the intervention did not lead to any positive changes in physical activity patterns, satisfaction with eating behavior or BMI of the young person at 3 or 12 months follow-up. In addition, this study shows that healthy eating and

Table 3. Young people's BMI and health behaviours at 3 and 12 months follow-up (Victoria Australia, 2007-2011)

				Unadjusted		Adjusted	
BMI	**N**	**Intervention**	**Control**	**β (95% CI)**	**p-value**	**β (95% CI)***	**p-value***
3 Months		**Mean (s.d.)**	**Mean (s.d.)**				
BMI-z (if age <18)	170	0.56 (0.97)	0.32 (0.97)	0.20 (−0.13, 0.52)	0.24	0.00 (−0.20, 0.21)	0.97
BMI (if age >=18)	507	23.2 (4.6)	23.2 (4.1)	−0.26 (−1.04, 0.52)	0.52	0.16 (−0.19, 0.51)	0.38
12 Months		**Mean (s.d.)**	**Mean (s.d.)**				
BMI-z (if age <18)	155	0.56 (0.92)	0.29 (0.99)	0.20 (−0.13, 0.53)	0.23	−0.10 (−0.33, 0.12)	0.38
BMI (if age >=18)	446	22.9 (4.7)	23.6 (4.5)	−0.68 (−1.51, 0.14)	0.38	−0.14 (−0.55, 0.28)	0.52
Physical activity		**Intervention**	**Control**	**Unadjusted**		**Adjusted**	
Moderate activity every day	**N**	**n (%)**	**n (%)**	**OR (95% CI)**	**p-value**	**OR (95% CI)***	**p-value***
3 Months	712	109 (37.5)	158 (37.5)	0.98 (0.69, 1.41)	0.93	1.06 (0.72, 1.54)	0.78
12 Months	620	95 (36.5)	130 (36.1)	1.01 (0.70, 1.46)	0.95	1.03 (0.68, 1.56)	0.88
Vigorous activity at least twice a week	**N**	**n (%)**	**n (%)**	**OR (95% CI)**	**p-value**	**OR (95% CI)***	**p-value***
3 Months	713	187 (64.0)	279 (66.3)	0.90 (0.64, 1.27)	0.56	0.96 (0.69, 1.34)	0.83
12 Months	620	159 (61.2)	237 (65.8)	0.83 (0.53, 1.30)	0.41	0.88 (0.59, 1.31)	0.53
Satisfaction with eating behaviour		**Intervention**	**Control**	**Unadjusted**		**Adjusted**	
Satisfied with eating behaviour	**N**	**n (%)**	**n (%)**	**OR (95% CI)**	**p-value**	**OR (95% CI)***	**p-value***
3 Months	713	231 (79.1)	341 (81.0)	0.89 (0.62, 1.27)	0.51	0.90 (0.65, 1.25)	0.54
12 Months	620	205 (78.9)	291 (80.8)	0.89 (0.61, 1.30)	0.54	1.00 (0.71, 1.40)	1.00

OR=Odds ratio; CI=Confidence interval; All CIs and p-values adjusted for repeated outcome measures over time and clustering by general practice

* Adjusted for: BMI categories at exit interview, age, gender, socioeconomic status and billing type of practice, recruiter

exercise were not discussed by the clinician in a large group in of overweight and obese young people. Finally, the study also reveals that a large group of overweight and obese youth report willingness to change their eating or exercise behavior.

Strengths and limitations

The experimental design reported according to CONSORT criteria for cluster randomized trials[29] and the efforts to minimize response bias by blinding young people and research assistants are major strengths of this study. The intervention for clinicians was focused more on responses to substance use and unprotected sex and not specifically on healthy eating and exercise which should be taken into account when interpreting the findings.

We used self-reported measures of height and weight and physical activity patterns from young people's interviews. This might have led to an underestimation of the percentages determined as overweight and obese[30], and an overestimation of the amount of physical activity[31], but this is likely to be similar across the intervention and comparison practices. In addition, height and weight data were not available for all participants. Height and weight were included to the exit interview after the first 219 participants were recruited into the study. Since the reason for the missing values is procedural we assume that the missing responses for BMI are unlikely to bias our results. Furthermore, we measured whether or not young people were satisfied with their eating behavior and not whether they actually consumed a healthy diet. It remains unclear whether the intervention influenced young people's actual dietary habits. However, since young people's satisfaction with their eating behavior at follow-up were not significantly different from exit interview and there were no differences between young people in intervention and comparison practices it is unlikely that the intervention influenced actual eating behavior.

Another limitation might be that analyses using 3 and 12 months outcomes did not account for missing values. However, since drop-out rates were comparable among study arms, no differences between the groups were found, and follow-up data were not different from exit interview, our findings would unlikely change with imputing missing values. Furthermore, multiple imputation approach for missing values was conducted for the analysis in the main outcome paper and indeed no difference was found in study outcomes compared to the complete case analyses.[25]

Eating energy dense foods and exercising too little are risk-factors for becoming obese and almost all Australian adolescents have at least one of these risk-factors.[6] Our study focused on discussing healthy eating and exercise during consultations and young people's willingness to change these behaviors. In determining whether clinicians discussed eating and exercise behavior with young people, we have assumed that the approaches the clinician used were based on the motivational interviewing style

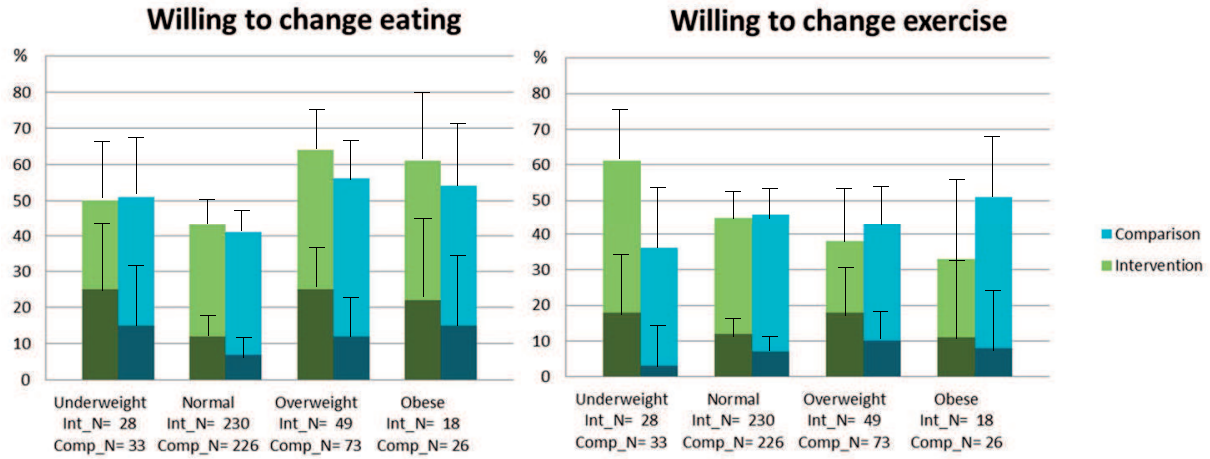

Figure 2. Percentage of young people reporting willingness to change their eating and exercise behaviour at exit interview for each BMI category. Darker colours represent the percentage of young people that reported that the clinician discussed healthy eating or exercise at the recruitment consultation. Error bars are the upper limits of the corresponding 95% Confidence Intervals.

they were taught, but we cannot know this for certain. There is therefore a possibility that the intervention was not delivered as intended.

Willingness to change is an essential first step for effective treatment[32] and it would be of benefit for clinicians to know that a large proportion of overweight and obese youth reported willingness to change their eating and exercise behavior. To explore this further we performed additional analyses comparing all young people with whom behavior was discussed to those with whom it was not discussed and it appeared that discussing eating behavior was associated with willingness to change eating behavior at the exit interview (OR 1.39 95% CI 1.02 to 1.88, adjusted for study arm). For exercise behavior no associations between discussing behavior and willingness to change were found (results not shown). It would be interesting to know if discussing behavior with young people would indeed influence their willingness to change especially for overweight and obese young people. However, this question could not be answered with the present data.

Comparison with existing literature

Our study confirms the findings of other health promotion trials that more than discussing the issue should be offered to make a real difference in lifestyle behaviors.[17, 33] A family-based, lifestyle interventions with a behavioral program aimed at changing diet and physical activity thinking patterns has proven to be more effective than standard care alone in reducing the weight of overweight adolescents.[34]

Clinicians in intervention practices discussed eating and exercise behavior more often than clinicians in the comparison practices but still not frequently (28% compared to 22% of the consultations). Since time during consultation is limited and the intervention was

broad and included all health risk-taking behaviors of the HEADSS-acronym, it is likely that clinicians chose to discuss some of the risk-taking behaviors and not healthy eating and exercise in all consultations. An intervention specifically focusing on raising weight related behaviors instead of all health risk related behaviors of the HEADSS-acronym might increase the number of consultations in which healthy eating and exercise are discussed. However, since length of consultations are short better methods and a clearer focus on which services can be best provided by whom are required to efficiently and effectively provide preventive care.[35]

Literature reports that one of the barriers GPs experience in weight management of their patients is the feeling that patients might not be motivated to change.[14] However, our study shows that a large percentage of young people report willingness to change eating and exercise behavior but have never discussed this subject with any clinician in their general practice. These 'missed opportunities' highlight that there is room for improvement for offering health promotion advice in general practice. Clinicians discussing healthy eating and exercise could be a meaningful first step in a multidisciplinary treatment program for overweight and obese young people; it could identify young people willing to change their behavior who could start a more intensive treatment program.

Implications for practice and research

Training clinicians to discuss general health risk behaviors in consultations of young people increases the number of consultations in which healthy eating and exercise are discussed. Since, the intervention did not change young people's BMI, physical activity patterns or satisfaction with eating behavior at follow-up, a more intensive intervention might be warranted. Without the availability of a more intensive lifestyle intervention program for clinicians to use or refer to, positive behavior changes are unlikely to occur even when the clinician discusses healthy eating and exercise with young people in general practice. However, clinicians discussing these issues could be a meaningful element in combined weight management program, especially since it could identify overweight and obese youth that report willingness to change their behavior.

Future research should examine if discussing healthy eating and exercise with young people influences willingness to change, and investigate how clinicians can effectively help young people to improve their behavior.

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APPENDIX A1 CONSORT 2010 CHECKLIST OF INFORMATION TO INCLUDE WHEN REPORTING A CLUSTER RANDOMISED TRIAL

Section/Topic	Item No	Standard Checklist item	Extension for cluster designs	Page No *
Title and abstract				
	1a	Identification as a randomised trial in the title	Identification as a cluster randomised trial in the title	Title page
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	See table 2	2-3
Introduction				
Background and objectives	2a	Scientific background and explanation of rationale	Rationale for using a cluster design	3
	2b	Specific objectives or hypotheses	Whether objectives pertain to the the cluster level, the individual participant level or both	4
Methods				
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	Definition of cluster and description of how the design features apply to the clusters	4-6
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons		Pag 4 & Protocol paper
Participants	4a	Eligibility criteria for participants	Eligibility criteria for clusters	4-5
	4b	Settings and locations where the data were collected		4
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	Whether interventions pertain to the cluster level, the individual participant level or both	4 & Figure 1
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	Whether outcome measures pertain to the cluster level, the individual participant level or both	5 & Appendix A1
	6b	Any changes to trial outcomes after the trial commenced, with reasons		N/A

Section/Topic	Item No	Standard Checklist item	Extension for cluster designs	Page No *
Sample size	7a	How sample size was determined	Method of calculation, number of clusters(s) (and whether equal or unequal cluster sizes are assumed), cluster size, a coefficient of intracluster correlation (ICC or *k*), and an indication of its uncertainty	Protocol paper
	7b	When applicable, explanation of any interim analyses and stopping guidelines		N/A
Randomisation:				
Sequence generation	8a	Method used to generate the random allocation sequence		5
	8b	Type of randomisation; details of any restriction (such as blocking and block size)	Details of stratification or matching if used	5
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	Specification that allocation was based on clusters rather than individuals and whether allocation concealment (if any) was at the cluster level, the individual participant level or both	5
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	Replace by 10a, 10b and 10c	5
	10a		Who generated the random allocation sequence, who enrolled clusters, and who assigned clusters to interventions	5
	10b		Mechanism by which individual participants were included in clusters for the purposes of the trial (such as complete enumeration, random sampling)	5
	10c		From whom consent was sought (representatives of the cluster, or individual cluster members, or both), and whether consent was sought before or after randomisation	5

Section/Topic	Item No	Standard Checklist item	Extension for cluster designs	Page No *
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how		5
	11b	If relevant, description of the similarity of interventions		N/A
Statistical methods	12a	Statistical methods used to compare groups for primary and secondary outcomes	How clustering was taken into account	6
	12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses		6
Results				
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	For each group, the numbers of clusters that were randomly assigned, received intended treatment, and were analysed for the primary outcome	6 & Figure 1
	13b	For each group, losses and exclusions after randomisation, together with reasons	For each group, losses and exclusions for both clusters and individual cluster members	Figure 1
Recruitment	14a	Dates defining the periods of recruitment and follow-up		4
	14b	Why the trial ended or was stopped		N/A
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	Baseline characteristics for the individual and cluster levels as applicable for each group	Table 1
Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	For each group, number of clusters included in each analysis	Figure 2 and tables 1-2
Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	Results at the individual or cluster level as applicable and a coefficient of intracluster correlation (ICC or k) for each primary outcome	Page 6-8 and tables 1-2 ICC' for primary outcomes in main outcome paper
	17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended		Table 2

Section/Topic	Item No	Standard Checklist item	Extension for cluster designs	Page No *
Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory		9
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)		Main outcome paper
Discussion				
Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses		8-9
Generalisability	21	Generalisability (external validity, applicability) of the trial findings	Generalisability to clusters and/or individual participants (as relevant)	Main outcome paper
Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence		8-10
Other information				
Registration	23	Registration number and name of trial registry		Protocol paper
Protocol	24	Where the full trial protocol can be accessed, if available		4
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders		12

APPENDIX A2 QUESTIONS REGARDING EATING AND EXERCISE

Satisfaction with eating behaviour

Are you satisfied with your eating habits? Yes / No

(analysed as reported)

Physical activity patterns

1. In a normal week, how many times do you engage in less vigorous exercise which lasts 20 minutes or more (i.e. exercise that does **not** make you breathe harder or puff and pant, such as walking, moderate roller blading etc)

Never / Once a week / 2 or 3 times per week / 4, 5 or 6 times a week / Once every day / More than once every day

(the last two categories were coded as "Moderate vigorous activity every day": Yes. The other categories were coded as No)

2. In a normal week, how many times do you engage in vigorous exercise lasting 20 minutes or more (i.e. exercise that makes you breathe harder or puff and pant, such as netball, squash, jogging, aerobics, vigorous swimming etc)

Never / Once a week / 2 or 3 times per week / 4, 5 or 6 times a week / Once every day / More than once every day

(the last four categories were coded as "Vigorous activity at least twice a week": Yes. The other categories were coded as No)

Willingness to change

Are there some aspects of your life, which could be unhealthy or harmful, that you might consider changing in relation to the following:

Eating habits:	Yes / No
Exercise habits:	Yes/ No
Road and driving safety:	Yes/ No
Cigarette smoking:	Yes/ No
Drinking alcohol:	Yes/ No
Use of marijuana:	Yes/ No
Any other drug use:	Yes/ No
Use of contraception/ birth control:	Yes/ No

Protection from sexually transmitted infections: Yes/ No
(*only eating and exercise habits used in the present analyses; analysed as reported*)

Which of the following issues did the doctor raise with you?

Eating habits Raised / Discussed / Doctor expressed concern / Not raised at all / Not raised at all this time, but was before at this practice / Unsure

Exercise habits Raised / Discussed / Doctor expressed concern / Not raised at all / Not raised at all this time, but was before at this practice / Unsure

(Raised, Discussed and Doctor expressed concern were coded as 'Discussed'. Not raised at all was coded as 'never discussed'. Not raised at all this time, but was before at this practice was coded as 'discussed previously'. Unsure were left out of analyses)

Chapter 10

Discussing overweight in primary care

A shorter version was published

WD Paulis, M van Middelkoop, HJ Bueving,
PAJ Luijsterburg & BW Koes

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ABSTRACT

The aim of the present research brief is to explore weight management in a cohort of Dutch children (2-18 years) presenting in general practice. Height and weight of children were measured during regular consultation, data from medical records were extracted and child, general practitioner (GP) and parents filled-out questionnaires. From 733 enrolled children 14.3% was overweight and 5.0% obese. Weight was rarely the reason for children to encounter. GPs most often did not discuss healthy lifestyle during consultation, nor planned a follow-up or referral for weight. However, almost all parents agree GPs should discuss their child's excessive weight.

INTRODUCTION

Primary care is considered an appropriate setting for weight management.[1] Several clinical guidelines have been developed the last couple of years to help general practitioners (GPs) with weight management in children.[2] The guideline of the Dutch College of General Practitioners states that GPs should examine all presenting children who appear obese to identify obesity; if obese they should discuss this subject and treat or refer all children that need help in weight reduction.[3]

It is however shown that GPs experience several barriers in discussing weight with children and their parents.[4,5] We therefore explored in a cohort of Dutch children presenting in general practice:

1) whether weight was recorded as reason for presentation or as relevant information in the medical record,
2) weight management of the GP and
3) whether parents agree on GPs discussing excessive weight.

METHODS

We enrolled 733 children (2-18 years) during regular consultation in 73 general practices in the South-West of the Netherlands.[6] All participating GPs (n=91) were aware of the obesity-guideline and the purpose of the study.

For the purpose of the study GPs measured height and weight of children during consultation (entry of the cohort study). Data from the medical records were extracted on the reason for consultation at recruitment and in the previous twelve months and on whether weight was reported as relevant information in the medical history. Weight management by the GP was expressed by whether GPs planned a follow-up appointment for discussing weight or referred children for weight intervention. In addition GPs answered a question on whether they gave healthy lifestyle advice during consultations with overweight and obese children.

Child and parents filled-out a web-based questionnaire. One of the questions to parents was: *"If your child has excessive weight, do you think the GP should discuss this during consultation even if the complaint at consultation is something else?"*

Body Mass Index (BMI) was calculated from height and weight and international age and gender specific cut-off points were used to determine weight status.[7] To test differences in parental opinion of GPs discussing weight between parents of overweight, obese and normal-weight children a chi-square test was used.

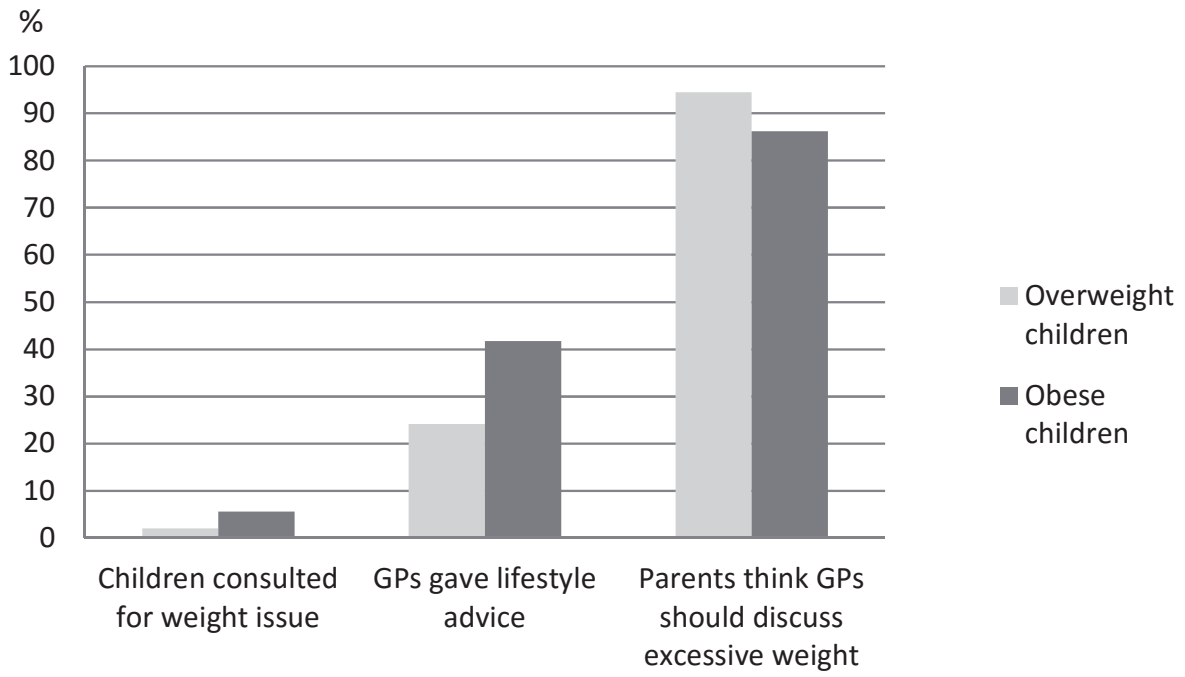

Figure 1. Percentage of overweight and obese children who consulted for weight issues, for whom GPs gave lifestyle advice during consultation and for whom parents report they think GPs should discuss excessive weight during regular consultation

RESULTS

Height and weight were measured for 715 of the 733 children; 17.5% was classified as underweight, 63.2% normal weight, 14.3% overweight and 5.0% obese.

Figure 1 shows that for two overweight and two obese children the recorded reason for presentation to the GP was a weight issue. Eight children consulted for weight in the previous twelve months. In the medical records of three children the term weight was found in the medical history (longer than 12 months ago).

Three overweight and three obese children were referred to the GP for weight by a Youth Health Care physician. Table 1 shows GPs weight management in overweight and obese children. Figure 1 shows that GPs gave lifestyle advice during consultation to 26 overweight and 15 obese children.

Of all parents (N=601) that answered the question on whether the GP should discuss excessive weight 93.8% agreed. For parents of overweight and obese children percentages are shown in Figure 1. There were no significant differences between the weight categories.

Table 1. GPs weight management in overweight and obese children

Follow-up appointments planned for weight management?	Total N=138 n (%)	Overweight N=102 n (%)	Obese N=36 n (%)
No	63 (45.7)	47 (46.1)	16 (44.4)
Not recorded in medical record	46 (33.3)	38 (37.3)	8 (22.2)
Yes, at general practice	11 (8.0)*	8 (7.8)	3 (8.3)*
Yes, referred to			
Dietician	13 (9.4)*	5 (4.9)	8 (22.2)*
Paediatrician	4 (2.9)	2 (2.0)	2 (5.6)
Psychologist	1 (0.7)*	0 (0.0)	1 (2.8)*
Physiotherapist	0 (0.0)	0 (0.0)	0 (0.0)
Other#	2 (1.4)	2 (2.0)	0 (0.0)

only one defined: referred to multidisciplinary weight intervention
*1 child referred to GP and dietician and psychologist

DISCUSSION

This research brief shows that weight is rarely the reason for overweight and obese children to consult the GP. GPs gave lifestyle advice to 30% of overweight and obese children, planned a follow-up appointment for 8% and referred 13%. A large majority (93.8%) of parents agreed that GPs should discuss excessive weight of their child during regular consultation, with no differences between parents of normal-weight, overweight and obese children.

Data from a study performed in Australia showed that GPs managed overweight and obesity once per 58 encounters with overweight or obese children.[8] In our cohort there were no treatment or referral appointments planned for most children, but GPs gave lifestyle advice during regular consultation in almost 30% of the encounters with overweight and obese children. However, for the purpose of the present study height and weight were measured of all children during consultation and the participating GPs were aware of the obesity-guideline. It is therefore likely that this observed percentage is an overestimation of the percentage of lifestyle advices given during regular consultations in the Netherlands.

A high percentage of parents, independent on the weight status of their child, note they agree that GPs should discuss excessive weight of their children during regular consultation (Figure 1). This is in line with previous literature.[9] Noteworthy, is that a previous study found that parents do see primary care as an appropriate setting for weight management but that they need to be reassured GPs will address their child's weight in a non-judgmental sensitive manner and are able to treat childhood obesity effectively.[10]

The present study shows that almost 30% of GPs gave lifestyle advice during consultation; whether they did this in a non-judgmental sensitive matter is unknown.

Given that overweight and obese children do not usually present with weight issues, it becomes important for GPs to find ways to initiate the discussion about weight and healthy lifestyle. Parents agree that GPs should initiate this discussion during regular consultation. However, this should preferably be done in a sensitive matter and effective treatment options need to be available.

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Chapter 11

General discussion

The prevalence of childhood obesity increased the last decades. Obesity is a complex disorder and there is no single effective treatment. Primary care has recently been suggested as a suitable setting to manage childhood obesity since access is easy and children are frequently seen.

It was the aim of the present thesis to reveal if overweight children differed from non-overweight children in their presentation in general practice and expose daily practice and opportunities for treatment of childhood obesity in primary care. For this purpose a cohort study including children attending general practices in the South-West of the Netherlands was set-up, literature was reviewed, a survey was sent to GPs all over the Netherlands and data from an Australian trial were analysed. The previous chapters described the results of these studies.

The present chapter concerns the interpretation of the main findings. Findings are discussed in the context of published literature and in light of methodological considerations. The implications for practice are described and finally recommendations for future research are addressed.

KEY FINDINGS AND METHODOLOGICAL ISSUES

Complaints of overweight and non-overweight children

The first part of this thesis focusses on complaints. Overweight and obesity in adulthood are well known to be associated with increased risks of various chronic diseases.[1, 2] As noted in chapter 1 there are several health consequences associated with childhood obesity too. However most literature studied complications of obesity reported by children in secondary care. It was unclear whether these complications are presented in primary care as well and whether only obese children reported complaints or overweight children too. Potential differences in type of complaints between overweight and normal-weight children could give us insight in the aetiology of complaints and might reveal opportunities for treatment of complaints as well as of excessive weight. Therefore we studied a cohort of Dutch children attending general practice, including both overweight and normal-weight children (chapter 2 and 3).

Regression analyses adjusted for age and marital status showed that obese children consulted the GP more often the previous twelve months (3.7 times) than normal-weight children (3.3 times). However, when adjusting for marital status all participants who did not answer this question were left out of the analyses. Adjusting for this potentially selective response it appeared that a higher number of consultations was associated with a lower age and with not fully completing the questionnaire but not with weight status. Neither were there associations found between weight status and type of complaints recorded by the GP. While weight was rarely recorded as reason for encounter (specifically

mentioned in chapter 10), significantly more overweight than normal-weight children reported somatic complaints, like being tired, experiencing pain and feeling weak, on a questionnaire filled-out at home.

Australian data (chapter 4) show that GPs were more frequently consulted by overweight (IRR: 1.28, 95%CI [1.04, 1.57]) and obese youth (IRR: 1.54, 95%CI [1.21, 1.97]) than normal-weight youth. But they did not consult for different health problems. The reason for presentation was seldom a weight issue. Though, obese youth did report lower physical health-related quality of life.

Combining both studies it can be concluded that overweight and obese children and youth in general practice are not different from their normal-weight peers in their presentation to the GP. They consult for comparable complaints and the reason for consultation is seldom a weight issue. Since overweight children do report somatic complaints on a questionnaire more often and obese youth report lower physical health-related quality of life, it seems that there are some experienced complaints but that these complaints do not prompt children and youth to see their GP or mention it during consultation.[3]

An explanation for not finding associations between registered complaints and weight status could be a lack of power since we were not able to include the calculated 500 overweight and obese children in the DOERAK cohort study. However, as described in chapter 3 analysing data in three groups (overweight and obese children in one group) to increase power did not change the results. Furthermore, to make sure lack of power was not the reason for not finding associations, we multiplied the dataset five times. Since still no associations were seen between weight status and type of complaints registered in the general practice last twelve months it is very unlikely that lack of power is an explanation for not finding associations between weight status and registered complaints according to the ICPC chapters. Maybe if complaints would be analysed according to their individual code instead of the chapter they belong to (e.g. R96 (asthma) instead of R (respiratory)), there would be associations with weight status. However, far more data would be needed to test such associations.

One should keep in mind that results might be influenced by a possible selection bias. As noted in chapter 3 parents of children in the DOERAK cohort study are more often highly educated compared to the average Dutch household. Therefore our cohort might not be representative for all children attending general practice. In addition, non-response analyses showed that non-participating children were significantly older than included children and GPs reported perceived overweight/obesity in 21.8% of the non-participating children compared to 16.9% of the included children. The possibility remains that children with excessive weight consulting the GP for more or different complaints were not included in this study, either because they were not invited or because they refused to participate. In that hypothetical case it could be that there were possible

associations between weight and complaints, which we would have missed since we can only draw conclusions based on data from children that participated in the study.

The Australian data (PARTY project) showed that both overweight and obese youth consulted the GP more often than normal-weight youth, which was not seen in the DOERAK cohort study. This might be explained by the different age groups included. Children in the DOERAK study had a mean age of 8.2 years (sd 4.0) whereas youth included in the PARTY Project had a mean age of 19.6 (sd 2.9). The relationship between excess weight and number of consultations might only exist in this older age group, maybe because excessive weight is more severe in this older group or because older children have excessive weight for a longer period of time which might cause more complaints.

It should be noted that in both studies we specifically observed children attending general practice. It could be that overweight and obese children do visit general practices more often than normal-weight children if looking at the open population. This is strengthened by the fact that the prevalence of overweight and obesity in children included in the DOERAK cohort study is higher (19.3%) than in the open population (13-15%)[4]; i.e. normal-weight children, and to a lesser extend overweight children, not visiting the GP were not included in the study.

The relationship between weight and musculoskeletal complaints is extensively studied in adults, but not in children. Therefore we reviewed articles specifically studying this relationship in children (chapter 5). Literature shows that overweight is already in childhood associated with musculoskeletal pain, low back pain, injuries and fractures. Since there were only a few prospective studies no conclusions could be made on the nature of the relationship between overweight and musculoskeletal complaints. Although the nature of the relationship is unclear the association between overweight and musculoskeletal complaints might induce a vicious cycle in which being overweight, musculoskeletal problems, and low fitness level reinforce each other. This underlines the need to prevent excessive weight gain.

The associations between overweight and musculoskeletal complaints shown in chapter 5, were not found in chapter 3 and 4. This could be explained by several things. Differences might be explained by a different setting. The relationship between excessive weight and musculoskeletal complaints might be more apparent in secondary care than in primary care. A recent study of Skinner et al in adolescents showed that cardiovascular risk factors were only associated with severe obesity[5] and maybe the same is true for musculoskeletal complaints. Children with severe obesity who are referred to secondary care might experience more musculoskeletal problems than their less overweight peers in primary care. Besides, the methods of measuring complaints might have influenced the results. Many of the studies included in our review measured musculoskeletal complaints using questionnaires. We defined complaints as registered complaint coded

by the GP when children consulted their practice. We did find a relationship between overweight and somatic complaints reported on a questionnaire in the DOERAK cohort. Therefore there might be an association between overweight and musculoskeletal complaints, but perhaps not that strong for overweight children to attend general practice for that complaint. Confounders could also explain the contradictory results between the review of chapter 5 and the DOERAK cohort (chapter 3) and PARTY Project (chapter 4). We used the crude estimates of individual studies in the review. Single studies included in the review that did adjust for confounders still found that overweight was associated with more musculoskeletal complaints, but the association became less strong. Looking at the DOERAK data (table 3b, chapter 3) the musculoskeletal complaints (ICPC-L), seem to be more prevalent among overweight and obese children. The crude estimate almost reaches significance. However when adjusted for age, socioeconomic status, ethnicity and marital status this association disappears. Since these factors are known to be associated with both weight and different type of complaints[6] it is important to adjust for them when investigating the association between complaints and overweight. Not adjusting for confounders might explain a part of the conflicting results found, but not all of it. Another explanation might be a possible publication bias. Although the funnel plot made in chapter 5 did not indicate a serious risk of publication bias one must keep in mind that in general positive results are more likely to be published than negative results.

Overall it was shown that overweight children might experience more somatic complaints, obese youth does report a lower physical health related quality of life and literature shows a relationship between overweight and musculoskeletal complaints already in childhood. However, overweight and obese children do not consult the GP for different complaints than normal-weight children. The reason for consultation is scarcely a weight issue. Since overweight children are not different from normal-weight children in their presentation to the GP, no different treatment approach seems warranted. However, GPs should be aware overweight children might experience complaints which they do not mention during consultation. Regarding weight management it is important for GPs to find ways to initiate the discussion about weight or healthy lifestyle with obese children and their parents since children rarely visit for weight issues.

Weight management in primary care; guidelines, daily practice, attitudes and barriers

Management of childhood obesity can be divided in diagnoses and treatment. As shown in the flowchart (Figure 3) in chapter 1 diagnosing obesity in children in the Netherlands is expected to be done by a youth health care physician or a GP. If there are no serious

comorbidities or complications treatment can take place in primary care, otherwise children should be referred to paediatricians and specialized care.

The Dutch College of General Practitioners (NHG) introduced an obesity-guideline in 2010.[7] To diagnose obesity this guideline recommends that GPs measure height and weight of all children presenting with weight complaints and all children who appear to be obese regardless of the reason for consultation. If a child is obese it is recommended that they discuss this subject with child and parents and treat or refer all children that need help in weight reduction. To investigate differences in the management of childhood obesity in different countries national clinical guidelines for primary care from six different countries were compared (chapter 8). All guidelines recommended that to diagnose obesity height and weight of children should be measured and the BMI should be compared with age and gender specific cut-off values of the BMI. This is in line with the Dutch guideline for GPs. Measuring height and weight is important since literature shows that health care professionals do not recognise overweight based on observation alone.[8] Therefore, it can be recommended to measure all children on a regular basis in general practice instead of only those who appear to be obese.

Guidelines differed in the cut-off values used for BMI. Most countries use their own classification system. The European Association for the Study of Obesity recommends using local BMI centile charts in daily practice.[9] In the DOERAK cohort study we used the international cut-off values of the BMI. When using Dutch reference values to determine the weight status of children instead, the group of underweight children became smaller and the group of overweight and obese children remained the same size. Depending on the purpose of the study one should decide which classification criteria should be used. When comparing data from different countries one should keep in mind that different cut-off values can influence the prevalence rates of underweight, normal-weight, overweight and obesity.

Recommendations regarding the treatment of childhood obesity in primary care appeared to be quite similar among the different national guidelines. The treatment goal in all guidelines was weight management or weight reduction, depending on the BMI and the remaining growth potential. A combined intervention with parental or family involvement is always recommended, having dietary changes, increase in physical activity and counselling as the most essential elements. These elements are also recommended by the 2009 Cochrane review on treatments interventions for childhood obesity.[9-11] The important role of parental involvement was also highlighted in previous studies.[12, 13] Although there is broad consensus in the recommendations of these guidelines and they are in line with literature, recommendations are vague including statements as 'eat healthy and not too much'. One of the reasons for the recommendations being not that explicit could be that evidence is lacking for explicit advice. However, these broad advices are not that helpful in daily practice and more explicit advice may be needed for

physicians to use.[14] Therefore, it is recommend to draw more attention to the practical tips with explicit advice from the American and European expert committees[9, 10], which GPs who want to give lifestyle advices to overweight and obese children could use in their practice.

After comparing the recommendations of national clinical guidelines for the management of childhood obesity in primary care, one might wonder whether GPs' attitudes and daily practice are in line with these recommendations.

Over 90% of the GPs responding to the survey (chapter 7, N = 333) feel they should play a role in diagnosing obesity in children. But 78% noted that the role of the youth health care physician in diagnosing obesity is more important. Only a few GPs noted they discuss obese children with colleagues from for example youth health care. In chapter 10 it was shown that only six from the 138 overweight and obese children were referred to the GP by youth health care. It is unclear whether the other obese children in this study were not diagnosed by youth health care, whether youth health care referred more children to GPs but they did not show up, whether children were diagnosed for obesity by youth health care but send directly to secondary care, or whether treatment for obesity is already started without interference of the GP. It is outside the scope of this thesis to study the collaboration between youth health care centres and general practices, but it seems that management of childhood obesity in primary care could benefit from better communication between youth health care and general practitioners in order to identify all children with obesity and treat or refer those who need help with weight reduction.

Only 24% of GPs reported to measure the BMI often or always to diagnose obesity in children. This is in accordance with results from other studies in different countries.[15-18] One of the main reasons for not calculating BMI reported in those studies is that GPs consider it to be unnecessary, since they feel confident about their visual diagnosis. As noted in the previous section, however, health care professionals do not recognise obesity based on observation alone and measuring the BMI is recommended.

Chapter 10 discusses GP's weight management in the cohort of Dutch children. It was shown that GPs gave lifestyle advice to 30% of overweight and obese children, planned a follow-up appointment for 8% and referred 13%. For the purpose of the study height and weight were measured of all children during consultation and the participating GPs were made aware of the obesity-guideline. It is therefore likely that these observed percentages are an overestimation of the percentages for lifestyle advices given during regular consultations and children referred for weight management in the Netherlands.

When comparing these data to the survey from chapter 7 it is shown that only 4% of GPs responding to the survey report they always refer children with obesity to multidisciplinary intervention programs, which is the preferred referral according to the obesity-

guideline for GPs. One of the barriers GPs experience in referring obese children is the feeling that children and parents do not want to be referred. This is in accordance with research findings from the USA, where physicians reported a lack of parental involvement and patient motivation to be barriers of major importance.[19, 20] To some extend this is also comparable with findings from interviews with Dutch youth health care physicians.[21] They reported that the most important impeding factors for referring parents of overweight children to an intervention were denial of the overweight problem by parents and their resistance towards discussing weight issues. In chapter 9 we found, however, that more than half of overweight and obese youth in the Australian trial were willing to change their eating and or exercise behaviour. Whether Dutch children and their parents are motivated to change is unknown. Since literature shows that higher motivation is associated with better treatment outcomes[22] it is important for GPs to assess whether parents and children are motivated to change and only refer them to more intensive intervention programs if they are sufficiently motivated.

Another barrier for referring children reported by GPs is the lack of efficacy of existing interventions to refer to. This is in line with the results of several other studies.[20, 23] A review by Sargent et al. demonstrated that multidisciplinary interventions in primary care may be effective.[24] Since the authors of this review used a variety of different outcome measures to indicate effectiveness and studies with a significant result in only one of these different outcome domains were considered to be effective, the available evidence on effective interventions in primary care is still marginal and the magnitude of the effect is hard to interpret. Additionally, in some neighbourhoods there are no interventions available to which a GP can refer children and most of the available interventions have not yet been studied. Multidisciplinary interventions including the elements diet, active lifestyle, counselling and parental involvement show best results[11, 24], but the effectiveness of existing interventions is largely unknown and further research on the effectiveness of childhood obesity interventions in primary care is necessary.

The majority of GPs reported they feel competent in diagnosing (80%) obesity in children and 50% of GPs feels competent in treating obese children. However, 74% of respondents of the survey reported they preferred to be educated in diagnosing obese children and 86% in treating obese children. Since self-reported daily practice is not in line with the obesity-guideline, additional training and guidance might be of additive value for daily practice. In a recent publication from the United States it was suggested that if all primary care physicians are expected to address obesity, nutrition, and physical activity with their patients, training programs need to change.[25] This is in line with the opinion of many of today's primary care residents that recognized in another study that the current educational system has poorly prepared them for the high prevalence of obesity and lifestyle-related chronic disease which they are about to confront in practice.[26] In the Netherlands, healthy lifestyle advices to adult patients is already part of the

training program for GP-trainees. However, so far there is no specific attention to the management of childhood obesity in this program and this could be of additive value.

When interpreting the self-reported results of chapter 7 one must be aware of a possible response bias. Responding GPs might have special interest in the subject; they may have a more positive attitude towards or are more actively involved in the management of childhood obesity compared to the non-responders. In that case results might give a positive overestimation of the attitudes and daily practices of the average GP.

In summary, there is a gap between GPs' attitudes and daily practices. Self-reported GP handling and observed weight management in the Dutch cohort does not correspond with the obesity-guideline for GPs. Previous research showed that a guideline alone is not likely to make any real changes[27, 28] and our findings seem to underline this. Several barriers are experienced in both diagnosing and referring obese children. It is recommended to offer GPs extra courses, making them more comfortable discussing the problem of childhood overweight. Besides, further research into the effectiveness of intervention programs in primary care is necessary. When there are effective intervention programs available in primary care, the need to diagnose obesity might be more apparent to GPs and they will feel more confident to refer children.

Weight management in primary care; some opportunities and issues to keep in mind

As shown in chapter 7 GPs experience barriers in raising the issue of obesity during consultation. We therefore investigated whether GPs could be trained to raise eating and exercise behaviour in regular consultations. In chapter 9 the results of an Australian cluster randomized controlled trial are described and discussed. It shows that clinicians in intervention practices discussed both eating and exercise behaviour significantly more often (28% of consultations) than clinicians in comparison practices (22%). Although the difference was not very large it was statistically significant and GPs who received the training discussed healthy eating and exercise especially more to overweight and obese young people. Because the intervention training was very broad and included diverse risk-taking behaviours, better results may be obtained if GPs follow a training specifically focussing on healthy eating and exercise only.[29]

While GPs discussed healthy eating and exercise more often in intervention practices, there were no differences between young people attending clinicians in either arm in physical activity levels, satisfaction with eating behaviour or BMI at three and 12 month follow-up. This study confirms findings from other studies that discussing lifestyle behaviours is not enough to make a real difference in these behaviours and a more intensive intervention may be warranted.[30, 31]

Half of the overweight and obese young people in the Australian trial reported willingness to change eating or exercise behaviour, but most had not discussed these behaviours previously with the GP. These 'missed opportunities' highlight that there is room for improvement for offering health promotion advice in general practice. Current evidence of childhood obesity interventions show large drop-outs and small effectiveness.[11] One explanation could be that interventions are already started while children and parents are not ready to change yet. Clinicians discussing healthy eating and exercise could therefore be a meaningful first step in a multidisciplinary treatment program for overweight and obese young people; it would identify young people willing to change their behaviour who consequently could start a more intensive treatment program which might then more likely to be successful.

Only 26% of GPs responding to the survey of chapter 7 report that they often or always raise the issue of obesity, even if children consult for a different complaint. GPs report they think it is hard to raise the issue of obesity to children and parents, especially if children consult them for non-weight related complaints. An explanation previously suggested in literature is that GPs are afraid to disturb their relationship with their patients.[32] Literature shows that when it comes to discussing weight both GPs and parents prefer the other to raise the topic.[33] This is in line with our findings from chapter 10 in which a large majority (93.8%) of parents in the Dutch cohort agreed that GPs should discuss excessive weight of their child during regular consultation even if children attend for other complaints. As previous literature suggested almost all parents find it useful to weigh their children when they attend for care.[34] So there seems to be broad consensus that discussing excessive weight of children can take place during regular consultations in general practice.

When discussing weight during regular consultations it is important to know whether parents are aware of the excess weight of their child. In chapter 6 the literature studying the relationship between actual weight status of children and the perceived weight status by parents was reviewed. It shows that 63.4% of the parents of overweight children fail to recognise overweight of their child. This percentage is even higher (86%) for parents of children aged 2-6 years old. Studies using image scales to assess parental perception show a higher percentage of overweight children perceived correctly by parents compared to studies using verbal descriptions (52.3% versus 37.6%). This suggests that parents might recognise the weight status of their overweight child, but do not verbally label it as overweight. Children with a normal weight status are almost never seen as being overweight, while children with overweight are often perceived as normal weight children. This indicates that parents often label their children as normal weight, irrespective of the child's actual weight status. Therefore, GPs should keep in mind that if they discuss weight during regular consultations, parents may not recognize their child's

excessive weight. The first logical step in the management of childhood obesity would therefore be raising awareness.

Whether being aware of overweight is a good thing or not was not investigated in this thesis. However, one must acknowledge that raising awareness is not necessarily a good thing. There is evidence suggesting that children who are aware of their excess weight report lower quality of life.[35] Furthermore, a previous study found that parents do see primary care as an appropriate setting for weight management but only if they are reassured GPs will address their child's weight in a non-judgmental sensitive manner and are able to treat childhood obesity effectively.[36] If there are no effective treatment options available one must question whether it is ethical to raise awareness at all.

A recent qualitative study from the Netherlands showed that children with obesity and their parents notice the GP should play an active role not only in signalling the weight problem, but also in offering on-going support.[37] This is in line with the assumption of the Dutch government who reasoned that since general practices are situated in the neighbourhood of a patient, access is easy, children are regularly seen, GPs often know all members from the household and have a personal, trustworthy relationship with children, GPs could play a key role in the management of childhood obesity.[38] This reasoning, however, could be used to emphasize the important role of GPs in all sorts of preventive care. It has been reported that time constraints during consultation limit the ability of clinicians to conduct health promotion activities. A clearer focus on which services can be best provided by whom is needed to efficiently and effectively provide preventive care.[39] Findings from the UK suggest that primary care can only play a limited role in addressing the current obesity epidemic. These researchers conclude that for progress to be made, greater effort needs to be made to address the causes of childhood obesity and to develop effective interventions that can be delivered outside, as well as within, the primary care setting.[28]

In the Netherlands government, parents and GPs themselves agree on an active role for GPs in the management of childhood obesity. Without effective treatment options for GPs to use or refer to one could argue what can be expected from such an active role.

Little was known on overweight and obese children in primary care. At the end of this thesis it can be concluded that overweight and obese children are not that different from their normal-weight peers in their presentation in general practice. There is broad consensus among several national clinical guidelines on which elements should be addressed if managing childhood obesity in primary care. Exact recommendations for the management however often lack clarity. Looking at GPs weight management in the Netherlands, it can be concluded that current handling is not in line with the obesity-guideline for GPs and several barriers are experienced by GPs. However, there seem to be some opportunities for the treatment of overweight and obese children in general

practice. Especially since GPs can be trained to discuss healthy eating and exercise more often and parents agree that GPs may discuss excessive weight of their child during regular consultation.

DIRECTIONS FOR FUTURE RESEARCH

Last ten years more than 10.000 articles were published on childhood obesity but still we know only just a little bit more than ten years ago. John Blundell stated at the European Congress on Obesity in 2014 "More information is not necessarily more knowledge". I will end my thesis with some thoughts on future (research) directions, which hopefully will generate more knowledge in the future instead of only more information.

This thesis shows some conflicting results regarding the relationship between excessive weight and complaints in childhood and several questions remain open on whether subgroups of children at increased risk for becoming obese can be identified in general practice and what the nature of the relationship between weight and complaints is. Therefore, I would recommend to focus on large prospective studies. Cross-sectional studies give some ideas on the size of a problem and associated factors. But if we want to determine which risk factors are associated with sustained overweight or with health problems in the future, prospective studies are needed. DOERAK is a prospective observational cohort and the follow-up data might give insight in risk factors associated with either sustained overweight or health problems presented to the GP.

In order to determine which subgroups of children in general practice are at increased risk for becoming obese in the future you need substantial statistical power and therefore larger studies are needed. Since measuring height and weight is no routine in general practice a prospective cohort in general practices larger than our DOERAK cohort would be hard to establish. A large scale cooperation of youth health care and general practices might be an option.[40] Youth health care has height and weight data of almost all children in the Netherlands measured at fixed ages. If these data could be matched to medical files from general practices some insight in subgroups of children at risk of becoming obese in the future may be obtained.[41] However, medical files are confidential and all parents and children should give informed consent to use data from their medical file anonymized for research purposes. Therefore, such a study could be an option to gain more insight in subgroups at risk, but it would certainly not be a simple solution.

To investigate the nature of the relationship between weight and complaints not only prospective studies but also more and different measures are needed. A recent systematic review of Llewellyn et al showed that childhood obesity, classified using BMI, is asso-

ciated with moderately increased risks of adult diabetes, cardiovascular risk and certain cancers. However, they notice that the majority of these morbidities occur in adults who were of healthy weight in childhood based on their BMI, and therefore they conclude that BMI is not a good predictor of morbidities later in life.[42] Maybe, BMI is not the appropriate measure to identify those at risk and other measures of excessive weight could give more insight in the nature of the association. Or maybe the relationship between weight and complaints is explained by something else. Eating behaviour and physical fitness are obvious factors which may be involved in this relationship, but also stress levels in childhood expressed in levels of cortisol[43-45], other hormones like leptin and insulin[46-48], vitamin D levels[49] or inflammatory factors[50, 51] may be involved. Furthermore, childhood obesity is a complex phenotype, modulated by unique gene-environment interactions[52], these interactions between genes and the factors previously mentioned might not only explain why some become obese but also why some have increased risk of morbidities. In order to really understand the relationship between weight and complaints large prospective studies are needed with different measures of excessive weight and especially focussing on hypothetical underlying factors involved.

So far research on interventions for childhood obesity in primary care has primarily been focused on the evaluation of intervention programs for children. As mentioned previously the positive effects of these programs are small and the number of drop-outs relatively high. Possible explanations for the large number of drop-outs and the small effects might be that these interventions are not in line with the expectations of the participants, that these interventions are not tailored to the specific needs of individuals, and that children and their parents entering such an intervention are not ready to change yet. In this thesis it was shown that most parents do not recognize their child's excessive weight. If they would immediately be referred to an intervention program hardly any positive effects can be expected. Since parental involvement is a key element in effective weight management[11, 53, 54], the important role of the GP in the management of childhood obesity might be talking with parents and children, making them aware and referring them to intervention programs only then when they are ready to change. To help this process a Minimal Intervention Strategy (MIS) could be used.

The MIS is based on five general principles of motivational interviewing (expressing empathy, developing discrepancy, avoiding argumentation, rolling with resistance and supporting self-efficacy)[55], and offers materials and treatment structure for the guidance of patients in improving long-term healthy lifestyle using the stages of change model.[56] The interactive MIS is currently merely applied to help patients stop smoking. For the identification and treatment of adult obesity, the obesity-guideline refers to a MIS.[7] A collaborative pilot study of the NHG, Dutch Heart Foundation and two universities investigated the feasibility of MIS for obese adults in Dutch general practice. The pilot

study concludes that the utilization of MIS is very promising; GPs and advanced nurse practitioners were satisfied with the strategy and available materials. As a result, they discussed weight more easily in regular consultations.[57] However, no further research has been done on the effectiveness of this MIS and the guideline does not offer any specific tools for the management of childhood obesity. Adjusting the MIS for the management of childhood obesity and evaluate whether GPs could use this MIS to get more parents and children ready for referral to intervention programs, tailored to those behaviours which they are ready to change, would nicely fit to several results from this thesis; the need GPs reported for extra training and guidance, their feeling that children and parents are not motivated to change and the small number of children that were referred to intervention programs.

In addition to a Minimal Intervention Strategy, referral options need to be available. Last couple of years many interventions to tackle childhood obesity were developed and almost as many stopped before properly being evaluated. It has been suggested that for the evaluation of childhood obesity treatment programs, the traditional RCT study design, randomizing individuals to intervention A or comparison B, is not optimal.[58] The diversity in the obesity phenotypes requires complex and individualized treatment strategies and to evaluate these strategies long term follow-up data are necessary. The traditional RCT is not well suited to evaluate these long-term outcomes and generalizability of these findings is often limited to a very specific setting and group of participants. Besides, these methodological issues a traditional RCT study design presents an ethical dilemma: what care should the control group receive? Therefore I would recommended to evaluate currently available childhood obesity interventions if possible using a cluster randomized stepped wedge design in which the whole population receives the intervention, but with randomisation built into the phasing of implementation in each practice or using an observational design in which participants are their own controls (for example while they are on the waiting list).

For both optimizing the Minimal Intervention Strategy and the referral options, the needs and expectations of children and their parents should be taken into account. If treatment does not match with the needs and expectations of participants all stages of treatment are likely to come to nothing.[59] Qualitative research on the needs and expectations of obese children and their parents is therefore an essential first step.

As noted in chapter 1 the cause of becoming overweight is multifactorial. Common sense dictates that for such a multifactorial problem there is not one simple solution for everybody. Management should focus on different factors involved and therefore a tailored multidisciplinary approach seems needed. In the Netherlands several cities attempt to tackle childhood obesity with integrated care. In this approach youth health care, general practices and other professionals work together in the neighbourhood of

a child to change both the environment and factors at a personal level. These initiatives are very promising[60], but it is hard to determine the effectiveness of such complex interventions because of the different groups and organisational levels involved, the different behaviours required by those receiving and delivering the intervention, the tailoring of these interventions, the number of different outcome measures needed and possible interacting factors. Therefore, to develop and evaluate these promising complex interventions it is recommended to follow the guideline of the Medical Research Council; Always start with a piloting phase to assess feasibility, evaluate the effectiveness using a study design most appropriate for the specific situation and when implementing the results make sure that all relevant stakeholders are actively involved.[61] Maybe, in the future, an optimized MIS in general practice and tailored referral options could be part of such a complex intervention to tackle childhood obesity.

Mrs. B and her son walk out of the general practice. The son will probably not visit the practice himself for weight-related complaints in the near future. Mrs. B most likely doesn't recognise her son's obesity. Although she would be okay with the GP mentioning the excessive weight and the GP thought about doing something to manage childhood obesity he probably did not discuss the excessive weight during consultation. Childhood obesity in primary care is not yet general practice.

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Summary

The prevalence of childhood obesity has at least doubled the last 30 years. Childhood obesity is associated with an increased likelihood to develop adult obesity, which translates into increased risk for chronic diseases, including diabetes mellitus type 2, cardiovascular disease and certain types of cancer. A complex interaction between the environment and risk factors at a personal level causes childhood obesity. Because of this situation, there is not one effective prevention or treatment strategy to tackle childhood obesity. It has been suggested that primary care could be a suitable setting to manage childhood obesity since access is easy and children are frequently seen. However, little is known on overweight and obese children in primary care.

We wanted to reveal if overweight children differed from non-overweight children in their presentation in general practice, study whether parents recognize overweight in their children, explore attitudes and barriers GPs experience towards childhood obesity management, and expose daily practice and opportunities for treatment. For this purpose a cohort study including children with and without overweight attending general practices in the South-West of the Netherlands was set-up, literature was reviewed, a survey was sent to GPs all over the Netherlands and data from an Australian trial were analysed. In this thesis the results of these studies are described.

The introductory **chapter 1** gives background information on the definition and prevalence of childhood overweight and obesity, the consequences of excess weight, causes of becoming overweight and potential prevention and treatment strategies. It also shows a framework for the management of childhood obesity in the Netherlands. The chapter concludes with the aims and outline of this thesis.

This thesis consists of four parts. In the first part *complaints* of overweight and obese children are studied. We wanted to determine whether overweight and obese children differ from normal-weight children in their presentation in general practice. Potential differences could give insight in the aetiology of complaints and might reveal opportunities for treatment of complaints and excessive weight. For this purpose the DOERAK cohort study was set up. In **chapter 2** the design of this study, investigating children (2 - 18 years of age) attending Dutch general practices, is presented. **Chapter 3** shows the baseline results of this study. 733 children were included; 17.5% was underweight, 63.2% normal weight, 14.3% overweight and 5.0% obese. Obese children consulted the GP more often the previous twelve months (3.7 times) than normal-weight children (3.3 times) (p=0.02), but after adjusting for potentially selective response this association disappeared. There were no associations between weight status and type of complaints recorded by the GP. Neither did parental perception of their child's general health status differ between the various weight categories. However, overweight children reported more somatic complaints on a questionnaire, like being tired, experiencing pain and feeling weak than normal-weight children. In **chapter 4** the health profiles of Australian young people from different weight categories are displayed. A cross-sectional design

with baseline data from the PARTY Project including 683 young people (14-24 years of age) presenting to general practice was used. It shows that GPs were consulted more often by overweight and obese youth, but not for different health problems compared to normal-weight youth. The reason for presentation was seldom a weight issue. Obese youth did report lower physical health-related quality of life. Given that overweight and obese youth consult their GP more often there might be some opportunities for regular weight attention. However, since young people do not present with weight issues, it becomes important for GPs to find ways to initiate the discussion about weight, healthy eating and exercise with youth.

The relationship between weight and musculoskeletal complaints was extensively studied in adults, but not in children. Therefore we reviewed articles specifically studying this relationship in children (**chapter 5**). Forty studies, together studying over one million children, were included. Overweight and obesity were associated with musculoskeletal pain, injuries and fractures as early as childhood. Prospective studies were scarce and therefore the nature of this relationship remains unclear.

In the second part of this thesis *awareness* of excess weight is studied. **Chapter 6** systematically reviews the literature reporting actual weight status of children and perceived weight status by parents. A total of 51 articles, covering 35 103 children, were included. It was shown that parents are likely to misperceive the weight status of their overweight child (63.4%), especially in children aged 2-6 years (86%). Since appropriate treatment starts with the correct perception of overweight, healthcare professionals should be aware of the frequent parental misperception of the overweight status of their children.

In the third part of this thesis *attitudes*, practices and perceived barriers by GPs in the management of childhood obesity are studied. In **chapter 7** the results of a survey questioning these items and send to GPs all over the Netherlands and results from telephonic interviews with GPs in the South-West of the Netherlands are described. Over 90% of the GPs feel they should play a role in diagnosing obesity in children. However, they think it is hard to raise the issue of obesity to children and parents, especially if children consult them for non-weight related complaints. Only 4% of GPs always refer children with obesity to intervention programs. Barriers GPs experience in referring obese children are lack of efficacy of existing interventions and the feeling that children and parents do not want to be referred. Additional training and guidance seem required for GPs in order to successfully manage childhood obesity in primary care.

In the last part of this thesis *treatment* options in general practice are discussed. **Chapter 8** compares national clinical guidelines for the management of childhood obesity in primary care of different countries. It was shown that there is broad consensus in the advices for managing childhood obesity in the primary care setting. All guidelines recommend a combined intervention, with diet, activity, counseling and family involvement being the most important elements. However, exact recommendations for these interventions often

lack clarity. In **chapter 9** the results are shown of the PARTY Project; an Australian intervention study training GPs to screen youth on several health risk factors and discuss these topics (including healthy eating and exercise) using motivational interviewing techniques. Young people (14-24 years) were recruited when consulting their general practice and 901 young people were included. Clinicians in intervention practices discussed eating and exercise behaviour more often post-consultation (28% of consultations) than clinicians in comparison practices (22%). However, this alone did not appear to improve BMI or eating and exercise behaviour of young people. There seem to be some missed opportunities since half of the overweight and obese young people reported willingness to change behaviour, but most did not discuss this subject with their GP. In **chapter 10** GPs weight management in overweight and obese children included in the DOERAK cohort study is discussed. Weight was also in this Dutch cohort rarely the reason for children to encounter. GPs most often did not discuss healthy lifestyle during consultation, nor planned a follow-up or referral for weight. However, almost all parents (93.8%) agree GPs should discuss their child's excessive weight during regular consultation.

Finally, in **chapter 11** the most important findings are discussed in light of existing literature and methodological considerations and some directions for future research are displayed. Overweight children might experience more somatic complaints, obese youth does report a lower physical health related quality of life and literature shows a relationship between overweight and musculoskeletal complaints already in childhood. However, overweight and obese children do not consult the GP for different complaints than normal-weight children. Since overweight children are not different from normal-weight children in their presentation to the GP, there is no different treatment policy warranted. However, GPs should be aware overweight children might experience complaints which they do not mention during consultation. Regarding weight management it is important for GPs to find ways to initiate the discussion about weight with obese children and their parents since children rarely visit for weight issues. There is broad consensus among several national clinical guidelines on which elements should be addressed if managing childhood, but exact recommendations often lack clarity. When looking at GPs weight management (measuring the BMI, discussing the subject and planning follow-up appointments or refer children) in the Netherlands it can be concluded that GPs experience several barriers and current handling is not in line with the obesity-guideline issued by the Dutch College of General Practitioners. However, there seem to be some opportunities for the treatment of overweight and obese children in general practice. Especially since GPs can be trained to discuss healthy eating and exercise more often and parents agree that GPs may discuss excessive weight of their child during regular consultation.Therefore, at the end of this thesis it was concluded that GPs can play a role in the management of childhood obesity, but at this time this role is not yet fulfilled; Childhood obesity in primary care is not yet general practice.

Samenvatting

Het aantal kinderen met obesitas is enorm gestegen de afgelopen dertig jaar. Kinderen met obesitas hebben een grotere kans op obesitas op volwassen leeftijd en dat gaat gepaard met een hoger risico op chronische ziektes zoals diabetes type 2, hart- en vaatziekten en bepaalde vormen van kanker. Obesitas wordt veroorzaakt door een complexe interactie van verschillende factoren. Zowel factoren uit de omgeving als factoren op persoonsniveau spelen een rol. Daardoor is er niet één effectieve preventie- of behandelstrategie. De Nederlandse overheid heeft aangegeven dat de huisarts een belangrijke rol zou kunnen spelen in de aanpak van overtollig gewicht bij kinderen, omdat de huisarts vrij toegankelijk is, kinderen vaak bij de huisarts komen, de praktijk in de buurt van het kind gesitueerd is, en huisartsen vaak het hele gezin kennen. Maar tot op heden was er nog maar weinig bekend over kinderen met overgewicht en obesitas in de huisartspraktijk.

Wij wilden onderzoeken of kinderen met overgewicht verschillen van kinderen zonder overgewicht in het aantal en het soort klachten waarvoor ze bij de huisarts komen, uitzoeken of ouders het overgewicht van hun kind wel herkennen, attitudes en barrières die huisartsen ervaren met betrekking tot de aanpak van overgewicht bij kinderen verkennen, en de huidige dagelijkse praktijk en mogelijkheden voor behandeling van obesitas bij kinderen in kaart brengen. Om dit te doen is er een cohort studie opgezet van kinderen met en zonder overgewicht die in Zuid-West Nederland de huisarts bezochten, is de bestaande literatuur bestudeerd, is een vragenlijst rondgestuurd naar huisartsen verspreid over heel Nederland en zijn data van een Australisch onderzoek geanalyseerd. De resultaten van deze studies zijn in dit proefschrift beschreven.

In de introductie (**hoofdstuk 1**) geef ik achtergrondinformatie over de definitie en prevalentie van overgewicht en obesitas bij kinderen, over de gevolgen van overtollig gewicht, over de oorzaken van gewichtstoename en over verschillende preventie- en behandelstrategieën. Daarnaast is een behandelschema voor de aanpak van obesitas bij kinderen in Nederland weergegeven. Het hoofdstuk eindigt met een beschrijving van de doelen en de indeling van dit proefschrift.

Het proefschrift bestaat uit vier delen. In het eerst deel worden klachten van kinderen met overgewicht en obesitas bestudeerd. We wilden achterhalen of kinderen met overgewicht en obesitas met andere klachten bij de huisarts komen dan kinderen zonder overgewicht. Mogelijke verschillen zouden inzicht kunnen geven in het ontstaan van die klachten en aanwijzingen kunnen opleveren voor mogelijke behandelingen van zowel klachten als van de aanpak van overgewicht. Om dit uit te zoeken, is de DOERAK cohort studie opgezet. In **hoofdstuk 2** staat de opzet van deze studie, waarin kinderen (2 – 18 jaar) die de huisarts bezochten in Zuid-West Nederland deelnamen, beschreven.

Hoofdstuk 3 geeft de eerste resultaten van deze studie weer. Er hebben 733 kinderen meegedaan; 17.5% had ondergewicht, 63.2% normaal gewicht, 14.3% overgewicht en 5.0% obesitas.

Kinderen met obesitas gingen de afgelopen twaalf maanden vaker (3.7 keer) naar de huisarts dan kinderen met een normaal gewicht (3.3 keer) (p=0.02), maar nadat we hadden gecorrigeerd voor mogelijk selectieve respons verdween deze associatie. Verder zijn er geen relaties gevonden tussen de gewichtsstatus van kinderen en de klachten die door de huisarts werden geregistreerd. De inschatting van de gezondheid van kinderen door de ouders verschilden ook niet voor kinderen met en zonder overgewicht. Wel rapporteerden meer kinderen met overgewicht dan zonder overgewicht somatische klachten (zoals moe zijn, zwak voelen en pijn ervaren) op een vragenlijst die zij thuis invulden. In **hoofdstuk 4** zijn de gezondheidsprofielen van jongeren uit verschillende gewichtscategorieën weergegeven. De baseline data van het PARTY project werden geanalyseerd en er werd in kaart gebracht waarvoor en hoe vaak jongeren (14 – 24 jaar) de huisarts bezochten. De huisarts werd vaker bezocht door jongeren met overgewicht en obesitas, maar niet voor andere klachten dan jongeren met een normaal gewicht. De reden voor consult was vrijwel nooit een probleem met het gewicht. Jongeren met obesitas rapporteerden wel een lagere fysieke gezondheidsgerelateerde kwaliteit van leven. Gezien jongeren met overgewicht en obesitas vaker op consult komen, lijken er mogelijkheden voor de huisarts om het overgewicht in de gaten te houden. Maar omdat jongeren zich niet presenteren met problemen met het gewicht, zal de huisarts mogelijkheden moeten zoeken om gewicht of een gezonde leefstijl ter sprake te brengen in het consult.

De relatie tussen gewicht en klachten aan het bewegingsapparaat was uitvoerig bestudeerd in volwassenen, maar niet in kinderen. Daarom beschrijf ik in **hoofdstuk 5** een literatuuroverzicht van studies die deze relatie in kinderen onderzochten. Veertig studies, die samen meer dan een miljoen kinderen bestudeerden, werden meegenomen. Overgewicht en obesitas bleken al op de kinderleeftijd geassocieerd met meer pijn aan het bewegingsapparaat, en het vaker voorkomen van verwondingen en fracturen. Gezien er maar weinig prospectieve studies waren gedaan, blijft het onduidelijk hoe deze relatie exact ontstaat.

In het tweede deel van dit proefschrift is onderzocht of ouders het overgewicht van hun kind herkennen. In **Hoofdstuk 6** is een literatuurstudie weergegeven waarin artikelen, waarin de daadwerkelijk gemeten gewichtsstatus van een kind is vergeleken met hoe ouders de gewichtsstatus inschatten, systematisch werden vergeleken. Er zijn 51 artikelen, met in totaal 35103 kinderen, meegenomen. Uit de studie bleek dat de meerderheid van de ouders het overgewicht van hun kind niet herkennen (63.4%), in het bijzonder bij jonge kinderen tussen de 2 en 6 jaar (86%). Aangezien een goede behandeling begint bij het herkennen van overgewicht, moeten artsen en andere zorgmedewerkers zich beseffen dat ouders het overgewicht van hun kind vaak niet herkennen.

In het derde deel van dit proefschrift worden de door de huisarts zelf gerapporteerde attitudes, gedrag en ervaren barrières ten aanzien van het aanpakken van overgewicht

bij kinderen bestudeerd. In **hoofdstuk 7** zijn de resultaten van een digitale vragenlijst waarin deze onderwerpen aan de orde kwamen en die naar huisartsen door heel Nederland werd verstuurd en de resultaten van telefonische interviews met huisartsen in Zuid-West Nederland weergegeven. Meer dan 90% van de huisartsen was het eens met de stelling dat huisartsen een rol moeten spelen bij het diagnosticeren van obesitas bij kinderen. Maar huisartsen gaven aan het lastig te vinden om het onderwerp obesitas ter sprake te brengen bij ouders en kinderen, met name als kinderen voor een klacht die niet gerelateerd is aan het gewicht op het spreekuur kwamen. Slechts 4% van de huisartsen gaf aan kinderen door te verwijzen naar multidisciplinaire interventie programma's. Barrières die huisartsen aangaven voor het verwijzen van kinderen waren het gebrek aan effectieve interventies en het gevoel dat ouders en kinderen niet verwezen wilden worden. Extra cursussen en ondersteuning lijken nodig om obesitas bij kinderen succesvol aan te pakken in de huisartspraktijk.

In het laatste gedeelte van dit proefschrift worden mogelijkheden voor het aanpakken van obesitas bij kinderen in de huisartspraktijk besproken. In **hoofdstuk 8** zijn verschillende nationale richtlijnen voor het aanpakken van overgewicht bij kinderen in de eerste lijn met elkaar vergeleken. Er was veel overeenstemming tussen deze richtlijnen. Alle richtlijnen adviseerden een interventie waarin het hele gezin betrokken werd en waarin eet- en beweeggedrag werden aangepakt met begeleidende bijeenkomsten voor gedragsverandering. De exacte adviezen in de richtlijnen waren echter veelal vaag. In **hoofdstuk 9** zijn de resultaten van het PARTY project weergegeven; een Australische interventie studie waarbij huisartsen getraind werden om divers 'ongezond gedrag' (waaronder eet- en beweeggedrag) bij jongeren op te sporen en ter sprake te brengen. Jongeren (14 - 24 jaar) werden benaderd voor de studie wanneer zij hun huisarts bezochten en 901 jongeren deden mee aan de studie. Huisartsen in de interventiepraktijken brachten eet- en beweeggedrag significant vaker ter sprake (28% van de consulten) dan huisartsen in de controlepraktijken (22%). Maar het ter sprake brengen lijkt niet genoeg om overgewicht aan te pakken, want de BMI en het eet- en beweeggedrag van jongeren na 3 en 12 maanden verschilden niet tussen jongeren uit de interventie- en controlepraktijken. Er lijken wat kansen gemist aangezien de helft van de jongeren met overgewicht en obesitas aangaf bereid te zijn hun gedrag te veranderen, terwijl ze dit niet met de huisarts hadden besproken. In **hoofdstuk 10** is besproken wat huisartsen die participeerden in de DOERAK studie hadden ondernomen om overgewicht en obesitas bij kinderen in die studie aan te pakken. Ook in de Nederlandse studie bleek dat kinderen vrijwel nooit met een klacht over hun gewicht bij de huisarts kwamen. Huisartsen brachten een gezonde leefstijl in de meerderheid van de consulten niet ter sprake. Ook werden kinderen niet vaak doorverwezen en werd er niet vaak een vervolgafspraak bij de huisarts ingepland om het over het aanpakken van overgewicht te hebben. Toch gaven vrijwel alle ouders (93.8%) aan het eens te zijn met de stelling dat

de huisarts overtollig gewicht bij hun kind ter sprake mag brengen, ook wanneer ze voor een andere klacht op consult komen.

Tot slot worden in **hoofdstuk 11** de belangrijkste bevindingen besproken en vergeleken met bestaande literatuur en er worden een aantal suggesties gedaan voor vervolgonderzoek. Kinderen met overgewicht rapporteerden meer somatische klachten, jongeren met obesitas een lagere fysieke kwaliteit van leven en uit de literatuur bleek dat overtollig gewicht al op jonge leeftijd geassocieerd was met diverse klachten aan het bewegingsapparaat. Toch komen kinderen met overgewicht en obesitas niet met andere klachten bij de huisarts dan kinderen met een normaal gewicht. Gezien kinderen met overgewicht en obesitas niet verschillen van kinderen zonder overgewicht in hun presentatie in de huisartspraktijk is er geen directe aanleiding voor de huisarts hen anders te behandelen. Maar huisartsen moeten zich wel bewust zijn van mogelijke klachten die kinderen met overgewicht ervaren maar die ze niet noemen tijdens consult. Met betrekking tot het aanpakken van overgewicht is het belangrijk dat huisartsen een manier vinden om dat onderwerp ter sprake te brengen, gezien kinderen zelf niet met een klacht over hun gewicht op het spreekuur komen. Er is brede consensus tussen richtlijnen uit verschillende landen over welke elementen een interventie voor het aanpakken van overgewicht bij kinderen in de eerste lijn zou moeten bevatten, maar de exacte aanbevelingen zijn vaag. Als het gaat over de aanpak van overgewicht bij kinderen door de huisarts (het meten van de BMI, het onderwerp bespreken en het inplannen van vervolgafspraken of het doorverwijzen) kan geconcludeerd worden dat de huisarts diverse barrières ervaart en dat het huidige handelen niet in overeenstemming is met de obesitas richtlijn voor huisartsen. Toch lijken er mogelijkheden voor het aanpakken van obesitas bij kinderen in de huisartspraktijk. Zeker gezien huisartsen na een training eet- en beweeggedrag vaker ter sprake brengen en ouders vinden dat de huisarts overgewicht van hun kind in een regulier consult ter sprake mag brengen. Daarom is aan het eind van dit proefschrift geconcludeerd dat de huisarts weldegelijk een rol kan spelen in de aanpak van obesitas bij kinderen, maar dat die rol tot nu toe nog niet is vervuld; kinderen met obesitas bij de huisarts, nog geen dagelijkse praktijk.

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En dan is er uiteraard ook nog een leven buiten onderzoek. De laatste vier en een half jaar heb ik mijn promotietraject gecombineerd met allereerst een docentenopleiding en vervolgens met een baan als docent bij de Hogeschool.

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Na de docentenopleiding kwam ik te werken bij de HBO-opleiding Sport en Bewegen in Overveen. Hoewel het vroeg opstaan was, heb ik hier twee jaar met heel veel plezier gewerkt. De studenten en collega's waren zeer enthousiast. Door hun passie voor een gezonde leefstijl heb ik ook met andere ogen naar het onderwerp overgewicht bij kinderen leren kijken. Dank hiervoor en Afke en Marije jullie in het bijzonder nog bedankt voor alle leuke gesprekken die we hebben gehad over onderwijs en onderzoek.

Mijn huidige collega's bij de opleiding fysiotherapie van de Hogeschool Rotterdam wil ik bedanken voor de goede gesprekken over het nut van wetenschap voor de praktijk. Ik vind het ontzettend fijn dat ik onderwijs en onderzoek hier kan combineren en het is een mooie uitdaging om het wetenschappelijk onderwijs zo vorm te geven dat alle partijen er baat bij hebben. Lennard, dank voor je vertrouwen. Ik hoop dat we nog veel mooi onderzoek samen zullen opzetten.

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En dan is zelfs ook nog een leven buiten werk. Een aantal mensen uit die omgeving wil ik hier persoonlijk bedanken.

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Lieve Marienke, bijna spastisch kon ik werk en privé gescheiden houden met petjes op en af. Om schizofreen van te worden. Om in stijl te blijven hier nog een persoonlijk dankwoord (petje af): dankjewel voor alle lol die we afgelopen jaren hebben gehad en dat we ons zo heerlijk gezamenlijk kunnen verwonderen over deze wereld. Je maakt Rotterdam een veel leukere stad om in te wonen! Wel jammer dat je geen verstand van voetbal hebt.

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Lieve Cor, is dit boekje dan waar ik al die jaren mee bezig ben geweest? Omgerekend heb ik zo'n 3,5 regel per dag geschreven. Ja, dat is ook niet te begrijpen! Dankjewel dat je er altijd bent om me met een halve grijns aan te kijken, je schouders op te halen en

'nee' te schudden. Die tegenpool heb ik nodig. Ik ontspan pas echt als ik tijd met jou en Luuk doorbreng. Het is niet in woorden te beschrijven hoe belangrijk jullie voor me zijn.

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About the author

Winifred Dorus Paulis was born on the 25th of December 1983 in Amsterdam, the Netherlands. She attended secondary school at the Barlaeus Gymnasium and graduated in 2002. She studied Human Movement Sciences at the VU University in Amsterdam from 2002-2006. During this time she worked as a research assistant for Prof.dr. P.J. Beek and she finished her Master studying active balance control in stroke patients and healthy elderly. In 2007 she started working in the Erasmus MC at the department of rehabilitation. In the gait lab she conducted measurements to help evaluate rehabilitation progress of patients for clinical purpose and she studied whether spasticity could be measured with orientation sensors. At the end of 2009 she switched to the department of general practice. Over there she was involved in conducting an educational RCT to evaluate the effectiveness of actively involving GP-trainees in scientific research. Together with the trainees she set-up the DOERAK cohort from which results are shown in this thesis. During this time Winifred's enthusiasm for education was enlightened and she decided in 2011 to follow the Exposz teacher training in Amsterdam to become a qualified teacher. Since February 2013 she combined working on the studies described in this thesis with teaching research methodology; from 2013 to 2015 at Inholland University of Applied Sciences of Sports, Exercise and Health in Overveen and since February 2015 at the University of Applied Sciences Rotterdam for Physical Therapy training. Now she will continue to work as a teacher and researcher at the University of Applied Sciences Rotterdam and as a post-doc researcher at the department of general practice of the Erasmus MC.

PhD Portfolio

PHD PORTFOLIO

Name PhD Student: Winifred Paulis
Erasmus MC Department: General Practice
PhD Period: 2009-2016

Promotor: Prof. dr. B.W. Koes
Supervisor: Dr. M van Middelkoop

1. PHD TRAINING	Year	Workload	
		Hours	ECTS
General courses			
Biomedical English Writing and Communication	2012-2013	112	4
Biostatistical Methods I	2012	160	5.7
Research Integrity	2010	20	0.7
Basiscursus regelgeving en organisatie voor klinische onderzoekers; BROK	2010	30	1
BROK update	2014	8	0.3
Specific courses			
Principles of Epidemiologic Data-analysis	2010	20	0.7
Cohort studies	2011	20	0.7
Presentations International conferences			
ECO, Sofia, Bulgaria, 2 poster presentations	2014	32	1.1
ECO, Liverpool, United Kingdom, 2 poster and 1 oral presentation	2013	52	1.9
ECO, Lyon, France, 2 poster presentations	2012	32	1.1
ECOG, Pècs, Hungary, poster and oral presentation	2011	36	1.3
Presentations National conferences			
NHG-wetenschapsdag, poster and oral presentation	2014	36	1.3
Over gewicht, symposium GP-trainees, chair	2013	8	0.3
Conferentie Onderzoek van Onderwijs, oral presentation	2012	20	0.7
HGZO congres, oral presentation	2011	20	0.7
NHG-wetenschapsdag, poster and oral presentation	2011	36	1.3
Jeugd & Gezondheid, oral presentation	2011	20	0.7
International collaboration			
Research Visit University of Melbourne	2013	160	5.7
2. TEACHING			
Lecturing for DOERAK project	2010-2013	180	6.4
Lecturing Sports Medicine to GP-trainees	2012	24	0.9
Lecturing EBM to GPs	2011-2012	24	0.9
Supervising 4 Medical Students	2010-2012	240	8.6
Supervising GP-trainee	2011	40	1.4
TOTAL			**47.4**

List of publications

THIS THESIS

Paulis, W.D., M. Palmer, P. Chondros, S. Kauer, M. van Middelkoop and L.A. Sanci. "Health profiles of overweight and obese young people attending general practice. " *Submitted*

Paulis, W.D., M. van Middelkoop, H.J. Bueving, P.A.J. Luijsterburg and B.W. Koes. "Complaints of overweight, obese and normal-weight children attending general practice. " *Submitted*

Paulis, W.D., M. van Middelkoop, S. Kauer, P. Chondros, G. Patton and L.A. Sanci. "Addressing healthy eating and exercise in young people presenting to primary care: findings from a cluster randomized trial of training clinicians in health risk screening and motivational interviewing. " *Submitted*

Paulis, W. D., M. van Middelkoop, H. J. Bueving, P. A. Luijsterburg and B. W. Koes (2015). "Discussing overweight in primary care." Arch Dis Child **100**(9): 899-900.

Paulis, W. D., S. Silva, B. W. Koes and M. van Middelkoop (2013). "Overweight and obesity are associated with musculoskeletal complaints as early as childhood: a systematic review." Obes Rev.

Richardson, L., W. D. Paulis, M. van Middelkoop and B. W. Koes (2013). "An overview of national clinical guidelines for the management of childhood obesity in primary care." Preventive Medicine.

Rietmeijer-Mentink, M., W. D. Paulis, M. van Middelkoop, P. J. Bindels and J. C. van der Wouden (2012). "Difference between parental perception and actual weight status of children: a systematic review." Matern Child Nutr.

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OTHER INTERNATIONAL PUBLICATIONS

Ligthart, K. A., W. D. Paulis, D. Djasmo, B. W. Koes and M. van Middelkoop (2014). "Effect of multidisciplinary interventions on quality of life in obese children: a systematic review and meta-analysis." Qual Life Res.

Kemler, E., I. Vriend, W. D. Paulis, W. Schoots, M. van Middelkoop and B. Koes (2014). "Is overweight a risk factor for sports injuries in children, adolescents, and young adults?" Scand J Med Sci Sports.

van Grieken, A., N. P. Ezendam, W. D. Paulis, J. C. van der Wouden and H. Raat (2012). "Primary prevention of overweight in children and adolescents: a meta-analysis of the effectiveness of interventions aiming to decrease sedentary behaviour." Int J Behav Nutr Phys Act **9**(1): 61.

Scholten-Peeters, G. G., M. S. Beekman-Evers, A. C. van Boxel, S. van Hemert, W. D. Paulis, J. C. van der Wouden and A. P. Verhagen (2011). "Attitude, knowledge and behaviour towards evidence-based medicine of physical therapists, students, teachers and supervisors in the Netherlands: a survey." J Eval Clin Pract.

Huisstede, B. M., P. Hoogvliet, W. D. Paulis, M. van Middelkoop, M. Hausman, J. H. Coert and B. W. Koes (2011). "Effectiveness of interventions for secondary Raynaud's phenomenon: a systematic review." Arch Phys Med Rehabil **92**(7): 1166-1180.

Paulis, W. D., H. L. Horemans, B. S. Brouwer and H. J. Stam (2011). "Excellent test-retest and inter-rater reliability for Tardieu Scale measurements with inertial sensors in elbow flexors of stroke patients." Gait Posture **33**(2): 185-189.

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Rietmeijer-Mentink, M. and W. D. Paulis (2013). "Het obese kind." Huisarts en wetenschap **56**(5): 246.

Paulis, W. (2011). "Huisarts kan kinderen met overgewicht behandelen." Huisarts en Wetenschap **54**(5).