Patients with hip osteoarthritis : body weight and life style before and after arthroplasty

Paans, Nienke

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N. Paans

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Stellingen behorende bij het proefschrift

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1. Het is aan te bevelen de tijd tussen de diagnose heup artrose en het plaatsen van de prothese te benutten voor actieve, conservatieve behandeling.
(dit proefschrift)

2. De diagnose heup artrose leidt in de huisartsenpraktijk meestal in eerste instantie tot een expectatief beleid. (dit proefschrift)

3. In de praktijk wordt na het stellen van de diagnose heup artrose door de huisarts de interventie "bewegen en afvallen" niet voorgeschreven.
(dit proefschrift)

4. Bewegen in combinatie met afvallen lijkt de functie te verbeteren en de pijn te verminderen bij patiënten met heup artrose.
(dit proefschrift)

5. Het weigeren van een heup prothese, bij een patiënt met heup artrose, alleen op basis van het lichaamsgewicht lijkt niet gerechtvaardigd.
(dit proefschrift)

6. Bij het behandelen van heup artrose is het aanstellen van een leefstijlcoach aan te bevelen, zowel voor als na het plaatsen van een heup prothese.
(dit proefschrift)

7. Het stimuleren van een lichamelijk actieve leefstijl zou een onderdeel moeten zijn van het revalidatie traject na het plaatsen van een heup prothese.
(dit proefschrift)

8. Ik houd van kritiek, maar ik moet het er wel mee eens zijn. (Mark Twain)

9. Diëtiek uit het basispakket van de zorgverzekering halen is vragen om meer gezondheid gerelateerde problemen.

10. Het verzinnen van wetenschappelijke resultaten is een gevolg van de toenemende prestatiedruk die de maatschappij wetenschappers oplegt.

11. Alleen eten houdt de mens niet gezond; hij moet ook bewegen. (Hippocrates)

N. Paans, april 2012

Paranimfen: Ida Buist

                Mark de Vries

RIJKSUNIVERSITEIT GRONINGEN

Patients with hip osteoarthritis

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Proefschrift

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Contents

Chapter 1

General Introduction

Introduction

Osteoarthritis (OA) is an age-related chronic condition and the most frequent cause of musculoskeletal disability in developed countries, resulting in limited activities of daily living among the general adult population.[1,2] Although OA may affect any joint of the body, it most commonly affects the knee, followed closely by the hip.[3] The two main categories of hip OA are primary hip OA (also termed idiopathic)and secondary hip OA (from a known cause). Primary hip OA is believed to account for the majority of all hip OA.[4]

The prevalence of primary radiographic hip osteoarthritis in the United States was 27% in the year 2003 for adults over 45 years of age. In the Netherlands this prevalence in 2004 was 7.0% for adults aged over 55.[5] Due to an aging society and the epidemic of obesity[6,7] in the Western world,[8] the number of people developing hip osteoarthritis is expected to increase. In the United States it has been estimated that the prevalence of people with OA of the hip will increase from 43 million in 1997 to 60 million in 2020.[9] An increase in the prevalence of hip OA cases is estimated for the Netherlands too.[10]

Conservative, e.g. non-surgical, treatment options for OA of the hip are available and described in international guidelines[11-13] that advise losing weight as well as increasing activity. However, the hip OA guidelines are predominantly based on knee OA research and to a lesser extent on hip OA research. In the Netherlands there are national guidelines for the treatment of hip and knee OA[14] which in fact resemble the international guidelines. No specific guidelines are available for the general practitioner (GP) setting though. This is a major disadvantage, as general practitioners

act as gatekeepers for medical care. To that end it is interesting to know what kind of treatment a patient with hip OA receives in his initial contact moments with the general practitioner, and more specifically if the GP incorporates weight loss and/or exercise into the treatment plan. There is some literature providing information on GPs' general management of patients with hip complaints,[15,16] yet specific information with respect to treatment of hip OA is lacking. The first objective of this thesis is therefore to study the treatment policy of the general practitioner, and more specifically to what extent weight loss and/or exercise play a role in the conservative treatment of OA of the hip.

Regarding weight loss as a treatment option, a reduction of 10% of body weight over 18 months in older adults has been shown to significantly reduce joint loads in knee OA patients.[17] While increasing activity plays an additional role in losing weight, the combination of these two is analysed for its effect in knee OA patients, with a supplemental result: a combination of weight loss and exercise is more effective in improving self-reported physical function compared to either of them alone.[18] According to the above it is generally accepted that such a combination treatment will have an analogue effect in hip OA patients, but this remains speculative as no research has determined this yet. The second objective of this thesis is thus to study the effect of a combination treatment of weight loss and exercise in hip OA patients.

While hip OA is a degenerative disease, total hip joint replacement (THA) is the last treatment modality for advanced disease. Once a THA has been performed, overweight/obesity still plays an important role, as overweight/obesity is associated with a negative effect on functional

outcome after THA and on implant longevity.[19] Studies have also found a correlation between overweight/obesity and higher infection rates, risk of dislocation and aseptic loosening,[20-23] yet few have taken the influence of comorbidity and complications into account when assessing the influence of overweight/obesity on the outcome after THA.[24] The third objective of this thesis is therefore to analyse the effect of overweight/obesity on patient-perceived physical functioning and health-related quality of life one year after THA, taking into account the influence of comorbidity and perioperative complications.

As already mentioned a THA can be considered as the final treatment modality in end-stage OA. End-stage OA is characterised by severe limited physical function and pain and is unresponsive to conservative therapy.[25] Both patients and doctors argue that a THA is supposed to diminish pain and increase mobility. Consequently, patients assume weight loss will occur naturally after their surgery,[26] while losing weight in advance is thwarted by physical limitations and pain. Previous research indicates this is not the case: patients maintain the same body weight or even seem to gain weight after their hip replacement.[26-30] However, so far not much is known about differences in effect for different subgroups of patients (normal weight, overweight, obese) and about the long-term effect of a THA on body weight. The last objective of this thesis is therefore to determine to what extent a THA leads to weight loss in hip OA patients categorised into normal weight, overweight and obese, as well as to determine the long-term effect of a THA on body weight.

The present thesis

In **Chapter 2** and **Chapter 3** an answer is given to the first objective of this thesis concerning the treatment policy of general practitioners for patients with OA of the hip. Chapter 2 gives an impression of the time a hip OA patient spends at the GP's practice and Chapter 3 provides insight into the GP's management before the patient is referred to an orthopaedic specialist. Results are compared with national and international guidelines. **Chapter 4** describes the design of a cohort study that examines the effect of a combination therapy of weight loss and exercise in hip OA patients. **Chapter 5** presents the outcome of the second objective: what effect can be generated from a combination therapy of weight loss and exercise in hip OA patients, using physical function as primary outcome measure. In **Chapter 6** a more detailed analysis of the influence of overweight/obesity on physical functioning and health-related quality of life after THA is given, taking into account the impact of complications and comorbidities. Connecting to the fourth objective, **Chapter 7** investigates to what extent a THA results in weight loss. To that end, the effect of a THA is analysed for patients with normal weight, overweight or obesity, and an impression is given of the long-term effect of a THA on weight change. Finally, **Chapter 8** contains a general discussion of the studies presented in this thesis, with its strengths and limitations, and provides practical implications and recommendations for future research.

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Chapter 2

Time spent in primary care for hip osteoarthritis
patients once the diagnosis is set: a prospective
observational study

Nienke Paans[1] ■ Willem Jan van der Veen[3] ■ Klaas van der Meer[3] ■
Sjoerd K Bulstra[1] ■ Inge van den Akker-Scheek[1,2] ■ Martin Stevens[1].

[1]Department of Orthopaedic Surgery, University Medical Center Groningen, University of
Groningen, The Netherlands.

[2]Department of Orthopaedic Surgery, Martini Hospital Groningen, The Netherlands

[3]Department of General Practice, University Medical Center Groningen, University of
Groningen, The Netherlands.

Abstract

Background: Previous research on time to referral to orthopaedic surgery has predominantly used hip complaints as starting point instead of the moment the diagnosis of osteoarthritis (OA) of the hip is established, therefore little is known about the length of time a patient diagnosed with hip OA stays under the care of a general practitioner (GP). No knowledge on factors of influence on this time period is available either. Aim of this study was thus to determine the time an incident hip OA patient stays in the care of a GP until referral to an orthopaedic department. Influencing factors were also analysed.

Methods: A prospective observational study was conducted based on data over a 10-year period from a general practice-based registration network (17 GPs, >30,000 patients registered yearly). Patients with the diagnosis of hip OA were included. A survival analysis was used to determine time until referral to an orthopaedic department,and to determine factors of influence on this time.

Results: Of 391 patients diagnosed with hip OA, 121 (31%) were referred; average survival time until referral was 82.0 months (95% CI 76.6-87.5). Less contact with the GP for hip complaints before the diagnosis of hip OA was established resulted in a decreased time to referral.

Conclusions: The results of this study show that patients with hip OA were under the care of a general practitioner, and thus in primary care, for a considerable amount of time once the diagnosis of hip OA was established.

Introduction

Hip osteoarthritis (OA) is a common musculoskeletal disorder. In the Netherlands, the number of new cases of symptomatic OA of the hip was found to be 1.7 per 1000 in 2007[1]. In the US the most recent incidence rates were reported to be 0.9 per 1000 person-years[2]. Patients with end-stage OA often undergo a total hip arthroplasty (THA). THA is a highly successful treatment and the number of people indicated for this treatment is increasing[3,4].

In most European countries general practitioners are the gatekeepers for the medical decision-making[4]. Normally a patient with hip OA stays in the general practice until conservative treatment no longer suffices and hip replacement becomes an option. This is the moment the patients switches from primary to secondary care.

Previous research on the management by GPs predominantly used hip complaints as starting point instead of the moment the diagnosis of hip OA was established[5,6]. Hence little is known about the length of time a hip OA patient generally stays under the care of a general practitioner (GP) from the moment the diagnosis of hip OA is established until referral to orthopaedics – the switch to secondary care. Insight into the length of time from hip OA diagnosis until referral to orthopaedics is of importance because it provides insight into the time available for the application and/or development of non-surgical interventions. This is of major relevance as non-surgical interventions could significantly contribute to postponing the hip replacement which in turn can prevent future revision surgery.

The literature reports variations in management of hip complaints by the GP[5,6] and influencing factors on these variations are suggested, like older age

(>60 years) and a body mass index (BMI) over 30 kg/m[25-7]. The literature lacks information concerning influencing factors for time to referral for patients diagnosed with hip OA specifically though. The aim of the present study was therefore to determine the time an incident hip OA patient stays in the care of a GP until the patient is referred to an orthopaedic department. The presence of influencing factors on the length of this time period was also analysed.

Methods

This was an observational cohort study. Data on morbidity and medication were extracted from the Dutch Registration Network Groningen. This general practice-based register was established in 1989, consists of three group practices with about seventeen GPs and is based in the north-eastern Netherlands. Participating GPs register all care delivered to their patients. About 30,000 regular patients (24,000 of them aged 18 years or older) are registered yearly. These patients are demonstrated to be representative of the national population.

All consultations, with reasons for the visit as well as diagnoses, referrals and prescriptions, are registered in the RNG. Morbidity data are electronically recorded using the International Classification of Primary Care (ICPC), and each prescribed medication is provided with an ICPC-based indication[8]. This ICPC code is based on a simple biaxial structure consisting of a letter followed by a number. The letter represents a body system (e.g. L= musculoskeletal system), numbers 1-29 provide categories for symptoms and complaints, and numbers 70-99 represent a diagnosis/disease. The medicated prescriptions were automatically classified

with an Anatomical Therapeutical Chemical (ATC) code developed by the World Health Organization[9].

The RNG register is a validated[10] and structured register with regular meetings of participating general practices twice a year, for purposes of maintaining an unambiguous registration, which is an ongoing process.

Patient selection

Incident patients aged 18 or older who received a diagnosis of hip OA (ICPC code L89) in the period between January 1999 and December 2007 were included in this study. The diagnosis of hip OA was based on the definition of OA in the ICPC. The ICPC defines OA of the hip as a joint disorder of at least 3 months duration, with no constitutional symptoms and three or more of the following: intermittent swelling; crepitation; stiffness or limitation of movement; normal ESR, rheumatoid tests, and uric acid; over 40 years of age[8]. Patients with an incidence date preceding their entry to the general practice were excluded from this study (this phenomenon occurs when patients transfer to another general practice and bring along 'historical' data). Patients with time registration errors were also excluded.

Data selection

Registration data from January 1998 to December 2008 were used to obtain a follow-up period (FU) and a follow-back period (FB) of at least one year for all study patients (see Fig. 1). The start of the FU period was set at incidence date and the end at occurrence of the event 'first referral to orthopaedics', further addressed as 'referral'. If the event did not take place the end date was set at either the date of censoring or the end of the study

period (31-12-2008). A patient was censored when leaving the general practice or in case of death.

The start of the FB period was set at arrival in the general practice or at the beginning of the study period (01-01-1998). The end was set at the last day prior to the patient's incidence date. GP consultations for hip OA (ICPC code L89) in the FU period and hip complaints (ICPC code L13) in the FB period were recorded. These contacts were classified as telephone contact, consultation, house call or medication prescription. Considering that the amount of registered contact or prescriptions is affected by the exposure time during FU or FB, this amount was divided by that specific patient's exposure years (person-years). All GPs were visited to verify exact dates of hip replacements from the electronic surgical reports.

Age at incidence date, sex, different GP practices, number of contact moments during FB, and number of comorbidities and amount of pain medication during FB were assessed as possible influencing factors. Comorbidities were defined as medical conditions such as overweight, obesity, diabetes mellitus, hip fracture, knee osteoarthritis, and cardiac, pulmonary, haematological, renal and oncological diseases. Pain medication was any medication generally prescribed for musculoskeletal pain: prostaglandin synthetase inhibitors, non-steroidal anti-inflammatory drugs (NSAIDs), acetaminophen and opiates (ATC group M01 or N02).

Figure 1. Timeline of incident cases
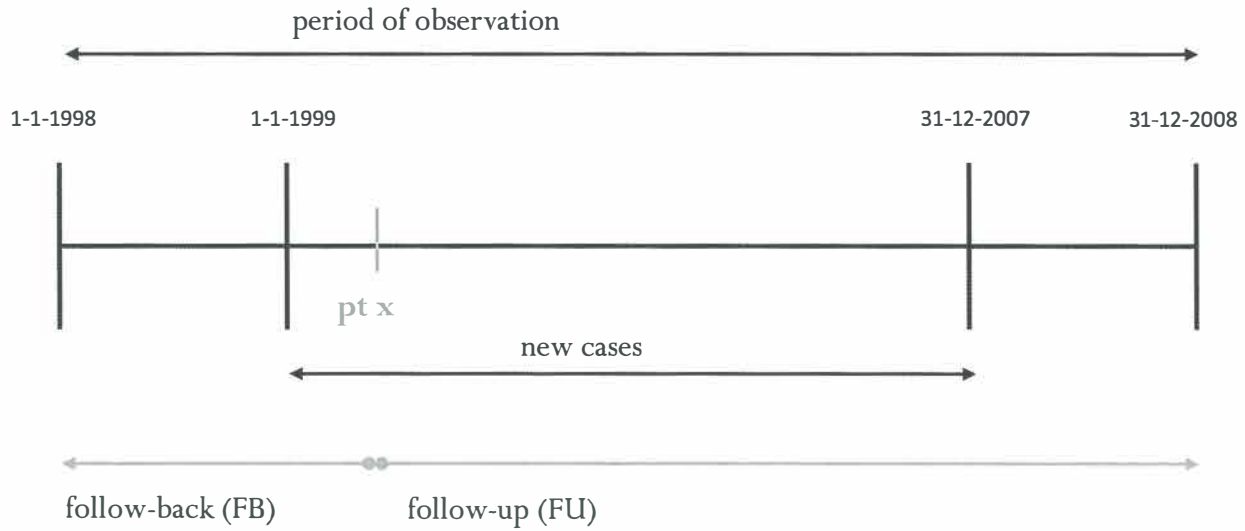
The data used in this study were not publicly available. The patients gave permission for use of their medical data if anonymised. The general practitioners gave permission to provide this anonymised data to the researcher. These GP permissions forms (in Dutch) are available upon request. Finally, the data acquisition was done in accordance with the regulations of the medical ethical board of University Medical Center Groningen.

Statistical analysis

All statistical analyses were computed using the Statistical Package for the Social Sciences (SPSS, Inc., Version 16.0, 2007, Chicago). Survival was described with Kaplan-Meier survival analyses, which were used to analyse time to referral and the influence of several factors on these survival times. A probability value of less than 0.05 is considered as statistically significant.

Results

The study group consisted of 391 patients; 72% was female, average age at the incidence date was 66.8 years (SD 14.0) and average exposure in the general practice during the FB period was 4.8 person-years (SD 2.8). Demographics and clinical information of the study group are shown in Table 1.

Table 1. Baseline characteristics of study group hip OA patients*

Variables	Hip OA patients (n = 391)
Demographics	
Age at incidence date, years	66.8 (14.0)
Female, %	71.1
Clinical factors	
Exposure during FB, years	4.8 (2.8)
Hip-related contact during FB, person-years, %	
< 1	89.8
1–2	6.4
2 >	3.8
Number of comorbidities during FB, %	
< 2	58.1
2–4	29.2
> 4	12.8

* Values are the mean (SD) unless otherwise indicated.
OA: osteoarthritis; FB: follow-back.

Of all patients (N=391), the average survival time a hip OA patient spent in general practice until referral was 82.0 months (95% CI: 76.6-87.5) (see Fig. 2). After a period of 12 months, 90 patients were referred (24%) for the first time, after 36 months 110 patients (37%).

The analysis for factors of influence on survival time showed that 0 to 0.2 GP contact times per year for hip complaints in the FB period significantly decreased the survival time to 78.2 months (95% CI 71.8-84.6). Age, sex, number of comorbidities, amount of pain medication and different GP practices did not influence time to referral (p= 0.925, p=0.675, p=0.336, p=0.223, and p=0.800 respectively).

Figure 2. Survival until referral to orthopedics
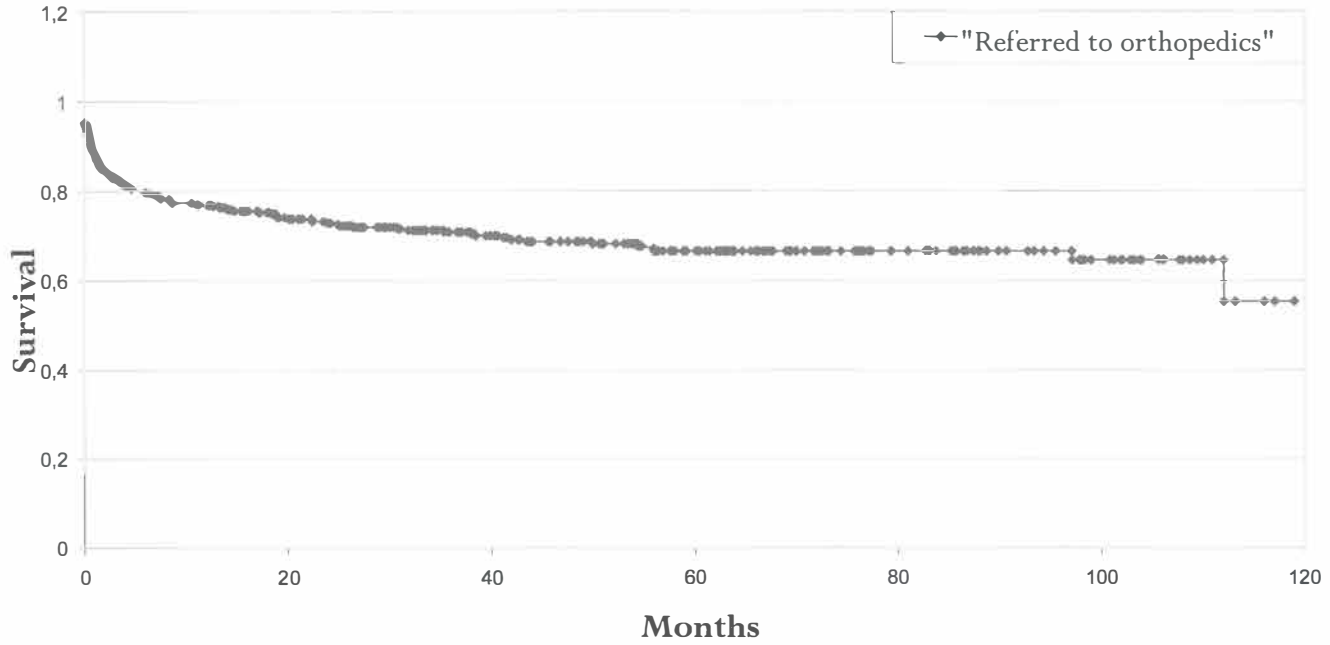
Discussion

This study showed that incident hip OA patients stayed on average 7 years (82 months) under the care of a general practitioner until their referral to orthopaedics. Of all patients in this study, 24% were referred 12 months after hip OA diagnosis and 37% after 36 months. The clinical consequence of this result is the conclusion that a considerable period of time is available to apply non-surgical interventions before surgery is suggested as an option. This is important, as non-surgical interventions could significantly contribute to postponing hip replacement, which in turn can delay or prevent future revision surgery. Future research should therefore explore whether and to what extent non-surgical interventions are applied during this time under the care of a general practitioner.

A previously published American study[11] reported 17.6% referrals to orthopaedics in 20 months. However, that study made a distinction between orthopaedic referrals for evaluation, joint injection or arthroscopy and orthopaedic referrals for actual surgery. Only the latter category was considered as a "referral" for the study's outcome. This difference could explain the lesser number of referrals compared with the present study.

Contrary to earlier research on influencing factors on management of hip complaints, this study showed just one influencing factor on the time until referral to orthopaedics in hip OA: a low frequency of contact for hip complaints with the GP before the diagnosis of hip OA is set accelerates the moment after the GP refers to orthopaedics. In our opinion, the only plausible explanation for this factor is that in patients who postpone GP contact the longest, the OA is so severe and advanced that the GP decides

not to delay any further and refers to orthopaedics. However, this cannot be confirmed with our data.

Information about influencing factors on time at the GP practice for patients diagnosed as having hip OA, as presented in this study, is practically never reported in previous studies. Only the previously mentioned American study[11] examined predictors of time to referral to orthopaedic surgery for consideration of joint replacement, and reported that recruitment site was a predictor for time to referral. A possible explanation postulated by the authors for this finding is possible differences in regional waiting lists between the two analyzed groups. In the present study no difference was found in time to referral for the different GP practices. In line with the assumption of this American study, the present finding could be explained by referrals to various orthopaedic departments with separate waiting lists. The present study also presented sex as a non-influencing factor, which was in accordance with the American study[11].

Strengths and limitations

The present study showed the period of time an incident patient with hip OA currently stays in general practice. To our knowledge, no recent study has reported this information before. It was a strength to have had access to an elaborate prospective database of a medical registration network such as the RNG, enabling us to gather information for an 11-year period spanning from January 1998 to December 2008. In this 11-year period the GPs were not informed about this specific data extraction and there were no limits on their treatment decisions (no fee-for-service). In addition it was a strength that the number of incident patients in the study group and the referral

behaviour of the RNG GPs were comparable with national figures: incidence figures of hip OA determined in Dutch GP practices in 2007[1] were 1.7 per 1000 in one year (versus 1.6 per 1000 in one year in this study). In 2008 GP referral to orthopaedics according to the Netherlands Institute for Health Services Research was 16.4 per 1000 registered male patients and 21.3 for the registered female patient[12]. In the same year the referral behaviour of the RNG network was 16.5 per 1000 patients. A limitation of the study was that only access to information of registered care was gathered, but none about severity of the hip complaints, and no additional investigations were included such as X-rays of the affected hip, as these could have provided more information about the differences between patients at the moment the diagnosis was established.

Conclusions

Average time to referral was 82 months, i.e. 6.8 years. This indicates that a considerable period of time after the diagnosis is set is spent under the care of a GP, and thus in primary care. The importance of this knowledge can be translated into the assumption that general practice can operate as an optimal setting for the application and/or development of new promising conservative interventions.

Abbreviations

OA: Osteoarthritis; GP: General Practitioner; THA: Total Hip Arthroplasty; BMI: Body mass index; RNG: Registration Network Groningen; ICPC: International Classification of Primary Care; ATCcode: Anatomical Therapeutical Chemical code; WHO: World Health

Organization; FB: follow back; FU follow up; NSAIDs: non-steroidal anti-inflammatory drugs.

Competing interests

The authors have declared no conflicts of interest.

Authors' contributions

MS, NP, IvdAS and WvdV participated in the design of the study and in collecting the data, performed the statistical analysis and drafted the manuscript. KvdM and SB participated in the progress and revision of the manuscript. All authors read and approved the final manuscript.

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Chapter 3

Does medical care in general practice for patients
with hip osteoarthritis meet the guidelines?
A prospective study.

Nienke Paans[1] ■ Inge van den Akker-Scheek[1,2] ■ Willem Jan van der Veen[3]
Klaas van der Meer[3] ■ Sjoerd K Bulstra[1] ■ Martin Stevens.[1]

[1]Department of Orthopaedic Surgery, University Medical Center Groningen, University of
Groningen, The Netherlands

[2]Department of Orthopaedic Surgery, Martini Hospital Groningen, The Netherlands

[3]Department of General Practice, University Medical Center Groningen, University of
Groningen, The Netherlands

Abstract

Background: In Europe, most patients with hip osteoarthritis (OA) receive their initial medical care from the general practitioner (GP). The aim of this study was to examine the frequency and nature of GP medical care of hip OA patients, and to determine if this care meets national and international guidelines for the treatment of hip OA.

Objective: To examine the frequency and nature of GPs medical care of hip OA patients, and to determine if this care meets (inter)national guidelines.

Method: A prospective observational study was executed. The data collection was carried out on anonymised records from a general practice-based research register. Patients aged 18 years and older who were diagnosed with hip OA in the period between January 1999 and December 2007 were selected for this study. GP contact data was gathered 1 year before and 1 year after diagnosis (total follow-up (TFU)).

Results: A total of 391 incident hip OA cases were identified. During the TFU the GP intervened in almost half of the patients. About a third had no contact with the GP at all. Of the 192 patients who received an intervention, 26% had a referral to orthopaedics. In 9.9% of cases the guidelines were pursued.

Conclusion: This study showed that the medical care of the GP can be defined mainly as expectant. Initial interventions consisted of pain medication or referral to orthopaedics. Combined interventions as proposed in the (inter)national guidelines were not reported often.

Introduction

Hip osteoarthritis (OA) is a major cause of pain and disability. As a result, it is associated with poor health status [1,2]. OA is the most common diagnosis for total hip replacement surgery. In 2007, OA of the hip affected approximately 7% of the population aged 65 years and older in the Netherlands [3,4]. Due to an aging society, an increase of 25% for hip OA is estimated by 2050 of people aged 65 years and older in the Netherlands, [5] which will give rise to a higher prevalence of hip OA [6].

In the Netherlands the initial medical care of hip OA is given by a general practitioner (GP). The medical care provided by GPs is based on clinical guidelines when available. Dutch guidelines for osteoarthritis were composed by orthopaedic surgeons in 2007[7] (hip or knee) and by GPs in 2008[8] (knee). International guidelines are established by ACR[9] (hip or knee, 2002), EULAR[10] (hip, 2005) and OARSI[11] (hip or knee, 2008). These guidelines describe conservative treatment (pharmacological and non-pharmacological), as a single treatment or in combinations, and surgical treatment. Pharmacological treatment usually involves pain medication. As non-pharmacological treatment, exercise, aids (cane, insoles) and weight reduction are advised.

Hip replacement is described as surgical treatment and although technical developments have prolonged the survival of a prosthesis to 10 years[12], a prosthesis deteriorates over time and subsequently may require revision surgery. However this procedure has an increased risk of surgical complications and worse outcome. A potential benefit of conservative treatments is postponing hip replacement and consequently revision surgery. Therefore proper conservative treatment by the GP is of eminent importance.

To our knowledge, a prospective study about the application of medical care by GPs solely for hip OA has not been published before. The question thus arose of which medical care is currently conducted by GPs for hip OA, and whether this medical care meets the actual guidelines. Consequently, the main objective of this study was to describe the determinants, nature and frequency of GP medical care, and to establish whether this care meets national and international guidelines for treatment of hip OA.

Methods

Design and setting

A prospective observational cohort study. To select patients with hip OA, data on morbidity and medication from the Dutch Registration Network Groningen (RNG)[13] were extracted. This general practice-based register in the northeast of the Netherlands was established in 1989, and consists of three group practices with about seventeen GPs. About 30,000 regular patients (of which 24,000 are aged 18 and older) are registered yearly. Participating GPs register all care delivered to their patients. Consultations, with reasons for the encounter as well as diagnosis and prescriptions, are collected in the RNG. Morbidity data are electronically recorded using the International Classification of Primary Care (ICPC), and each prescribed medication is provided with an ICPC-based indication[14]. This ICPC code is based on a simple biaxial structure consisting of a letter followed by a number. The letter represents a body system (e.g. L= musculoskeletal system), numbers 1-29 provide categories for symptoms and complaints, and numbers 70-99 represent a diagnosis/disease. The medication prescriptions were automatically classified with an Anatomical Therapeutical Chemical (ATC) code developed by the World Health Organization[15].

The RNG is a validated[16] and structured register with regular meetings, twice a year, of participating general practices in order to maintain an unambiguous registration, which is an ongoing process.

Patient selection

Patients aged 18 years and older who received a diagnosis of hip OA (ICPC code L89), irrespective of radiographic conformation, in the period from 1 January 1999 to 31 December 2007 were included in this study. The diagnosis of hip OA was based on the clinical definition of OA in the ICPC, developed by the World Organisation of Family Doctors[14]. In the ICPC OA of the hip is defined as: joint disorder of at least 3 months duration, with no constitutional symptoms and three or more of the following: intermittent swelling; crepitation; stiffness or limitation of movement; normal ESR, rheumatoid tests, and uric acid; over 40 years of age[14].

Following patient selection, all GPs were visited to retrieve these patients' available orthopaedic surgery information. Exclusion criteria included patients who received the diagnosis of hip OA from a previous GP not connected to the three group practices of the RNG (this leads to 'historical' data). Patients with time registration errors were also excluded.

Determination of the timeline

After establishing the moment of hip OA diagnosis, a follow-back (FB) and a follow-up (FU) period were set, creating together the total follow-up period (TFU). Reason for including a FB period is that the GP can start a hip OA-related intervention while the diagnosis is not yet ascertained.

To determine the length of FB and FU all the data was assembled and examined. This resulted in an accumulation of data within one year before and one year after the moment the hip OA diagnosis was made. Expansion of this period to two years resulted in only 1% more data in the FB and 2 to 4% more data in the FU, therefore the start of the FB and the finish of the FU periods were fixed at one year before and one year after diagnosis (see Figure 1).

If a patient received a hip replacement in the FU, this FU period ended at that moment, resulting in a shorter FU period. There was a shortened FB or FU if a patient entered a GP practice during the FB period or left a GP practice (moving, death, etc.) during the FU period. Average FB and FU exposure times were therefore expressed in person-days.

Figure 1. Follow back period and follow up period

period of observation

1 year   pt x   1 year

moment of hip OA diagnosis

follow back (**FB**)   follow up (**FU**)

total follow up (**TFU**)
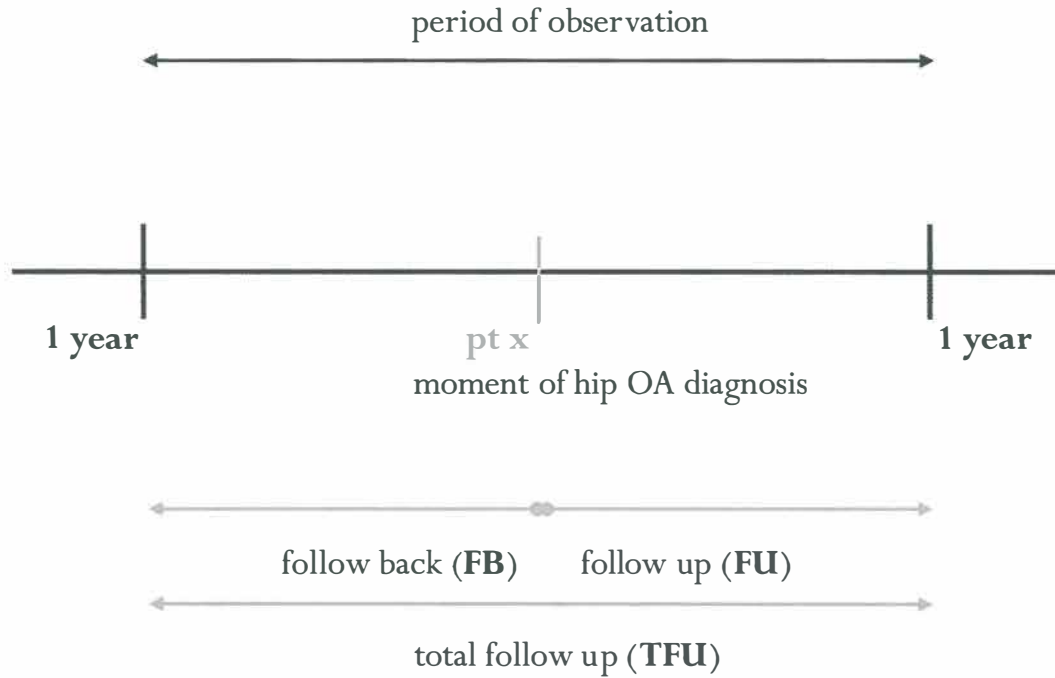
Medical care consumption

Frequency of medical care for hip complaints (ICPC code L13) in the FB period and hip OA (ICPC code L89) in the FU period was counted. Medical care was defined as all contacts with the GP or GP practice except for contacts related to prescription renewal. These contacts were categorized as 1) no intervention, 2) a conservative intervention like prescription of pain medication, referral to exercise therapies (physical therapy, Cesar therapy, rehabilitation), referral to a dietician, or 3) a possible surgical intervention like referral to orthopaedics. Pain medication was defined as all medication generally prescribed for musculoskeletal pain like prostaglandin synthetase inhibitors, non-steroidal anti-inflammatory drugs (NSAIDs), acetaminophen and opiates. The associated ATC group used in this study for this pain medication is M01 (anti-inflammatory steroids and anti-rheumatic drugs like rofecoxib or diclofenac) or N02 (analgesics like tramadol or codeine). A separate analysis was conducted per period for the TFU, FB and FU periods.

Data analysis

Microsoft Access 2003 was used to organize and select data from the RNG database. All calculations were made using the statistical package SPSS for Windows (SPSS Inc., version 16.0, 2007, Chicago). Patient characteristics were described in means and standard deviations or percentages distribution depending on the continuous or categorical nature of the variables. The number and distribution of different kinds of interventions were presented as frequency and percentages for the FB, FU and TFU times. Subsequently, the nature of the conservative interventions applied to the hip OA patients were calculated and presented as frequency and percentages for the FB, FU and TFU times, in accordance with proposed national and international guidelines.

To analyse the link between frequency of contact and patient variables (gender and age), a regression analysis was performed using General Linear Models. Variation in follow-up time (exposure) was taken into account by specifying an offset-term for each individual observation as the natural logarithm of the person-days. The parameters, estimated with a Poisson distribution while taking into account the offset-term, represent the natural

logarithms of the ratio between the rate of the studied categories and the rate of the reference category (rate ratio).

Results are presented as rate ratios, obtained after taking the exponent of the parameter estimates and their corresponding 95% Wald confidence intervals. Reference categories are gender, female, and age >= 70.

Results

Patient retrieval from the RNG database resulted in 403 hip OA patients. Twelve patients were excluded because of registration errors. The characteristics of the remaining 391 patients are shown in Table 1.

Table 1. Characteristics and clinical features of patients group N=391

		Mean (SD)	N (%)
Age at hip OA diagnosis		66.8 (14.0)	
	Categories		
	18-70		202 (51.7)
	>70		189 (48.3)
Gender			
	Female		278 (71.1)
	Male		113 (28.9)
Comorbidity*			
	< 2		227 (58.1)
	2--4		114 (29.2)
	> 4		50 (12.8)
Exposure FB (person-days)		353.1 (57.7)	
Exposure FU (person-days)		322.4 (92.9)	
Surgical intervention (during the FU)			78 (19.9)

*number of comorbidities,
FB=follow-back, FU=follow-up, OA = osteoarthritis

By using rate ratio's, in which exposure was expressed in natural logarithms, negative log function outcomes had to be excluded from the analysis. One person had a FB period of 0 days which resulted in a negative log function and was therefore excluded from analyses of the FB and the TFU.

Number of interventions

In the total follow-up period (TFU) the GP intervened in almost half of all pa-tients one or more times with pain medication or a referral. About one-third of the patients had no contact with the GP at all. In 19.2% of cases the patient did have contact with the GP but received no intervention (see Table 2).

In the FB the majority of patients had no contact with the GP, in the FU this was a lesser number of patients. The number of patients in the FU who did have GP contact but no intervention was quite similar to the number of patients who had at least one intervention (see Table 2).

Table 2. Frequency of patients with or without GP interventions 1 year before and 1 year after hip OA diagnosis.

	FB # (%)	FU# (%)	TFU # (%)
No GP contact	335 (85.9)	52 (13.3)	124 (31.7)
GP contact without intervention	26 (6.7)	159 (40.7)	75 (19.2)
GP contact with 1 intervention (pain medication or referral)	29 (7.4)	148 (37.9)	138 (35.3)
GP contact with 2 interventions (pain medication and/or referrals)	0 (0)	32 (8.2)	45 (11.5)
GP contact with 3 or more interventions (pain medication and/or referrals)	0 (0)	0 (0)	9 (2.3)
Total patients	390 (100)	391 (100)	391 (100)

= frequency, % = percentage, FB = follow-back, FU = follow-up, TFU = total follow-up, GP = general practitioner

Exploration of interventions

Of all patients, 192 had one or more interventions during the TFU period. In the majority of cases pain medication was prescribed or patients were referred to an orthopaedic surgeon, either way without any other intervention. The combination of pain medication and physical therapy or the combination of physical therapy and a diet, as possible part of a total management, was applied in 9.9% of the cases (see Table 3).

In the FB period pain medication prescription was the main intervention, followed by referral to an orthopaedic surgeon. Pain medication was also the most applied intervention in the FU. Physical therapy was prescribed less often, and the combination of pain medication prescription and physical therapy even less (see Table 3).

Patient characteristics associated with the amount of contact during FB, FU and TFU

In the TFU period the older patients ($\geq$ 70 years) had significantly more contact moments than the younger patients (CI 0.75-0.99). In the FB period the outcome parameters elicited no significant differences in frequency. When exploring the FU women were more likely to have had GP contact for their hip OA after being diagnosed (CI 0.69-1.00) compared to male patients. No significant differences in frequency were found for gender and age in the outcome parameters pain medication prescription and referrals.

Table 3. Frequency of patients with GP interventions in hip OA patients 1 year before and 1 year after diagnosis.

	FB # (%)	FU # (%)	TFU # (%)
(possible) Surgical intervention			
Orthopedics*	9 (28)	38 (21)	50 (26)
Conservative intervention			
Pain medication*	19 (59)	59 (33)	61 (32)
Physical therapy*	2 (6)	25 (14)	24 (13)
Diet*	0 (0)	0 (0)	0 (0)
Pain medication and Physical therapy**	0 (0)	18 (10)	17 (9)
Physical therapy and Diet**	0 (0)	1 (1)	1 (1)
Other - not further defined	2 (6)	39 (22)	39 (20)
Total patients with interventions	32 (99)	180 (101)	192 (101)

* This intervention occurred alone, not as a part of a management with more interventions

** This combination can occur alone, or as a part of a management with more interventions

Discussion

GPs' medical care of hip OA patients predominantly showed an expectant management and limited agreement with national and international guidelines.

In the TFU period about one-third of patients had no contact with the GP at all. This was mainly the case before the diagnosis of hip OA was made (86%) versus 13% after diagnosis. The majority of interventions took place in the FU period. When exploring the nature of the interventions that were applied, these consisted mainly of prescription of pain medication or just referral to an orthopaedic surgeon. Only a small number of patients received a conservative intervention consisting of exercise in combination with diet, or exercise in combination with pain medication as proposed in the guidelines.

The current study showed a considerable number of patients who did not have GP contact at all, which has been discussed before in the literature[17,18]. A possible reason for a patient not consulting the GP is suggested to be related to non-severity of the problem and consultations other than a GP (like a chiropractor or osteopath)[17]. In the situation that a patient did have contact with the GP but left the practice with no intervention, we suggest it is not unlikely that the GP discussed the options of medical care or lifestyle changes.

Our finding that a large proportion of patients received pain medication as an initial intervention is in agreement with the 2008 study of Lee et al. [19] who analyzed the medical management of osteoarthritis in general. Besides the large number of patients who received pain medication as a first intervention, a considerably number of patients in our study was referred to orthopaedics without any other intervention. This latter result has not been previously reported.

The outcomes in the present study regarding exercise and weight loss interventions show a disagreement with the existing guidelines for hip OA[9,11]. This non-agreement is in line with the study of Bierma et al., where management inconsistency was described in relation to guidelines for musculoskeletal problems[20]. They analyzed the management of hip complaints among GPs in the Netherlands in 2000. However, in the comparison with the

present study it has to be taken into consideration that the patient population of Bierma et al. consisted of patients with hip complaints, not hip OA.

More recently, in 2006 a retrospective study from Canada also concluded there was no unanimity in prescribing conservative non-pharmacological treatments, like exercise, which are advocated in the guidelines for hip OA[21]. This Canadian study involved patients with hip OA about to undergo total hip arthroplasty, who were questioned about the preceding management of their hip OA. In this article it is suggested that this dearth of exercise treatments is possibly related to unawareness of the benefits or lack of necessary skills or time regarding exercise prescription. Considering exercise prescription as a start for a lifestyle change, another study postulates that GPs often face many barriers in offering lifestyle advice to patients[22,23]. This could also be the case in the Netherlands and therefore be an explanation for the presented results.

Considering weight loss as one of the proposed non-pharmacological conservative treatments, the current study shows a lack of implementation of this treatment modality. It can be postulated that the GP had referred to a dietician before in relation to another medical problem.

The finding that women with OA visit physicians more often and in general seek more treatment for their hip OA complaints compared with male patients is in line with previous research[24,25] that proposes several explanations for gender differences, like different pain experiences or biomechanical differences[25].

In the present study older patients showed more GP contact than the younger patients in the total study period. This outcome cannot be supported by previous research for hip OA. Help-seeking behaviour in people with chronic knee pain was previously analyzed[18,26] but nonetheless no association with age was demonstrated.

Strengths and weaknesses

To our knowledge, this study is the first to describe the nature and frequency of the medical care of hip OA patients in GP practices. Another major strength is the prospective design in which the medical care decisions

of the GPs were not influenced. Additionally this study reported data of a large study group of 391 incident hip OA patients collected in a time frame of 10 years. Finally, it was a strength that the number of these incident patients in the study group was comparable with the incidence figures of hip OA determined in Dutch GP practices in 2007[27], 1.6 per 1000 and 1.7 per 1000 in one year respectively.

Weak point of this study was the 1 year follow-up, given the obviously chronic nature of OA. The medical care for such a disease can be stretched out over several years. However, adding a year did not result in much more additional information in this current study.

No further information on GP-patient communication was available, leaving unanswered questions about patient perspectives on the experienced pain and medical instructions or lifestyle advice given by the GP.

Future research
More research would be useful to establish the link between availability of hip OA guidelines for the GP and referrals to an orthopaedic department. Registering a high BMI as a medical problem in the GP records can be of great value in the assessment of medical care delivered in this patient population.

Conclusion
This study shows that the nature of medical care provided by GPs can be mainly defined as expectant. It also shows that within a time frame of one year before diagnosis and one year after diagnosis the nature of medical care consists mainly of pain medication prescription before diagnosis and pain medication prescription or referral to orthopaedics after diagnosis. For hip OA, the applied medical care is often not conform medical guidelines.

Declaration
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Conflicts of interest: None.

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Chapter 4

The effects of exercise and weight loss in overweight
patients with hip osteoarthritis: design of a prospective
cohort study

Nienke Paans[1] ■ Inge van den Akker-Scheek[1,2] ■ Klaas van der Meer[3]
Sjoerd K Bulstra[1] ■ Martin Stevens.[1]

[1]Department of Orthopaedic Surgery, University Medical Center Groningen, The Netherlands

[2]Department of Orthopaedic Surgery, Martini Hospital Groningen, The Netherlands

[3]Department of General Practice, University Medical Center Groningen, The Netherlands

Abstract

Background: Hip osteoarthritis (OA) is recognised as a substantial source of disability, with pain and loss of function as principal symptoms. An aging society and a growing number of overweight people, which is considered a risk factor for OA, contribute to the growing number of cases of hip OA. In knee OA patients, exercise as a single treatment is proven to be very effective towards counteracting pain and physical functionality, but the combination of weight loss and exercise is demonstrated to be even more effective. Exercise as a treatment for hip OA patients is also effective, however evidence is lacking for the combination of weight loss and exercise. Consequently, the aim of this study is to get a first impression of the potential effectiveness of exercise and weight loss in overweight patients suffering from hip OA.

Methods/Design: This is a prospective cohort study. Patients aged 25 or older, overweight (BMI > 25) or obese (BMI > 30), with clinical and radiographic evidence of OA of the hip and able to attend exercise sessions will be included. The intervention is an 8-month exercise and weight-loss lifestyle program. Main goal is to increase aerobic capacity, lose weight and stimulate a low-calorie and active lifestyle. Primary outcome is self-reported physical functioning. Secondary outcomes include pain, stiffness, health-related quality of life and habitual activity level. Weight loss in kilograms and percentage of fat-free mass will also be measured.

Discussion: The results of this study will give a first impression of potential effectiveness of exercise and weight loss as a combination program for patients with OA of the hip. Once this program is proven to be effective it may lead to postponing the moment of total hip replacement.

Introduction

Osteoarthritis (OA) is the most common joint disorder in the world[1]. OA is recognized as a substantial source of disability with significant social and financial costs due to surgical and medical interventions and frequent absenteeism from work. OA of the lower limb is primarily concentrated in the hip and knee joint. Pain is the principal symptom of OA. At first it occurs after use of the joint, and is relieved by rest. In later stages of OA, pain may be present during rest and even sleep. Other symptoms of OA include stiffness following rest and instability of the joint[2,3].

Most recent numbers from the US (1990) show incident rates of OA of the hip of 0.5 per 1000 per year[4]. In the Netherlands the incidence in 2000 was 1.25 per 1000 per year[5], and its prevalence will increase with the aging of Western society[6,7]. In Europe, the percentage of people over 65 years was 17% in the year 2004. Although at 14% the Netherlands is still below this percentage, it is expected to increase to 24% by the year 2050[8]. For this reason, the number of people with OA of the hip in the Netherlands is expected to increase by 1.8 to 4.3% in the period 2004-2024[6]. A similar trend is seen worldwide[9,10].

An additional risk factor for OA is being overweight or obese[11]. Being overweight is defined as having a Body Mass index (BMI) of 25-30 kg/m^2, and being obese as having a BMI of 30 kg/m^2 or more. An increase of overweight or obese people is seen not only in America[12] but in Europe as well[13-15]. In the Netherlands in 2007, 45.5% of adults were overweight or obese[16]. Results from the 2003-2004 National Health and Nutrition Examination Survey (NHANES) indicate that 66% of American adults are either overweight or obese[17]. In this respect, not only the number of older people contributes to the increase of patients with hip OA, but the number of overweight or obese people as well.

To date, conservative treatment modalities for OA of the lower limb have focused on pain relief and preservation of joint function[7,18]. In these modalities, modification of lifestyle factors such as physical inactivity and overweight/obesity is considered a core element[7,19]. With respect to the treatment of OA of the knee, it has been proven that modification of physical inactivity and obesity is an effective conservative treatment modality. Weight loss as a single therapy reduces symptoms of OA of the knee[20,21], and

therapeutic exercise induces the same effect[7]. Combining these two treatments shows even more effect on pain and functionality in knee OA[22]. However, with respect to the treatment of OA of the hip this evidence is lacking. Previously conducted studies have focussed mainly on knee OA, or the combination of knee and hip OA, without distinguishing by joint[23]. One Cochrane review, which did distinguish by joint, found that exercise treatments designed to reduce pain and improve functioning were effective in knee OA patients, but the same conclusion could not be drawn for hip OA patients due to insufficient data[24].

The aim of this prospective cohort study is thus to get a first glimpse of the potential effectiveness of a combination program of exercise and weight loss on overweight and obese patients suffering from hip OA.

Methods/design

Study design
A prospective cohort study will be conducted at the department of orthopaedics of University Medical Center Groningen (UMCG) in collaboration with the Allied Health Care Center for Rheumatology Rehabilitation (AHCRR) Hilberdink. The study design, procedures and informed consent are approved by the Medical Ethics Committee of UMCG.

Identification and recruitment of study participants
Patients aged 25 or older, with clinical and radiographic evidence of OA of the hip who are also overweight (BMI > 25) or obese (BMI > 30) will be included. A BMI of 40 will be used as the upper limit. The clinical evidence of hip OA is based on the definition determined by Altman et al.[25]: a) hip internal rotation $\geq 15°$, pain with internal rotation of the hip, morning stiffness of the hip for ≤ 60 minutes, or b) hip internal rotation $< 15°$ and hip flexion of $\leq 115°$, which has a sensitivity of 86% and a specificity of 75%. The radiographic diagnosis for OA of the hip will be established by means of the Kellgren and Lawrence criteria[26], of which grade 1-3 will be included.

Exclusion will be based on conditions which prevent safe participation in an exercise program (angina pectoris, peripheral vascular disease, stroke, congestive heart failure, chronic obstructive pulmonary

disease, insulin-dependent diabetes, psychiatric disease, renal disease, liver disease, active cancer other than skin cancer and anaemia); problems of the foot or ankle that could interfere with an exercise program; rheumatic arthritis; an inability to walk without a cane or other assistive device; participation in another research study; inability to finish the study or unlikely to be compliant with the opinion of the clinical staff because of frailty or illness; inability to fill in a questionnaire as a result of language problems or dementia. The assessment to include or exclude will be determined by the orthopaedic specialist or the general practitioner.

Recruitment will originate from three sources: 1) the outpatient OA clinic of the Orthopaedic Department of UMCG or the Orthopaedic Department of Martini Hospital Groningen; 2) general practices in the local area of the AHCRR and at the Department of General Practice of UMCG; and 3) patients who present themselves directly at the AHCRR and meet the inclusion criteria, as established by their general practitioner (see figure 1). Patients with hip OA who meet the inclusion criteria and are not yet indicated for hip replacement are invited to participate.

Figure 1. Identification and recruitment of study participants

University Medical Center Groningen; Martini hospital Groningen

General Practices

Potentially eligible patients will be identified through medical specialists & general practitioners, and are asked permission to be contacted by researcher

Potential eligible patients will be screened through medical diagnostics by research staff

Researcher contacts patients

Information letter and informed consent form sent to eligible patients

Consent given?

YES
Initial questionnaire mailed and appointment scheduled

NO
No further contact made

Participant shows up at appointment with initial questionnaire

Participant joins the study

Intervention

The intervention is an 8-month exercise and weight-loss combination program under the supervision of physiotherapists and a dietician at the AHCRR, and will be presented to the patient as a lifestyle program.

The exercise portion consists of an individual 3-month part and a 5-month group session part. The individual part consists of defining and improving the physical load potential of the patient, reducing current disabilities like lack of joint mobility and stability, optimising quality of movement, improving illness perceptions and enhancing physical fitness. The group part is focused on teaching self-management and coping, stimulating an active lifestyle, finding an optimal balance between exertion and relaxation, increasing aerobic capacity and physical fitness, increasing muscle strength, and decreasing limitations of activities of daily living. Aerobic capacity and physical fitness improvement will be achieved with the help of various devices like treadmills, free weight benches, stationary exercise bikes, steppers and/ or rowing machines. All exercises will focus on personal needs, and personal preferences for aerobic equipment will be taken into consideration. A weekly exercise session lasts approximately 1 hour. In addition, patients are urged to achieve a minimum of 30 minutes of moderately intense physical activity on most, preferably all days of the week, in order to comply with national/ international physical activity guidelines[27-29]. At the beginning of every exercise session patients are asked for their activities of last week.

Parallel to the individual and group phase of the exercise program, the weight-loss program is implemented by a certified dietician. This diet part of the intervention is based on principles of social cognitive theory, which argues for the important role of cognitive control systems in the acquisition of behavioural proficiencies[30]. The weight loss program is divided into three phases: an intensive, a transition and a maintenance phase in concordance with Messier et al[22]. The main goal of the first phase is to heighten awareness of the importance of and need for changing eating habits. In this phase the ability to read and understand the diversity of labels in food products will be enhanced, and the patient will set goals he believes he can achieve. In the transition phase, problems the patient encounters will be discussed and self-insight will be enhanced concerning the choices that can be made when buying food. Goal in this phase is to prevent relapse. Finally, in the maintenance phase the

main objective is to maintain the achieved weight loss and to preserve the motivation to keep on going with the healthy eating habits. Adherence to the intervention is based on attendance at scheduled sessions.

In addition to the combination program (exercise and weight loss), patients receive a manual consisting of written information that focuses on health education, including topics about the medical background of OA, OA treatments, and coping with chronic pain.

Sample size

Considering the calculation of the sample size, the study of Messier[22] is used as a reference. In this study Messier showed that a combination of exercise and weight reduction in patients with OA of the knee led to a significant improvement ($\alpha < 0.05$) on the primary outcome measure of self-reported physical function. In order to find an analogous improvement of self-reported physical function of approximately 25% between the first (T0) and last measurements (T2) in patients with OA of the hip, a minimum of 20 patients is needed. This number is based on a power (1-B) of 0.80 and a significance level of 5% (two-sided). When a dropout rate of 20% is taken into account, at least 25 participants have to be included.

Outcome measurements

At baseline (T0), information is gathered about the patients' demographics (educational level, marital status, family composition) and comorbidities as well as about medication and supplemental use.

Primary outcome measurement

The Western Ontario and McMaster Universities Osteoarthritis Index (WOM-AC): self-reported physical functioning is the primary outcome measure, to be measured with the physical function subscale of the Dutch version of the WOMAC (Dutch-WOMAC)[31,32]. The WOMAC Index is a disease-specific measure of health status and is widely used and recommended in OA research. The validity, reliability and responsiveness of this measure have been demonstrated in an extensive range of studies[33]. The Dutch version of the WOMAC has also been considered valid, reliable and reproducible[32]. The Dutch WOMAC consists of three dimensions: pain (5 items), stiffness

(2 items) and physical functioning (17 items). Responses on the 24 items are given on a 5-point Likert scale. All scores will be recoded into a 100-point scale, indicating a score of 0 as the worst possible health condition and 100 the best possible health score.

Secondary Outcome measurements
To add information about the potential effectiveness of the intervention, participants will be assessed using a range of standardised, self-report measures that include:
1. *Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)*: the other two dimensions of the Dutch WOMAC, pain and stiffness.
2. *Short Form Health Survey (SF-36)*: the SF-36 measures health-related quality of life and is considered to be valid, reliable and reproducible[34]. The SF-36 is composed of 36 questions, organised into 8 multi-items scales: physical functioning, role limitations due to physical health problems, bodily pain, general health perceptions, vitality, social functioning, role limitations due to emotional problems and general mental health[34].
3. *Short QUestionnaire to ASsess Health enhancing physical activity (SQUASH)*: The SQUASH is designed to give an indication of habitual activity level. The SQUASH consists of 6 main questions and is subdivided in 4 categories: (A) commuting activities, (B) leisure-time activities, (C) household activities, and (D) activities at work and school. With the help of the Ainsworth compendium of physical activities[35], the SQUASH subdivides activities into three intensity categories for adults and for older adults (up to age 55 and older). These intensity categories are determined by MET values. MET stands for metabolic equivalent and is defined as 'the ratio of the work metabolic rate to the resting metabolic rate'. For adults, intensity of activities with a MET-value between 2 and < 4 was classified as light, between 4 and < 6.5 as moderate, and ≥ 6.5 as vigorous. For older adults, intensity of activities between 2 and < 3 MET was classified as light, between 3 and < 5 MET as moderate, and ≥ 5 MET as vigorous.

Activities with a MET-value lower than 2 will not be analysed because they are considered to contribute negligibly to habitual activity level. The SQUASH is structured in such a way that it is also possible to assess compliance with physical activity guidelines. The SQUASH is proven to be a fairly reliable and reasonably valid questionnaire[36]. The measurement properties of the SQUASH have been assessed in a population of adults, where it showed an overall reproducibility of 0.58 (95%-CI 0.36–0.74). The relative validity in this study was 0.45 (95%-CI 0.17–0.66)[36]. In a population of overweight people37 and of people after total hip arthroplasty[38], the Squash was validated with use of an accelerometer with a correlation of 0.40 (p = 0.05) and 0.67 (p = 0.01) respectively. Furthermore, Spearman's correlation coefficient for overall reliability in the overweight study was not applicable, but the hip arthroplasty study showed a value of 0.57 (95%-CI 0.35-0.73)[38].

Patients will also be evaluated using objective measurements, which include:
1. *6-Minute Walk Test (6MWT)*. The 6MWT is a functional walking test developed to measure functional status[39]. The test provides information about gait speed and functional and endurance capacity. The primary outcome is the total distance walked. The 6MWT is considered a reliable test [40,41].
2. *20-Meter Walk Test (20MWT)*. The 20MWT is a short, safe test used to measure gait speed like the 10MWT[42,43]. Patients walk indoors on a 20-m long track, and the time spent to complete the walk (in seconds) will be measured. Time recording will be accomplished with electronic timing equipment by means of photocell gates (HL 2-31 Photocell, Tagheuer, la Chaux-de-Fond, Switzerland).
3. *Weight and fat-free mass assessment*. The amount of lost weight and the amount of fat-free mass can give an indication of improvement of the overweight problem. Weight will be measured with a calibrated scale, always performed by the same dietician. The fat-free mass measurement will be assessed by a hand-held impedance analyser (Omron Body Fat Monitor, model BF 306). It is concluded that the Omron BF 306 body fat monitor yielded results close to the DEXA Body Fat%[44].

4. *Compliance with the program.* Compliance will be registered by AHCRR diet and exercise session attendance. This attendance will be assessed by dividing number of exercise sessions participants actually attended by the number of sessions participants were asked to attend, multiplied by 100%.

The first measurement will take place before the combination program begins (T0). The second measurement (T1) will take place at the beginning of the exercise group portion of the combination program after 3 months, and the third measurement (T2) at the end of the combination program after 8 months (see figure 2).

Figure 2. Study design and assessment points

Study population (n = 25)

Initial questionnaire (T0)

- Demographics
- Womac
- SF-36
- Squash

Initial objective measurement (T0)

- 6MWT & 20MWT
- Weight / Fat-free %
- Compliance

Secondary 3-month (T1)
Questionnaire

- Womac
- SF-36
- Squash

Final 8-month (T2)
Questionnaire

- Womac
- SF-36
- Squash

Final 8-month (T2)
Objective measurements

- 6MWT & 20MWT
- Weight / Fat-free %
- Compliance
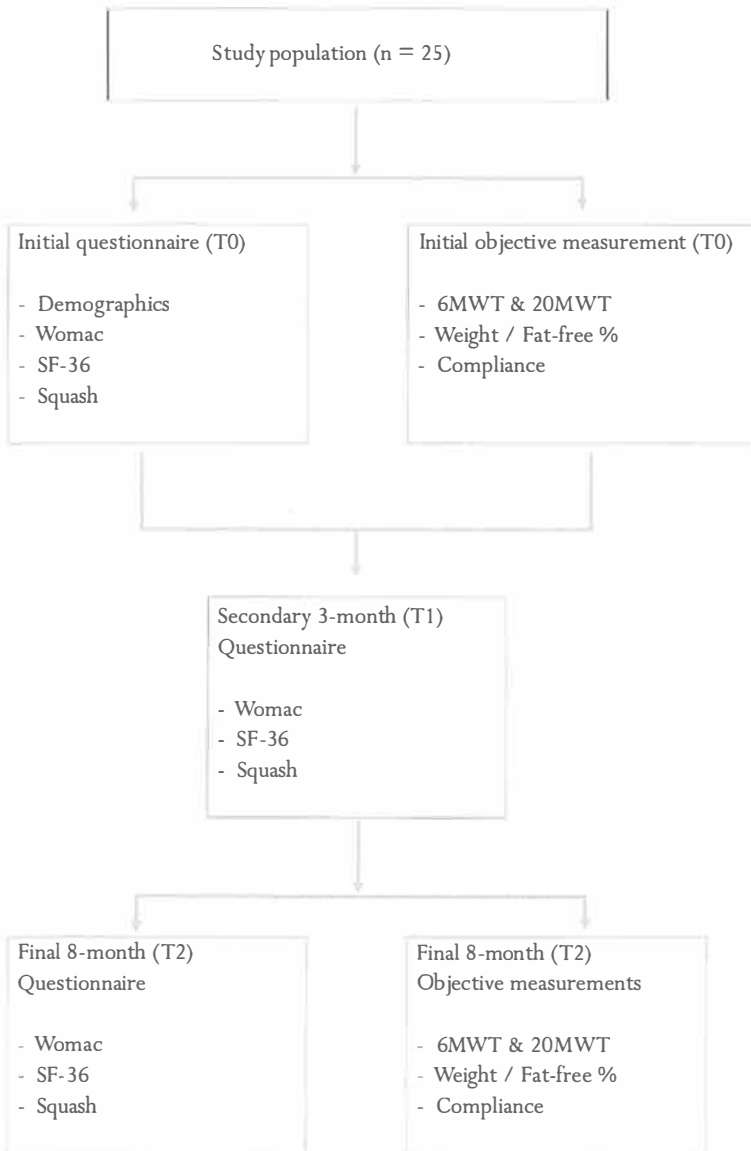
T0 = start of the intervention program, T1 = 3 months, T2 = 8 months, end of the program

Statistical analysis

All statistical analyses will be computed using the Statistical Package for the Social Sciences (SPSS, Inc., Version 16.0, 2007, Chicago). Descriptive statistics will be used to describe the group. Changes in response outcomes from measurement points T0 to T2 will be assessed with the GLM ANOVA repeated measurements analyses. Changes in outcomes between measurement points T0 and T2 (pre- and post-measurement) will be analysed with a paired samples T-test. For all test procedures, a probability value of less than 0.05 will be considered as statistically significant.

Time frame

This study has an 18-month time frame. It is anticipated that identification of potential study participants and recruitment will commence in January 2009. Data analysis will be performed in February 2010 and the final report will be drafted afterwards.

Discussion

The objective of this prospective cohort study is to get a first glimpse of the potential effectiveness of exercise and weight loss on overweight patients suffering from hip OA. If this study indeed demonstrates that the proposed combination program seems to be effective for hip osteoarthritis, it will be followed by a randomised controlled trial (RCT). In this RCT the effectiveness of the combination program will be investigated in a more controlled setting and will also include a closer look at the cost effectiveness of the combination program. Potential effectiveness of the combination program implies benefits for patients as well as society.

Patient benefits

A potential benefit for the patient is that the moment of joint replacement can be postponed. Although technical developments have prolonged the lifecycle of hip prostheses, a prosthesis tends to be replaced after a mean of 10 years[45] (what is known as a revision). Revision surgery has greater risks than primary surgery, such as an increased chance of septic loosening. Especially in the case of young people, this is an important reason to postpone a total joint replacement. Conservative therapy (e.g. exercise in combination with weight

loss) can therefore be a valuable tool towards accomplishing this[46], and although scientific evidence is lacking, structured exercise and weight loss are already recommended in the clinical setting as a conservative treatment option for patients with OA of the hip[47].

Secondly, regular physical activity can have a positive effect on the general health and fitness of the patient. There is a known dose-response relation between physical activity and health, and according to the recommendations of the ACSM is it important to promote physical activity in older adults that emphasises moderate-intensity aerobic activity and muscle-strengthening activity[27,29]. Regular physical activity has been consistently and reliably linked to a reduction in all-cause mortality, cardiovascular disease and many other debilitating conditions[29]. In addition to the beneficial effects of physical activity on health, regular physical activity also increases older adults' ability to perform their daily activities, thus enhancing their quality of life[48].

In case of weight loss, health benefits are observed in patients with OA in the form of reduced self-reported disability[20] and improved self-reported physical function[20,22]. Published reviews in the obesity literature indicate that obesity impairs health-related quality of life (HRQL) and that higher degrees of obesity are associated with greater impairment[49]. Rejeski[48] pursued this subject in patients with OA, demonstrating that lifestyle modifications like dietary and physical activity behaviours are important interventions for enhancing HRQL[48]. Additionally, weight loss has induced positive improvements in sexual quality of life dimensions[50], which can also be considered as important in the overall rating of quality of life.

Social benefits
In light of the forecasts of a sharp accumulation of patients with OA, the potential effectiveness of the proposed combination program provides substantial social benefits. This conservative program, considered as lifestyle management, can assist in the approach towards dealing with the large number of people with hip osteoarthritis and most probably reduce the medical costs these patients incur, like physician appointments, medication, outpatient clinical visits and physiotherapy. Eventually, research into the combination of exercise and weight loss in overweight and obese patients

suffering from hip OA can provide government agencies and social insurance organisations with evidence to incorporate this kind of therapy for hip osteoarthritis into medical insurance packages. The positive effects of the combination program could end up supporting referral to the program by clinicians caring for people with OA of the hip.

In conclusion, this study will provide highly relevant data on the potential effect of exercise and weight reduction among people suffering from OA of the hip.

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Chapter 5

The effect of exercise and weight loss in overweight/
obese patients with hip osteoarthritis: results of a
prospective cohort study

Nienke Paans[1] ■ Inge van den Akker-Scheek[1,2] ■ Roelien Dilling[3]
Martine Bos[4]■ Klaas van der Meer[5] ■ Sjoerd K Bulstra[1] ■ Martin Stevens[1]

[1]Department of Orthopaedic Surgery, University Medical Center Groningen, The Netherlands

[2]Department of Orthopaedic Surgery, Martini Hospital Groningen, The Netherlands

[3]Allied Health Care Center for Rheumatology Rehabilitation, The Netherlands

[4]Vive Diet and Lifestyle Consultancy, The Netherlands

[5]Department of General Practice, University Medical Center Groningen, The Netherlands

Abstract

Background: Osteoarthritis (OA) is the most common joint disorder in the world and is recognized as a substantial source of disability. For OA of the knee, exercise in combination with weight loss is a proven effective conservative treatment option, yet this evidence is lacking for hip OA.

Objective: To get a first impression of the effect on physical function of a combined exercise and weight-loss program in patients with hip OA who are overweight/obese.

Design: A prospective cohort study.

Subjects and methods: Thirty-five patients aged 25 years or older, with clinical and radiological evidence of hip OA who were overweight/obese (BMI $>$ 25 kg/m^2) were included. The patients participated in an 8-month exercise and weight-loss combination program. A BMI of 40 kg/m^2 was used as upper limit. Primary outcome was self-reported physical functioning, as measured with a subscale of the WOMAC. Additionally, an objective measurement was taken using the 6-minute walking test (6MWT).

Results: Participation in the combination program resulted in a clinically relevant improvement of self-reported physical function. In addition, significant improvement was seen in walking ability as an objective measure of physical function.

Conclusions: To our knowledge, this is the first study to investigate the effect of exercise and weight loss as a combination treatment in hip OA patients. The results indicate that the combination of exercise and weight loss is just as effective in hip OA patients as it is in knee OA patients.

Introduction

Osteoarthritis (OA) is a chronic musculoskeletal disease that usually affects hands and weight-bearing joints such as knees and hips. OA is the most common joint disorder in the world[1] and is recognized as a substantial source of disability. In 2007, OA of the hip affected approximately 7% of the population aged 65 years and older in the Netherlands.[2,3] Due to an aging society, an increase of 25% for hip OA is estimated for people aged 65 years and older in the Netherlands by 2050,[4] which will give rise to a higher prevalence of hip OA.5 A similar trend is seen worldwide.[6,7]

In addition to an aging society, the increasing number of over-weight or obese persons will also give rise to a higher prevalence of hip OA.[8] Recent research strongly indicates that overweight/obesity is a risk factor for hip OA.[9] The number of overweight or obese persons is a serious problem in the world. Approximately two-thirds of the world population are overweight or obese, and obesity has increased in Europe and globally in the last decade.[10-14]

Most recent recommendations for the conservative treatment of hip OA focus on pain relief and preservation of joint function, and combinations of non-pharmacological and pharmacological interventions are described.[15-19] As a non-pharmacological intervention it is recommended that both exercise and weight loss play an important role in managing symptoms in patients with hip as well as knee OA. However, these recommendations are mostly based on knee research.

There is evidence in the literature demonstrating the benefits of exercise for both hip and knee OA patients. Furthermore, knee OA research shows that combining exercise with weight loss produces more effects on pain and function than either of them alone.[20,21] For weight loss and the combination of exercise and weight loss, the recommendation for hip OA is primarily based on knee OA research because of the limited availability of evidence on patients with hip OA. The main problem is that in the existing studies where an intervention effect for both knee and hip OA were analysed, the outcomes were not distinguished by joint.[22] Hence for hip OA the evidence for a combined treatment of weight loss and exercise is lacking, whereas it is plausible this combination treatment would have a positive effect in hip OA too.

The objective of this study was therefore to get a first impression of the effect on pain and physical function of a combined exercise and weight loss program in patients with hip OA who are overweight/obese.

Methods/Design
Study design
A prospective cohort study was conducted at the Department of Orthopaedic Surgery of University Medical Center Groningen (UMCG) in collaboration with the Allied Health Care Center for Rheumatology and Rehabilitation (AHCRR) Hilberdink and Vive Diet and Lifestyle Consultancy, both situated in Groningen, the Netherlands. The study was designed to analyze the effect of a combination program of exercise and weight loss on overweight and obese patients with hip OA.
The study was approved by the Medical Ethics Committee of UMCG. A detailed description of the design of the cohort study is published elsewhere.[23] Trial Registration number is NTR1053.

Identification and recruitment of study participants
Patients aged 25 years or older with clinical and radiological evidence of hip OA[24,25] who were overweight or obese (BMI > 25 kg/m^2) were included. A BMI of 40 kg/m^2 was used as upper limit. Exclusion was further based on conditions which prevented safe participation in an exercise program. Patients who were on waiting lists for hip replacement at enrolment were also excluded. Eligibility was determined by the orthopaedic surgeon or the general practitioner, depending on the recruitment source.

The recruitment originated from five sources: 1) the outpatient OA clinics of the Orthopaedic Department of UMCG and Martini Hospital Groningen; 2) general practitioners in the local area of the AHCRR and at the Department of General Practice of the UMCG; 3) patients who presented themselves directly at the AHCRR and met the inclusion criteria as established by their general practitioner; 4) local paper advertising; and 5) website advertising of UMCG.

Eligible patients who came through sources 1 to 3 were identified through medical specialists and the researcher asked for permission to contact them. If written consent was given the initial questionnaire was mailed to the

patient and an initial appointment was scheduled. Patients who responded through sources 4 or 5 were first seen at the outpatient OA clinic of the Department of Orthopaedic Surgery of UMCG, where the orthopaedic surgeon determined if the patient was eligible for the study.

Intervention

The intervention was an 8-month exercise and weight-loss combination program, and was introduced to the patient as a lifestyle program. The program was supervised by physiotherapists and a dietician. The exercise portion consisted of an individual and a group session part lasting 3 and 5 months respectively. The individual part consisted of defining and improving the physical load potential of the patient, such as improving muscle strength and practicing activities in which limitations are established, reducing current disabilities like lack of joint mobility and stability, optimizing quality of movement, improving illness perceptions, and enhancing physical fitness. The group part focused on teaching self-management and coping, stimulating an active lifestyle, finding an optimal balance between exertion and relaxation, increasing aerobic capacity and physical fitness, increasing muscle strength, and decreasing limitations of activities of daily living. Aerobic capacity and physical fitness improvement were achieved with the help of various devices like treadmills, free-weight benches, stationary bikes, steppers and rowing machines. All exercises focused on personal needs, and personal preferences for aerobic equipment were taken into consideration. The weekly sessions lasted approximately 1 hour.

The diet portion was based on principles of social cognitive theory[26] and was divided into three phases: an intensive, a transition and a maintenance phase in concordance with Messier.[21] The main goal of the first phase was to heighten awareness of the importance of and the need to change eating habits. In this phase the ability to read and understand the diversity of labels in food products was encouraged, and the patient set goals he believed he could achieve. In the transition phase, problems the patient encountered were discussed and self-insight was stimulated concerning the choices that could be made when buying food in order to prevent relapse. Finally, in the main-tenance phase the main objective was to sustain the achieved weight loss and preserve the motivation to keep on going with the healthy eating habits.

In addition to the combination program of exercise and weight loss, patients received a manual consisting of written information that focused on health education and OA. During the whole program the focus lay on teaching self-management and stimulating an active lifestyle combined with healthy eating. Adherence to the combination program was based on attendance of scheduled sessions and utilization of the possibilities to catch up with any missed session.

Outcome measurements
At baseline (T0), information was gathered about patients' demographics (educational level, marital status, family composition) and comorbidities as well as about pain medication and glucosamine use.

Primary outcome measurement
Self-reported physical functioning as primary outcome measure was measured with a subscale of the Dutch version of the Western Ontario and McMaster Universities Osteoarthritis Index (Dutch-WOMAC).[27,28] The WOMAC Index is a disease-specific measure of health status and is widely used and recommended in OA research. All scores were recoded into a 100-point scale, with a score of 0 indicating the worst possible health condition and 100 the best possible health score.

Secondary outcome measurements
Additional measurements were conducted and divided into subjective (e.g. questionnaires) and objective measurements.

Questionnaires
By means of two subscales of the Dutch-WOMAC, information was gathered on stiffness and pain. An impression of health-related quality of life was acquired by means of the Short Form 36 item (SF-36) general health questionnaire,[29] using the subscales of physical functioning, role-physical, bodily pain, and general health. In addition, pain was also measured with a 10-point VAS score (average hip pain experience in the previous period).[30] All VAS scores were recoded, indicating a score of 0 as "the worst possible pain"

and 10 as "no pain". Physical activity behavior was measured with the Short QUestionnaire to ASsess Health enhancing physical activity (SQUASH)[31]. The SQUASH questionnaire is well-known and frequently used in the Netherlands to measure physical activity behavior.[32-35] Outcome was activity score in minutes per week, measured in three intensity categories based on MET values.

All questionnaires used are reliable and valid for the use in the Dutch situation and were completed at home. By doing this, possible unintended influences on the results caused by an unblinded researcher were prevented.

Walking tests

The measurement of functional status and gait speed consisted of the 6-Minute Walking Test (6MWT)[36] and the 20-Meter Walking Test (20MWT). The 20 MWT is a short, safe test used to measure gait speed comparable to the 10 MWT.[37,38] Patients walk indoors on a 20-m-long track, and the time spent to complete the walk (in seconds) is measured. Time recording was accomplished with electronic timing equipment using photocell gates (HL 2–31 Photocell, Tagheuer, la Chaux-de-Fond, Switzerland).

Weight and fat-free mass

Weight was measured in kg with the help of a calibrated scale, fat-free measurement by a handheld impedance analyzer Omron Body Fat Monitor (model BF 306).[39]

Compliance

The adherence of the patient to the program was registered. Attendance was assessed by dividing the number of exercise sessions participants actually attended by the number of sessions participants were asked to attend, multiplied by 100%.

The first measurements (questionnaires, walking tests, body fat and weight measurement) took place before the combination program started (T0). The second measurement (T1) took place at the beginning of the exercise group portion of the combination program after 3 months (questionnaires,

weight measurement), and the third measurement (T2) at the end of the combination program after 8 months (questionnaires, walking tests, body fat and weight measurement).

Sample size

A priori, the sample size calculation was based on the primary outcome measure of self-reported physical function as determined with the Dutch-WOMAC. To determine the magnitude of a minimal difference the study of Messier was used as a reference, in which a combination of exercise and weight reduction in patients with OA of the knee led to a significant improvement ($\alpha < 0.05$) on the primary outcome measure of self-reported physical function. In order to detect a similar improvement in self-reported physical function of approximately 25% between the first (T0) and last measurements (T2) in patients with OA of the hip, a minimum of 20 patients was needed. This number is based on a power (1-B) of 0.80 and a significance level of 5% (two-sided). When a dropout rate of 20% was taken into account, at least 25 participants were to be included.

Statistical analysis

The data were analyzed using the Statistical Package for the Social Sciences (PASW statistics 18.03.2010, New York). Descriptive statistics were used to describe the main characteristics of the group. Generalized estimating equations (GEEs) were used to investigate the time-course of all measurements in the patients. The GEE adjusts for the correlation between repeated observations taken from the same subject and is able to handle longitudinal data on subjects with a varying number of unequally spaced observations. In all analyses, an exchangeable correlation structure was assumed. For all test procedures, a probability value of less than 0.05 was considered as statistically significant. For effect modification analysis, the variables of age and gender were taken into account and a significance level of $p<0.01$ was considered statistically significant.

Results

The total number of patients recruited through five different sources and eligible for the study was 35. Patients who were lost to follow-up during the program (n= 5) suffered from too much pain (n=1), major depression (n=1), an ankle fracture (n=1), or an inability to reach the physiotherapy institute every week (n=2). These patients did not differ at baseline from those who completed the final measurements on age or BMI. The amount of body fat was lower in those patients who were lost to follow-up (41% versus 31%). The patient group therefore consisted of 30 patients, of which 57% were women and 67% were obese (see Table 1).

Table 1. Characteristics of overweight or obese hip OA patients (n=30)		
Age in years, mean ± SD		56.9 ± 11.9
Women, n (%)		17 (56.7)
Education, n (%)		
	Low	14 (46.7)
	Middle	8 (26.7)
	High	8 (26.7)
Therapy length in months, mean ± SD		8.3 ± 1.6
Use of pain medication*, n (%)		
	Yes	10 (33.3)
	No	14 (46.7)
	Unknown	6 (20.0)
Use of glucosamine, n (%)		
	Yes	10 (33.3)
	No	19 (63.3)
	Unknown	1 (3.3)
BMI in kg/m^2, mean ± SD		32 ± 3.9
Body fat %, mean ± SD		41 ± 6.4

* prostaglandin synthetase inhibitors, nonsteroidal anti-inflammatory drugs (NSAIDs), acetaminophen or opiates.

Primary outcome

The primary outcome was self-reported physical function as measured with the subscale of the WOMAC. The GEE analysis showed that patients significantly improved their physical function after three and after eight months compared to their baseline score (see Figure 1).

Secondary outcome measurements

Questionnaires

There was a significant decrease in WOMAC pain, VAS pain and SF-36 pain after 3 months, and a more prominent decrease after 8 months compared to baseline (see Table 2). The SF-36 score of physical functioning and physical role limitations perception also showed a significant change after 3 and 8 months (see Table 2). The SF-36 score of general health perception only showed a significant improvement after 8 months. No change in activity scores as determined with the SQUASH was observed except for the vigorous-intensity activities, which after 3 months showed an increase of 57 minutes per week (95%CI 14.1 to 99.4 / p <0.05).

Figure 1. Change in physical functioning (result of GEE analysis)
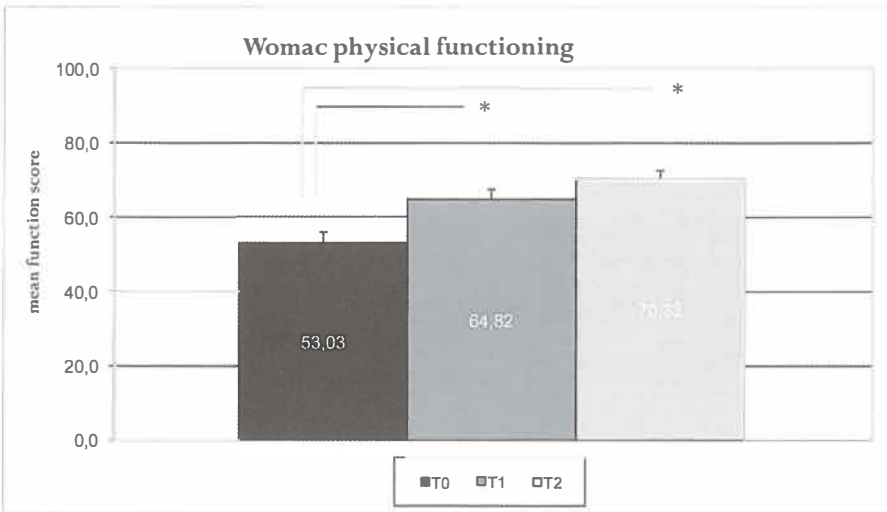
Presented are group mean with standard error (SE). Number of observations: 90.
T0 = baseline, T1 = after 3 months, T2 = after 8 months, * = statistically significant change compared to baseline.

Table 2. GEE regression results for the change in time

Variable	Baseline score	Time (months)	Regression coefficient (95 % CI)
Subjective results			
WOMAC	59.8	Base	0[a]
pain		Post 1	9.9 (4.6 to 15.1)*
		Post 2	15.2 (9.4 to 21.0)*
WOMAC	49.6	Base	0[a]
stiffness		Post 1	11.3 (5.7 to 16.8)*
		Post 2	16.8 (12.3 to 21.4)*
VAS	3.7	Base	0[a]
pain		Post 1	2.5 (1.7 to 3.3)*
		Post 2	3.1 (2.3 to 4.0)*
SF-36	45.6	Base	0[a]
Physical		Post 1	12.5 (7.7 to 17.4)*
functioning		Post 2	21.5 (14.8 to 28.1)*
SF-36	35.8	Base	0[a]
Role-Physical		Post 1	24.7 (9.7 to 39.7)*
		Post 2	36.8 (17.8 to 55.9)*
SF-36	52.5	Base	0[a]
Bodily Pain		Post 1	11.1 (5.7 to 16.6)*
		Post 2	19.2 (10.0 to 28.4)*
SF-36	61.9	Base	0[a]
General Health		Post 1	5.4 (-0.9 to 11.7)
		Post 2	9.4 (3.4 to 15.3)*
SQ-activity score	2037.5	Base	0[a]
(min/week)		Post 1	212.4 (-4.8 to 429.6)
		Post 2	-35.6 (-289.6 to 218.5)
SQ-light activity	1473.2	Base	0[a]
score		Post 1	104.8 (-50.9 to 260.6)
(min/week)		Post 2	-8.7 (-250.3 to 232.8)
SQ- moderate	392.2	Base	0[a]
activity score		Post 1	50.8 (-116.5 to 218.2)
(min/week)		Post 2	-68.2 (-226.0 to 89.7)
SQ- vigorous	172.2	Base	0[a]
activity score		Post 1	56.8 (14.1 to 99.4)*
(min/week		Post 2	41.3 (-6.2 to 88.9)
Objective results			
Walking test	433.3	Base	0[a]
6 minutes (meters)		Post 2	48.1 (26.7 to 69.4)*
Walking test	15.3	Base	0[a]
20 meter (seconds)		Post 2	-1.2 (-1.8 to -0.6)*
Body weight (kg)	95.0	Base	0[a]
		Post 1	- 2.8 (-4.4 to -1.2)*
		Post 2	- 5.6 (-7.7 to -3.4)
Body fat (%)	41.0	Base	0[a]
		Post 2	-3.3 (-4.6 to -2.1)*

[a] Set to zero (baseline score used as reference). * significant change = $p<.05$.
GEE, generalized estimating equations. Base = baseline, Post 1 = after 3 months,
Post 2 = after 8 months.

Walking tests
Both walking tests (6MWT and 20MWT) showed a significant improvement after 8 months (Table 2).

Weight and fat-free mass
After 3 months and also after 8 months there was a significant decrease in body mass of respectively 2.8 kg (95% CI: -4.4 to -1.2 / p <0.05) and 5.6 kg (95%CI: -7.7 to -3.4 / p < 0.001) compared to baseline (Table 2). Body fat was 41.0% at baseline and showed a significant reduction of -3.3% in 8 months (95%CI -4.6 to -2.1 / p=0.000).

Confounding and Effect modification
No confounding for any of the outcome measurements was found. Additionally, the GEE analysis showed no effect modification by gender and age at baseline for the change of physical function or pain score in time (data not shown).

Compliance
There was an adherence of 94% for both the individual- and the group-exercise portion. For the diet portion, adherence was 82%. Catch-up sessions were possible in both parts of the combination program (exercise and diet).

Discussion
The results of this study show an improvement of self-reported physical function in patients with hip OA who were overweight or obese after 8 months when following an exercise and weight loss program. The combination program resulted in an improvement in self-reported physical function. An improvement was also seen in objective measurements (e.g. walking abilities). Moreover, the increase of physical function can be considered clinically relevant, as a minimal improvement of 12% of the WOMAC score compared to baseline is suggested as a clinical relevant one.[40]

To our knowledge, the effect of exercise and weight loss as a combination program has not been studied before in hip OA patients. A comparison can therefore only be made with those studies that examined the effect of exercise

and weight loss in knee OA patients, and with studies that examined the effect of only exercise in hip OA patients. First of all, in comparing the present study to other studies that implemented exercise and weight loss as a combination therapy in knee OA patients, there were only slight differences in the outcomes, such as the outcome of the self-reported physical function of the WOMAC. Messier et al.[21] used this outcome in their combination therapy study for knee OA patients, showing an improvement of 24% compared to baseline after the 6-month combination intervention. Our study resulted in a slightly greater improvement of 32% compared with baseline after 8 months of exercise and weight loss. The main differences between the study of Messier et al. and the present study were the mean age of the patient group, which was 12 years lower in our study, and the execution of the exercise intervention. In Messier's study the patients had to exercise 3 days/week at the facility for at least 4 months, after which they could choose for a home-based program or continuing at the facility. In our study the patients presented themselves once a week at the facility and additionally exercised at home during the entire program (8 months). Both differences could explain the slightly better results of our study.

The significant improvement of 11.1% on the 6-minute walking distance in our study was comparable with the study of Messier, who found an improvement of 15.9% after 6 months. In the present study, patients also had a decrease in self-reported WOMAC pain score of 25.4% after 8 months, which is comparable with the decrease of 24.8% after 6 months observed by Messier et al. Rejeski et al., [41] after studying obese knee OA patients who underwent a combination intervention of exercise and weight loss, showed a decrease of pain of 12.2 points in the SF-36 bodily pain subscale after 18 months compared with the baseline score. In our study the outcomes were obtained after 8 months and showed more improvement compared with Rejeski (19.2 points of the SF-36 bodily pain score). The different mean age at baseline may have contributed to a difference in pain outcome compared to our study (age 69 in Rejeski's study versus 57 in ours). Also, in our study patients were already included if they were overweight, which means a BMI of 25 kg/m^2 and higher (resulting in a lower mean BMI of 32 kg/m^2), instead of an inclusion criterion of a BMI of 28 kg/m^2 and higher like in the study

of Rejeski et al. (which resulted in a mean BMI of 34 kg/m^2). As weight has a high-loading impact on the joint,[42] which contributes to the extent of pain symptoms, this can be an explanatory factor.

For self-reported physical function measured with the SF-36, Rejeski found a baseline improvement of 8.5 points after 18 months. This improvement was comparatively rather low, as our study showed a 21.5-point improvement after 8 months. The amount of weight loss in our study was comparable to the study of Rejeski and Messier, that around 5%. Our additionally measured loss of body fat (3.3%) had not been analysed before in the literature, but gives a strong indication for an effective combination program involving calorie burning, which was aimed for in our study.

Now comparing the results of the present study to other studies that implemented solely exercise therapy in hip OA patients, it can be concluded they are in line with and slightly support the combination therapy of the present study. An example is the study of Juhakoski et al.,[43] which used the self-reported physical function score of the WOMAC. In this study exercise was administered in 12 sessions once a week at the facility, subsequently followed by home-based exercises. Compared to baseline, patients demonstrated an increase of 15.7% after 6 months on self-reported physical function. This is a lower increase compared to our study (32%), which probably can be explained by the shorter exercise program of Juhakoski (3 months versus 8 months in our study). The significant improvement of 11.1% of the 6-minute walking distance in our study was considerably higher compared to Juhakoski's, which showed an improvement of only 5% after 3 and 4% after 12 months. Additionally, in the present study patients had a decrease in the self-reported WOMAC pain score of 25.4% after 8 months; Juhakoski found a smaller decrease of 7.1% after 6 months.

Another study, by Tak et al.,[44] examined the effect of exercise in hip OA patients. Their observed decrease of pain measured with the VAS pain score was only 7%. The VAS pain score in the present study decreased considerably more — 84% compared with the baseline score. The baseline pain score in our study was however much worse (3.7 compared with 6.2 in Tak's study), therefore a regression to the mean effect in our study could be possible. Apart from the difference in content of the intervention (exercise versus exercise and weight loss), the difference between Tak's study and ours

is primarily based on the intervention length, theirs being substantially shorter at 8 weeks (1 session per week). Additionally, the mean age in their study group was higher (10 years). All those differences in study methods could have had an influence on the differences found in outcomes.

Despite the overall promising effect of the combination program, no significant change in self-reported activity could be demonstrated in our study. While our compliance score showed a good average compliance, it could be assumed that patients had at least one additional active encounter per week compared to baseline. A possible explanation for not demonstrating a change in activities could be the large standard deviations within this relatively small patient group, of whom it is known that activity scores are prone to large individual differences.

Strengths and limitations

To our knowledge, the present study is the first one published regarding exercise and weight loss as a combination treatment for hip OA patients. It takes a step forward in the research of conservative treatment aimed at hip OA patients exclusively. Additionally, our patient group originated from diverse sources, which gives a good generalizability to the average OA patient who has not had hip arthroplasty yet.

As the objective of the study was to get a first impression of the effect of exercise and weight loss as a combination treatment, it was decided to conduct a cohort study. This can be considered a limitation, as a study design with a control group is methodological stronger. Another consequence of this decision is that our patient group size was relatively small. The power of the study was not endangered though, presenting a study group of 30 patients, while our sample size calculation instructed inclusion of at least 25 participants.

Future research

Further research in a controlled setting is needed to determine the effect of exercise and weight loss as a combination in hip OA patients, and to determine if the effect can be maintained beyond 8 months and can subsequently postpone hip surgery as well.

Conclusion

Overall it can be concluded that the intervention of the present study generates the same beneficial effects for patients with hip OA compared with combination interventions of exercise and weight loss in patients with knee OA. It can also be concluded that the present intervention for hip OA patients shows more improvements in symptoms when exercise is accompanied by weight loss, compared with exercise-only interventions. Nevertheless, we are aware of the challenges of comparing differently executed programs in terms of type of exercises, mode of delivery and contact moments, which are all known to have their own effect on outcome.[20]

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Chapter 6

The influence of overweight/obesity on patient-perceived physical functioning and health related quality of life after primary total hip arthroplasty.

Martin Stevens[1] ■ Nienke Paans[1] ■ Robert Wagenmakers[2]
Jan van Beveren[3] ■ Jos JAM van Raay[4] ■ Klaas van der Meer[5]
Roy Stewart[6] ■ Sjoerd K. Bulstra[1] ■ Inge HF Reininga[1]
Inge van den Akker-Scheek[1,4]

[1]Department of Orthopaedics, University Medical Center Groningen, The Netherlands

[2]Department of Orthopaedics, Amphia Hospital Breda, The Netherlands

[3]Department of Orthopaedics, Röpcke-Zweers Hospital, Hardenberg, The Netherlands

[4]Department of Orthopaedics, Martini Hospital, Groningen, The Netherlands

[5]Department of General Practice, University Medical Center Groningen, The Netherlands

[6]Department of Health Sciences, Community & Occupational Medicine, University Medical Center Groningen, The Netherlands

Abstract

Background: Overweight/obesity in patients after total hip arthroplasty (THA) is a growing problem and is associated with postoperative complications and a negative effect on functional outcome. Objective of this study is to determine to what extent overweight/obesity is associated with physical functioning and health-related quality of life one year after primary THA.

Methods: A retrospective analysis of prospectively collected data from 653 patients who had undergone a primary THA was conducted. Physical functioning, health-related quality of life, body mass index (BMI), comorbidity and postoperative complications were assessed by means of a questionnaire and from medical records. To determine to what extent overweight/obesity is associated with physical functioning and health-related quality of life after THA, a structural equation model (SEM) analysis was conducted.

Results: The association of BMI corrected for age, gender, complications and comorbidity with physical functioning is -0.63. This means that an increase in 1 kg/m² BMI leads to a reduction of 0.63 points in the physical functioning score as measured with the Western Ontario and McMaster Universities Osteoarthritis Index (100-point scale). The prevalence of complications or comorbidity leads to a reduction of respectively 5.63 and 7.25 (one or two comorbidities), and 14.50 points in the case of more than two comorbidities on the physical functioning score. The same pattern is observed for health-related quality of life.

Conclusions: The influence of overweight/obesity on physical functioning and health-related quality of life is low. The impact of complications and comorbidity is considerable. Refusing a patient a THA solely on the basis of overweight or obesity does not seem justified.

Introduction

Osteoarthritis (OA) of the hip is one of the most prevalent age-related musculoskeletal conditions, leading to a significant impairment in patients' ability to perform activities of daily living and having a large impact on health-related quality of life[1,2]. In the US population, symptomatic OA of the hip is reported to affect 8.7% of men and 9.3% of women aged 45 years or older[3]. Among the Dutch population these prevalences were 2.5% for men and 5.0% for women in 2000[4]. Total hip arthroplasty (THA) is a highly successful and widely applied treatment for advanced OA of the hip, with 202,500 primary THAs performed in the US in 2003[5] and 20,266 in the Netherlands in 2008[6].

In the year 2006, an estimated 40% of adults aged over 65 in the US general population were overweight, and another 22% were obese[7]. In the Dutch general population, almost 57% of adults over age 65 were overweight in 2006, while 14% were obese[8]. Overweight is also a growing problem in patients after a THA. Overweight/obesity is associated with a negative effect on functional outcome afterTHA and on implant longevity. It can affect polyethylene wear negatively. Studies have also found a correlation between obesity and higher infection rates and risk of dislocation, aseptic loosening and revision[9-12]. Moreover, with respect to general health, overweight/obesity is considered a risk factor for hypertension, diabetes type 2, coronary heart disease, stroke, gallbladder disease, respiratory problems and some forms of cancer (National Institutes of Health)[13]. The World Health Organization (WHO) considers obesity as a chronic disease[14].

Limited research has been conducted so far into the potentially negative effect of overweight/obesity on functional outcome and health-related quality of life after THA[9]. Based on the scarce research done it is difficult to draw uniform conclusions, as different instruments, points in time and perspectives (physician-based vs. patient-based) have been used[15-22]. Moreover, for research conducted into the effect of overweight/obesity on functional outcome and health-related quality of life after THA, one must ask whether comorbidity and complications also have to be taken into account[21]. As mentioned, overweight and obesity are associated with a variety of additional health problems, and the same applies for postoperative complications.

Few studies have taken the influence of comorbidity and complications into account when assessing the influence of overweight/obesity on patient-perceived physical functioning and health-related quality of life. Therefore, the aim of the current study is to analyse the effect of overweight/obesity on patient-perceived physical functioning and health-related quality of life 1 year after THA. As overweight/obesity is considered one of the risk factors for a spectrum of comorbidity and postoperative complications, the additional effect on physical functioning and health-related quality of life of comorbidity and postoperative complications in combination with overweight/obesity was analysed.

Materials and Methods

Subjects

A retrospective analysis was done on prospectively collected data. Data was collected in three orthopaedic centres' (one university medical centre, two regional hospitals) in the Netherlands. All patients who had undergone an elective primary THA because of primary OA of the hip between February 2005 and January 2007 were consecutively included. Patients who had died at the time of follow-up, who had other lower-limb arthroplasties performed in the period of follow-up, or who had cognitive limitations were excluded. Patients were sent a self-report questionnaire with an explanatory letter 1 year postoperatively (mean, 52.4 weeks; SD, 3.9 weeks).

Surgery was performed by 15 staff surgeons, or under direct supervision of one of these surgeons. Patients were operated using a posterolateral or anterolateral approach. This approach was surgeon-specific, with each surgeon using the same approach consistently for all THAs performed during the study period. Different types of implants and fixation types were used. Patients were allowed full weight bearing the second day after surgery, using crutches during the first three postoperative months.

The study was approved and conducted in accordance with the regulations of the medical ethical boards of the participating hospitals. Patients were informed in the explanatory letter that return of the completed questionnaire would be taken as consent to participate.

Instruments

To measure patient-perceived physical functioning, the Dutch-language version of the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) was used[23,24]. The WOMAC is a widely used disease-specific questionnaire for measuring outcome after THA[25]. Using a Likert scale, individuals rate themselves on multiple items grouped into three domains: pain (5 items), stiffness (2 items) and physical functioning (17 items). The scores of the subscales make up the total score. The total score of 96 points is recoded into a 100-point scale, with a higher score representing better physical functioning. To get an impression of health-related quality of life, the subscale of self-perceived general health of the Short-Form 36 health survey (SF-36) was used[26]. General comorbidity was measured with the 12-item list from Nilsdotter[27]. Patients were rated as having no complications, one or two complications, or more than two. Body mass (kg) and height (m) were self-reported. Body mass index (BMI) was calculated by dividing body mass in kilograms by height in square meters. A BMI < 25 kg/m^2 was considered a normal weight, between 25 and 30 kg/m^2 overweight and > 30 kg/m^2 obese. Age, gender and complications (perioperative and postoperative) were extracted from the medical records.

Statistical analysis

Statistical analyses were performed using the SPSS 16 software (SPSS Inc, 233 S Wacker Dr, Chicago, IL 60606, USA) and Mplus version 5[28]. Descriptive statistics were used to depict the main characteristics of the patients. ANOVA with Bonferroni adjustment was used to compare continuous variables between three BMI groups (BMI < 25 kg/m^2, BMI 25-30 kg/m^2 and BMI > 30 kg/m^2). To determine to what extent overweight/obesity (independent variable) is predictive of patient-perceived physical functioning (WOMAC total score) and self-perceived general health (dependent variables), linear regression analysis was used. In addition, comorbidity (no, one to two, >2; no comorbidity=ref.) and complications (yes/no; no = ref.) were included as dummy variables in the analyses to correct for their influence. A p-value of < 0.05 was considered statistically significant.

The linear regression analysis was performed with a structural equation model (SEM) technique in order to determine to what extent overweight/obesity is associated with patient-perceived physical functioning and self-perceived general health after THA. Dependent variables were patient-perceived physical functioning and self-perceived general health. Independent variables were BMI, age, gender, complications and comorbidity. BMI was centered at 25 as being the upper limit of a healthy weight and age at 70 years (the mean age of this study population). In addition, based on the SEM, the correlation of the two dependent variables was calculated.

Results

Of the 848 eligible patients, 653 (77.0%) returned complete question-naires and were included. There were 484 female patients (74.1%). Mean age at surgery was 70.3 years (SD, 8.2 years; Table 1). Mean BMI of the patients was 27.0 kg/m² (SD, 4.1 kg/m²). Most of the patients lived with a partner (59.1%) and had a lower educational level (49.3%; Table 1).

Table 1. Baseline characteristics of the study population.

	Total	BMI < 25	BMI 25–30	BMI > 30
	N=543-653*	N=191-213*	N=229-275*	N=111-137*
	Mean (SD/%)	Mean (SD/%)	Mean (SD/%)	Mean (SD/%)
Age	70.3 (8.2)	70.8 (8.8)	70.1 (8.0)	69.5 (7.8)
Gender (% women)	74.2%	80.3%	68.9%	73.0%
Education				
Lower	322 (54.8%)	87 (40.8%)	147 (53.5%)	77 (56.2%)
Secondary	201 (34.2%)	88 (41.3%)	72 (26.2%)	40 (29.2%)
Higher	65 (11.1%)	26 (12.2%)	32 (11.6%)	6 (4.4%)
Missing values	65 (10%)	12 (5.6%)	24 (8.7%)	14 (10.2%)
BMI	27.0 (4.1)	22.9 (1.7)	27.2 (1.3)	33.0 (2.9)
Comorbidity				
None	181 (27.7%)	50 (23.5%)	77 (28.0%)	36 (26.3%)
1-2	263 (40.3%)	98 (46.0%)	111 (40.4%)	50 (36.5%)
> 2	209 (32.0%)	65 (30.5%)	87 (31.6%)	51 (37.2%)
Missing values	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Complications				
Yes	47 (7.2%)	13 (6.1%)	25 (9.1%)	9 (6.6%)
No	603 (92.3%)	198 (93.0%)	249 (90.5%)	128 (93.4%)
Missing values	3 (0.5%)	2 (0.9%)	1 (0.4%)	0 (0%)

*due to missing data the n is variable

A total of 181 patients (27.7%) reported no additional comorbidity, 263 patients (40.3%) one to two comorbidities, and 209 patients (32.0%) more than two comorbidities. Complications occurred in 47 (7.2%) patients. There were eight (1.2%) dislocations, three (0.5%) sciatic nerve palsies, three (0.5%) superior gluteal nerve palsies, two (0.3%) periprosthetic fractures, and two (0.3%) malpositioned prostheses necessitating revision surgery.

Patients did not differ with respect to mean age at surgery, comorbidity or complications between the three BMI categories. With respect to gender there were significantly more women in the BMI < 25 group.

In order to determine to what extent overweight/obesity influences patient-perceived physical functioning and self-perceived general health afterTHA, an SEM analysis was conducted. The model had four steps. The first step/model determined the association of BMI with patient-perceived physical function-ing and self-perceived general health, while the second model determined the independent effect of age and gender. In the third step/model, the effect of BMI, age and gender were added into the model. In the final step (model 4) comorbidity and complications were added to estimate their additional effect (Table 2).

The influence of BMI on patient-perceived physical functioning and self-perceived general health as depicted in model 1 (Table 2) was -0.35 (p=0.07) and -0.59 (p=0.001), respectively. This means that, with every increase of 1 kg/m² BMI the score on patient-perceived physical functioning as measured with the WOMAC (100-point scale) is reduced by 0.35 and on the self-perceived general health subscale of the Short-Form 36 (100-point scale) by 0.59 points. In model 2, the separate influence of age and gender are reported; in model 3, in combination with BMI. In both models, the influence of gender on patient-perceived physical functioning is distinct (respectively, -3.88 (p=0.02) and -4.53 (p=0.01)). Finally, model 4 reports the influence of BMI corrected not only for age and gender but also for complications and comorbidity.

Table 2. Structural equation model analyses. Estimate and standard error (SE) of patient-perceived physical functioning and self-perceived general health (SF-36) (dependent variables) on overweight/obesity, age, gender, complications and comorbidity (independent variables).

	Model 1				Model 2				Model 3				Model 4			
	Self-perceived general health		Patient-perceived physical functioning		Self-perceived general health		Patient-perceived physical functioning		Self-perceived general health		Patient-perceived physical functioning		Self-perceived general health		Patient-perceived physical Functioning	
	Estimate (P-value)	S.E.	Estimate (P-value)	S.E.	Estimate (P-value)	S.E.	Estimate (P-value)	S.E.	Estimate (P-value)	S.E.	Estimate (P-value)	S.E.	Estimate (P-value)	S.E.	Estimate (P-value)	S.E.
Intercept	65.59	0.89	80.98	0.84	64.92	1.53	82.72	1.44	65.91	1.60	84.44	1.50	75.07	1.83	90.92	1.78
BMI (centr: 25)	-0.35 (p=0.07)	0.19	-0.59 (p=0.001)	0.18					-0.41 (p=0.03)	0.19	-0.65 (p<0.001)	0.18	-0.40 (p=0.03)	0.18	-0.63 (p<0.001)	0.18
Age (centr: 70)					-0.30 (p=0.001)	0.10	-0.24 (p=0.01)	0.09	-0.31 (p=0.001)	0.10	-0.23 (p=0.01)	0.09	-0.24 (p=0.01)	0.09	-0.18 (p=0.04)	0.09
Gender (ref: male)					0.10 (p=0.96)	1.78	-3.88 (p=0.02)	1.68	-0.24 (p=0.90)	1.80	-4.53 (p=0.01)	1.70	-0.06 (p=0.97)	1.70	-4.41 (p=0.01)	1.65
Complications (ref: no complications)													-8.19 (p<0.001)	0.99	-5.63 (p<0.001)	0.96
Comorbidity (ref=0 = no; 1=1-2; 2= >2)													-7.02 (p=0.01)	2.82	-7.25 (p=0.01)	2.74
Correlation w. Physical functioning	0.41				0.41				0.41				0.35			

With respect to patient-perceived physical functioning, every increase in 1 kg/m² BMI leads to a reduction of 0.63 points on the WOMAC score (p=0.001). By contrast, the prevalence of complications or comorbidity leads to a reduction of, respectively, 5.63 (p=<0.001) and 7.25 (p=0.01) points on the WOMAC score in the case of one or two comorbidities and a reduction of 14.50 points on the WOMAC score in the case of more than two comorbidities. With respect to the self-perceived general health of the SF-36, the same pattern is seen, although the influence of gender is less prominent. The correlation between the two dependent variables, patient-perceived physical functioning and self-perceived general health, is 0.35 in the last model. The R^2 for these last models was 0.10 for patient-perceived physical functioning and 0.13 for self-perceived general health, which implies that 10% and 13% of the variance could be explained (data not shown).

Discussion

It is generally considered that overweight/obesity is associated with a negative effect on outcome after THA and on implant longevity. From the results of our study it can be concluded that the influence of overweight/obesity on patient-perceived physical functioning and self-perceived general health is low, both without and with correction for the other co variables. The sole influence of 1 kg/m² increase in BMI leads to a reduction in the score on patient-perceived physical functioning as measured with the WOMAC by 0.35 points and on self-perceived general health as determined with the Short-Form 36 by 0.59 points. This implies that, compared to a person with a BMI of 25 kg/m², someone with a BMI of 35 kg/m² of the same age and gender has a reduction in score on physical functioning and health-related quality of life of respectively 3.5 and 5.9 points. Corrected for the influence of complications, comorbidity, and the demographic variables, the influence of BMI remains more or less the same. On the other hand, the influence of complications is considerable and leads to a reduction in the physical functioning score of 5.63 points and health-related quality of life of 8.19 points. For comorbidity, the same pattern is seen with a reduction of 7.25 points for one or two comorbidities and 14.50 points for more than two comorbidities on the physical functioning score, and a comparable effect on

health-related quality of life with a reduction of, respectively, 7.02 and 14.04 points.

The question thus arises as to whether these effects can be considered clinically relevant. Angst et al.[29] report that differences larger than 6% of the maximum score on the WOMAC (96/100 points) and SF-36 (100 points) can be considered clinically relevant. With the exception of more than two comorbidities (reduction of 14.04 points on the SF-36 health perception scale), none of the variables lead to a relevant effect on their own, yet the combination of factors can rapidly lead to relevant differences. For example, being a woman in combination with a BMI of 30 kg/m^2 and one or two comorbidities already leads to a clinically relevant effect on the physical functioning score. Still, overall, it can be stated that the sole effect of BMI on physical functioning and health-related quality of life is low and will only lead to a clinically relevant effect in extreme situations. On the other hand, the effects of comorbidity and complications are substantial.

Based on the aforementioned results it can be argued that, in future research, comorbidity and complications have to be taken into account, otherwise an incorrect and incomplete picture is obtained. Until now, only a few studies have taken comorbidity and complications into account when assessing the influence of overweight/obesity on physical functioning and health-related quality of life. The findings of our study are in line with research by Kessler & Käfer[16], McCalden et al.[17], Moran et al.[18], Stickles et al.[19], and Andrew et al.[20]. Kessler & Käfer used the WOMAC as outcome measure. They concluded that overweight/obesity is of no influence, yet they measured 10 days and 3 months postoperatively. McCalden et al.[17] measured after a mean period of 8.4 years postoperatively and concluded that morbid obesity does not affect the postoperative outcome after THA as measured with the WOMAC, SF-12, and Harris Hip Score (HHS). Moran et al.[18] concluded that BMI did not lead to clinically relevant effects on the postoperative HHS and SF-36. Unlike the aforementioned studies, Moran et al. took both complications and comorbidity into account. However, it must be mentioned that we used a patient-based outcome (WOMAC) and Moran et al. used a physician-based outcome (HHS). Additionally, Stickles et al.[19] and Andrew et al.[20] concluded that obese patients enjoy as much improvement and satisfaction as non-obese patients. Stickles et al. found that there were no significant differences

between obese and non-obese patients with respect to their improvement on the WOMAC score and the Physical Component and Mental Component scores of the SF-36. Andrew et al. concluded that there was no difference in the change in the Oxford Hip Score (OHS) between obese and non-obese patients five years postoperatively.

It can be concluded that the results of our study are contrary to results reported by Busato et al.[21], who measured the effect of a high BMI on functional outcome in a cohort of 18,968 patients. They found that a high BMI is associated with decreased ambulation during a follow-up period of 15 years. By contrast, we measured only 1 year postoperatively, and our good results at that point do not rule out deterioration later on. Comparing our results with those of the study of Jackson et al.[22] leads to a mixed picture: they found a significant difference between obese and non-obese patients in favour of the non-obese group with respect to the postoperative HHS. And yet, they found no difference between the two groups in overall satisfaction with surgery.

Finally, it can be concluded that with the exception of the Moran study, none of these studies takes the additional effect of comorbidity into account. The substantial impact of comorbidity found in our study is in line with suggestions stated in research by Braeken et al.[15], who argued that more attention should be paid in future research to the potentially negative influence of comorbidity on physical functioning after THA.

Once again, a strength of our study is that not only the influence of overweight and obesity were taken into account but also the influence of additional comorbidity and postoperative complications. Additional strong points of our study are the size of our study group and the response rate of 77.0%. In order to get an impression of the representativeness of our study group we determined the response rate by BMI category. As the BMI of the non-responders was not available 1 year after THA, we used the BMI (of both responders and non-responders) that was determined when the patients were admitted to the hospital for surgery. Divided by BMI category the response rate was, respectively, 76.0% (BMI < 25 kg/m^2), 81.5% (BMI 25-30 kg/m^2), and 71.1% (BMI > 30 kg/m^2). From this, it can be concluded that no response bias was present. A weak point is that height and weight and thus BMI were self-reported. This probably leads to an underestimation of the problem, as it is known that people tend to underestimate their weight and

overestimate their height[30]. Secondly, we used the 12-item list from Nilsdotter[27] to get an impression of the presence of comorbidity. It can be argued that not all comorbidity is included in this instrument. On the other hand, the most prevalent comorbidities or health problems associated with overweight/obesity, like heart disease, hypertension, peripheral artery disease, diabetes and cancer, are included in this instrument. Finally, our study was limited to the patients' 1-year postoperative status. The long-term influence of overweight/obesity on patient-perceived physical functioning, health-related quality of life, and prosthetic longevity could not be determined. This latter point needs particular attention, as the present study used self-reported instruments and consequently no objective information was gathered about the effect of overweight on the prosthesis.

Conclusions

Overall it can be concluded that the influence of overweight/obesity on physical functioning and health-related quality of life both with and without correcting for the other co variables is low. On the other hand, the impact of complications and comorbidity is considerable. Especially the combination of factors can rapidly lead to clinically relevant differences. In that sense, it can be concluded that future research into the effect of obesity/comorbidity on physical functioning and health-related quality of life must take comorbidity and complications into account, otherwise an incorrect and incomplete picture is obtained. Finally, based on the results of this study, it can be concluded that refusing a patient a THA solely on the basis of overweight or obesity seems unjustified.

Competing interests
The authors declare that they have no competing interests.

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Chapter 7

Changes in body weight after total hip arthroplasty:
short- and long term effects

N Paans[1] ■ M Stevens[1] ■ R Wagenmakers[2] ■ J van Beveren[4]
K van der Meer[5] ■ SK Bulstra[1] ■ I van den Akker-Scheek[1,3]

[1]Department of Orthopedic Surgery, University Medical Center Groningen, University of Groningen,
The Netherlands

[2]Department of Orthopedic Surgery, Amphia Hospital, Breda, The Netherlands

[3]Department of Orthopedic Surgery, Martini Hospital, Groningen, The Netherlands

[4]Department of Orthopedic Surgery, Röpcke-Zweers Hospital, Hardenberg, The Netherlands

[5]Department of General Practice, University Medical Center Groningen, University of Groningen,
The Netherlands

Abstract

Background: Elevated body weight is associated with hip osteoarthritis (OA) and subsequently with total hip arthroplasty (THA). Patients with hip OA who are overweight often mention their restricted mobility as a factor that thwarts their attempts to be physically active and lose weight. There is some evidence that THA increases physical activity but none for losing body weight after THA.

Objective: The purpose of this study was to analyse the short- (1-year) and long-term (4.5-year) effects of a THA on body weight.

Design: This was an observational multicenter cohort study.

Methods: For the short-term effect all patients (N=618) were analysed, for the long term a random subgroup (N=100). Pre- and postoperative body weight and height were self-reported. Patients were categorized according to their preoperative body mass index (BMI<25 kg/m^2 = normal weight, 25-30 kg/m^2 = overweight, >30 kg/m^2 = obese). Clinical relevancy was set at a minimum of 5% weight loss compared with baseline.

Results: The mean age of the study group was 70 years (SD 8), 74% were women, mean preoperative body mass 79 kg (SD 14). One year after THA a significant decrease in body weight occurred of 1% and 3.4% for the overweight and obese BMI categories respectively (p<0.00). After 4.5 years a significant decrease in body weight of 6.4% occurred for the obese BMI category (p<0.000).

Limitations: Height and weight — and thus BMI — were self-reported.

Conclusion: Patients in the overweight and obese groups showed a decrease in body weight after 1 year, albeit not clinically relevant. After 4.5 years a decrease was observed that was clinically relevant in obese patients. It can be concluded that no clinically relevant reduction of weight occurred after THA, except in the long term for patients who were obese.

Introduction

Osteoarthritis of the hip is one of the most prevalent age-related chronic conditions.[1,2] It causes a significant impairment in patients' mobility and has a high impact on quality of life.[3] Total hip arthroplasty (THA) has become known as a highly successful treatment for advanced osteoarthritis. The incidence of patients with hip osteoarthritis (OA) who need a hip arthroplasty is growing. The yearly numbers of hip arthroplasty interventions in the Netherlands for 1995-2005 increased from 13,785 to 20,715 - almost 50%. A need for 51.000 hip prostheses per year is expected for the year 2030.[4] One explanation for this increase is that in Western societies, including the Netherlands, older adults are growing in number as well as in age.[5] Another explanation for the increase in the need for hip prostheses is the growing number of patients who are overweight,[6-8] as a high BMI is considered a risk factor in the development of OA.[9]

Patients who are overweight and awaiting hip arthroplasty are advised strongly to lose body weight in advance, by increasing physical activity or through nutritional change. An important reason for losing weight is to increase the chance of surgical success by lowering infection rates and reducing problems of wound-tissue healing.[10,11] However most of patients report not being able to lose weight because of physical limitations and pain. Because the hip arthroplasty is supposed to diminish pain and increase mobility, patients assume weight loss will occur naturally after their surgery.[12]

Losing weight after hip arthroplasty is no less important. A high body mass index (BMI) after hip arthroplasty surgery has implications for implant stability with a 6 fold higher risk for implant dislocation compared to patients with a low BMI.[13,14] In addition Roder et al (2008) showed that each extra unit of BMI increases stem-loosening odds.[15] Finally, it is known that a high BMI can also affect polyethylene wear negatively, which in turn has a negative effect on implant longevity.[16] With respect to general health, overweight or obesity is considered a risk factor for all kinds of serious illnesses, like diabetes type 2 and coronary heart disease,[17] which also advocates for losing weight after a THA.

From the small number of studies presenting change of body weight in patients with hip OA who were overweight, it can be concluded that these patients do not lose weight after hip arthroplasty; some of these studies

presented no change and some showed an increase in body weight. However, there are some points of criticism that can be raised with respect to these past studies, e.g. the fact that some used no BMI categories (normal weight, overweight or obese);[18,19] that patients were retrieved from one source (e.g. university or regional hospital), which might have consequences for the generalizability of results;[12,18-21] that some studies did not consider the influence of comorbidities or presurgical fitness status (American Society of Anesthesiologists [ASA] status) in their analyses;[12,18,19,21] and that the effect was determined only 1 year after THA.[18,20]

The objective of this study was therefore to analyse the short-term and long-term effect of THA on body weight taking into account the aforementioned points of criticism.

Methods

Design and setting

An observational multicenter cohort study was conducted at the University Medical Center in Groningen (university hospital), Martini Hospital in Groningen (large teaching hospital) and Röpcke-Zweers Hospital in Hardenberg (regional hospital). All hospitals are situated in the northern part of the Netherlands. Recruitment for the study started in 2005 and the last data were collected in 2010.

Ethical approval

The study was approved and conducted in accordance with the regulations of the medical ethics boards of the participating hospitals.
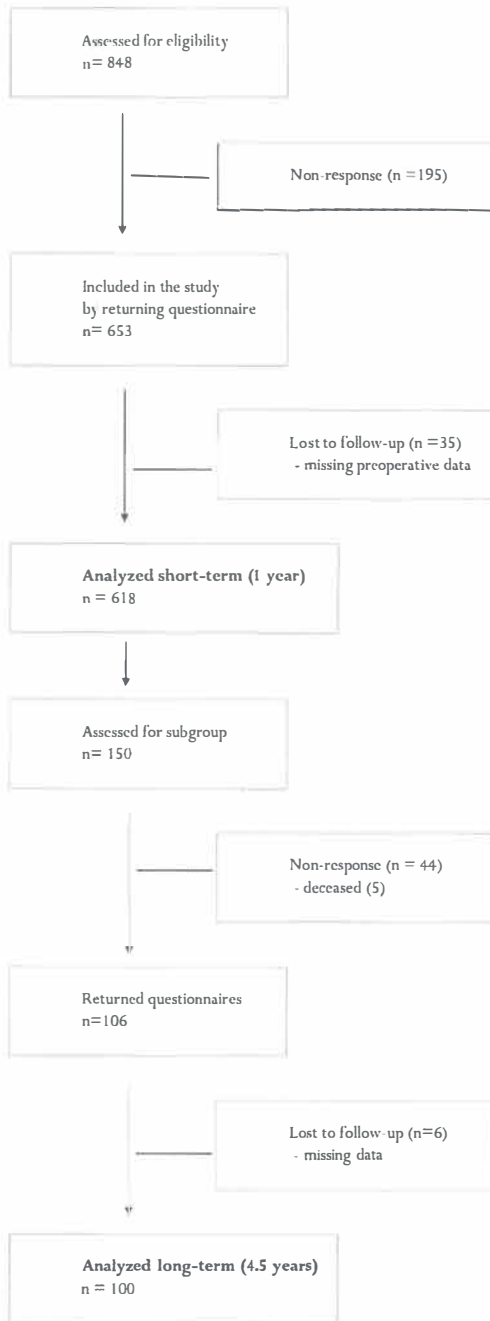
Data collection

Patients' sex, age at surgery, self-reported height, self-reported body weight and ASA (American Society of Anesthesiologists) status were recorded from medical records. The ASA status is a standard measure of fitness for surgery, scored in this study from 1 (normal, healthy) and 2 (mild systemic disease) to 3 (severe systemic disease).[22] Postoperative self-reported body mass was obtained through questionnaires, with a mean of 1 (short-term) and 4.5 years (long-term) postoperatively. These questionnaires also asked whether the patients had had other knee and/or hip surgery in the follow-up period.

Selection criteria

Patients admitted to the orthopaedic surgery department because of primary hip OA for an elective THA in 2005 and 2006 were eligible for the study (n=848) and invited to participate by sending a questionnaire 1 year after surgery (short-term effect). A total of 653 patients returned the questionnaire, and their medical records were assembled to collect body weight and height at time of surgery. A flow chart of the study population is presented in Figure 1.

To get an impression of the long-term effect, approximately 20% of the 1-year follow-up group was selected at random. In this draw the different ratios related to the origin of the patients from the 3 different hospitals were taken into account. In addition, a non-response of 20% was taken into account which eventually led to 150 patients who were sent a questionnaire for the second time.

Figure 1. Flow chart of the study population


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          ┌─────────────────────────┐
          │ Assessed for eligibility│
          │ n= 848                  │
          └─────────────────────────┘
                     │
                     │        ┌─────────────────────────┐
                     ├────────│ Non-response (n =195)   │
                     │        └─────────────────────────┘
                     ▼
          ┌─────────────────────────┐
          │ Included in the study   │
          │ by returning questionnaire│
          │ n= 653                  │
          └─────────────────────────┘
                     │
                     │        ┌─────────────────────────────┐
                     ├────────│ Lost to follow-up (n =35)   │
                     │        │ - missing preoperative data │
                     │        └─────────────────────────────┘
                     ▼
          ┌─────────────────────────┐
          │ Analyzed short-term (1 year)│
          │ n = 618                 │
          └─────────────────────────┘
                     │
                     ▼
          ┌─────────────────────────┐
          │ Assessed for subgroup   │
          │ n= 150                  │
          └─────────────────────────┘
                     │
                     │        ┌─────────────────────────┐
                     ├────────│ Non-response (n = 44)   │
                     │        │ - deceased (5)          │
                     │        └─────────────────────────┘
                     ▼
          ┌─────────────────────────┐
          │ Returned questionnaires │
          │ n=106                   │
          └─────────────────────────┘
                     │
                     │        ┌─────────────────────────┐
                     ├────────│ Lost to follow-up (n=6) │
                     │        │ - missing data          │
                     │        └─────────────────────────┘
                     ▼
          ┌─────────────────────────┐
          │ Analyzed long-term (4.5 years)│
          │ n = 100                 │
          └─────────────────────────┘
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Height, Body Weight and Body Mass Index (BMI)

Preoperative height and body weight from the medical records was self-reported, as well as the postoperative data. Preoperative BMI was calculated by dividing body weight in kg by height in square meters. For preoperative BMI, the patients were divided into BMI categories defined as normal weight (BMI < 25 kg/m^2), overweight (BMI between 25 and 30 kg/m2) and obese (BMI > 30 kg/m^2).[23]

Body weight change

Body weight change was measured per BMI category and considered clinically significant if the loss or gain was at least 5% of the preoperative weight.[24] This minimum amount of weight loss is required to induce metabolic and cardiovascular health benefits.[25]

Statistical analysis

Descriptive statistics were used to describe the study sample. The baseline characteristics between the study group and the subgroup were compared for differences using chi-square and independent t-test analyses. Generalized estimating equations (GEEs) were used to investigate the time-course of body weight in the patients who had a THA at baseline.[26] The GEE adjusts for the correlation between repeated observations taken from the same individual and is able to handle longitudinal data on participants with a varying number of unequally spaced observations. An exchangeable correlation structure was assumed in all analyses. All statistical analyses were performed with PASW Statistics 18. A significance level of p<0.05 was considered statistically significant. For effect modification analysis the variables sex, age at surgery, other knee and/or hip surgery and ASA status were taken into account and a significance level of p<0.01 was considered significant statistically.

Results

A total of 653 patients returned the questionnaire (77%) 1 year after surgery. The response rates for the 3 hospitals were respectively 61% (university hospital), 74% (large teaching hospital) and 95% (regional hospital). In 35 medical records preoperative weight and/or height could not be found. As a result, 618 patients were included in the 1-year follow-up. In the 5-year follow-up group 106 patients (71%) returned the questionnaire. The response rate for the three hospitals was respectively 60% (university hospital), 81% (large teaching hospital) and 73% (regional hospital). For 6 patients, data were incomplete, which led to the inclusion of 100 patients. The mean follow-up time of the long-term follow-up group was 4.5 years.

Demographic characteristics
Table 1 shows the demographic characteristics and the BMI and ASA classification of the short-term (1 year) and long-term (4.5 years) follow-up groups at baseline. In both groups most patients were overweight and had mild systemic disease at the time of surgery.

Table 1. Demographics (preoperatively)

|		Short-term (1 yr) follow-up group (n=618)	Long-term (4.5 yr) follow-up group (n=100)
Age (yrs)		70.2 (8.2)	70.7 (8.1)
Gender (n / % female)		458 / 74.1	72 / 72.0
Height (m)		168.1 (9.2)	168.9 (7.6)
Body weight (kg)		78.6 (14.0)	81.2 (16.4)
BMI category (n / %)			
	< 25	162 / 26.2	24 / 24.0
	25-30	294 / 47.6	46/ 46.0
	30 >	162 / 26.2	30/ 30.0
ASA physical status (n / %)			
	1	172 / 27.8	33 / 33.0
	2	398 / 64.4	60 / 60.0
	3	46 / 7.4	7 / 7.0

BMI = Body Mass Index / Values in mean (SD) unless otherwise indicated

The representativeness of this long-term follow-up group also was analysed. To that end, the demographic characteristics and baseline BMI and ASA scores were compared between the short-term follow-up groups. These data were shown to be comparable; no statistical differences were found.

Short-term effect of THA on body weight

In Figure 2 the mean (±standard error) body weight of patients is shown per BMI category preoperatively and 1 year postoperatively. The GEE analysis showed a significant increase in body weight of 0.7 kg in the group with normal weight 95% confidence interval [CI] = 0.1 to 1.4), which corresponds to a 1.1% weight gain; a significant decrease in body weight of 0.8 kg (95% CI = -1.2 to -0.3) in the group with overweight, which corresponds to a 1.0% weight loss; and a significant decrease in body weight of 3.2 kg (95% CI = -4.2 to -2.2) in the group with obesity, which corresponds to a 3.4% weight loss. The GEE analysis showed no confounding or effect modification by gender, other knee and/or hip surgery, or age at surgery for the change of body weight in time (data not shown).

Figure 2. Body weight changes 1 year after THA
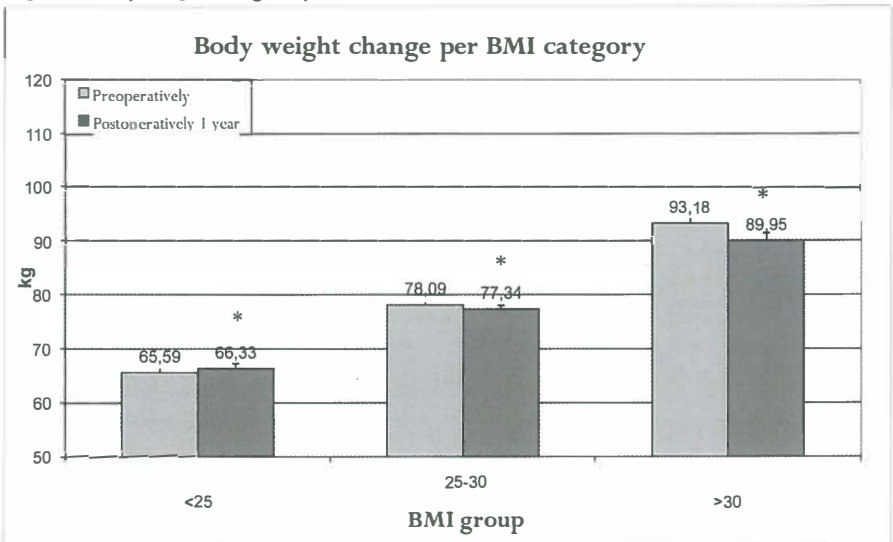
* Significant change compared to baseline p<0.05; shown are mean and SE

The ASA score did not affect the change of body weight in time (no confounding or effect modification) for any patients except those who were obese and had an ASA score of 3. In this particular group no confounding was shown but effect modification was significant (95% CI = 2.2 to 8.2), resulting in a smaller decrease in body weight compared with patients with ASA score of 1 who were obese (see Figure 3).

Long-term effect of THA on body weight
Figure 4 shows the mean (±standard error) body weight of patients preoperatively and 1 year and 4.5 years postoperatively per BMI category.

Figure 3. Effect modification of ASA score for patients BMI > 30 kg/m^2 1 year postoperatively
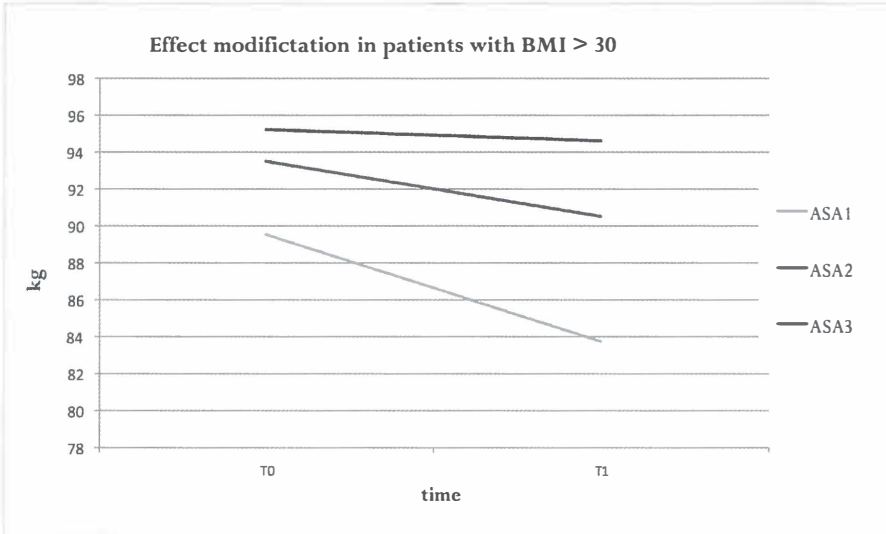
T0 = Time of surgery; T1 = one year after surgery

The GEE analysis of the long-term effect of THA on body weight showed no change in body weight in the group of patients who were of normal weight and the group of patients who were overweight, but a significant decrease of 6.2 kg of body weight for those patients who were obese (95% CI = -9.0 to -3.5), which corresponds to a 6.4% weight loss. The GEE analysis showed no confounding or effect modification by sex or age at surgery, for the change of body weight in time (data not shown).

The ASA score did not affect the change of body weight in time (no confounding or effect modification) for any patients except those who had a normal weight and an ASA score of 3. In this particular group no confounding was shown but effect modification was significant (95% CI = -8.2 to -2.4), resulting in a prominent decrease in body weight compared with who has a normal weight and an ASA of 1 (see Figure 5).

Figure 4. Body weight changes 1 and 4.5 years after THA

Body weight change per BMI category

Legend:
- Preoperatively
- Postoperatively 1 year
- Postoperatively 4.5 years

< 25 kg/m²: 64,59 64,52 64,33
25 - 30 kg/m²: 79,09 77,62* 79,62
> 30 kg/m²: 97,26* 92,63* 91,02*

BMI group
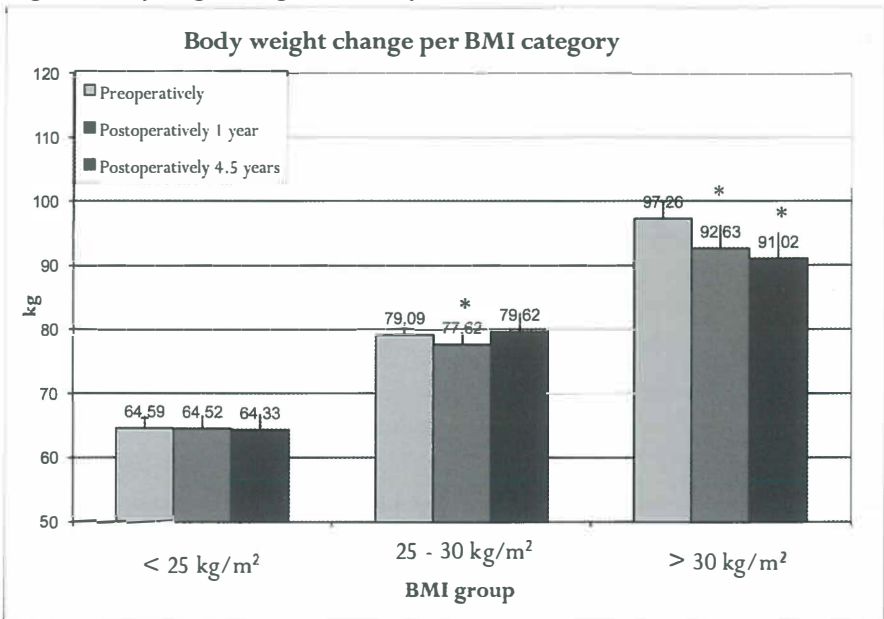
* Significant change compared to baseline p<0.05; shown are mean and SE

Figure 5. Effect modification of ASA score for patients with BMI < 25 kg/m^2 4.5 years postoperatively

Effect modification in patients with BMI < 25
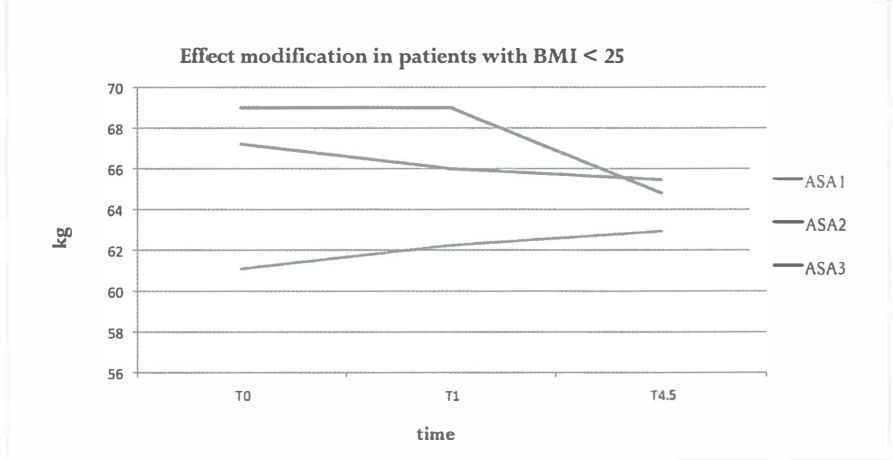
TO = Time of surgery; T1 = 1 year after surgery; T4.5 = 4.5 years after surgery

Discussion

The results of this study show that 1 (short-term) as well as 4.5 years (long-term) after THA there is no 5% clinically relevant reduction in body weight compared to preoperative body weight, except for patients with obesity in the long-term group. In addition, body weight change was influenced by an ASA 3 status, which led to a more apparent decrease in obese patients after 1 year compared with patients with an ASA 1 status who were obese. The same pattern in body weight was seen in normal-weight patients with an ASA 3 status in the long-term group compared with patients with ASA 1 status who were of normal weight.

The results of our study are in line with existing literature about weight change after THA surgery, which shows an increase or no change at all.[12,18-21] Although weight reductions were found in our research, they were small and considered not clinically relevant, with the exception of the patients with obesity in the long-term follow-up group. This latter finding is not seen in the study of Dowsey et al. (2010),[20] which categorized a study population of 471 patients into non-obese (BMI <30 kg/m^2), obese (BMI 30-40 kg/m^2) and morbidly obese (BMI >40 kg/m^2) groups. In that study the obese group gained 0.7 kg in 1 year, whereas in our study the obese group lost 3.2 kg in

1 year. The proportion of men and women in the study group was comparable to ours; therefore it provides no explanation for the differences in results. The contradictions in weight change in both studies could be explained by the different numbers of patients who are morbidly obese and the way they are categorized. In our study the percentage of patients who are morbidly obese was only 1.6%, so we did not categorize this specific group separately, whereas in the Dowsey et al. study 8% were morbidly obese. Vincent and colleagues stated that patients who are morbidly obese need far more time and effort for rehabilitation and subsequently to achieve physical improvements than patients who have less body mass,[27] which can have an effect on losing weight.

Aderinto et al.[19] examined a long-term (3 years) effect of THA surgery on body weight change. They categorized their study group of 140 patients into nonobese (BMI < 30 kg/m^2) and obese (BMI ≥ 30 kg/m^2) groups. Their obese group (n=59) showed an increase in body weight of 4 kg in 3 years. Again, this finding is in sharp contrast to our results of losing 6 kg after 4.5 years in the obese group (n=31). Cultural, sex (in Aderinto's and colleagues' study 55% were women; in our study 67%) and group size differences aside, we have no explanation for this contrast.

In a study by Middleton and Boardman[12] all patients had an increase in body weight, unlike the outcomes of our study. Middleton and Boardman examined the change of BMI, instead of body weight, two years after a THA surgery. It was not stated clearly, however, what had been the indication for surgery (OA, fracture, or other reasons) or whether there were comorbidities at the time of surgery, both of which could influence the outcome of the hip arthroplasty and subsequently a possible change in weight.

The finding in our study that sex and age at the time of surgery were no confounders or effect modifiers is in agreement with the findings of Aderinto et al.[19] and Dowsey et al.[20]. They showed that neither age nor sex predicted weight change after a primary THA. However, Dowsey et al. concluded that comorbidities had no association with weight change after a primary THA either. This finding is in contrast to our finding that patients with a preoperative ASA score of 3, indicating severe systemic diseases, present a different course of the weight change than patients with normal weight and obesity. For the patients who are obese, the smaller decrease in body weight

was not unexpected, as being obese and having severe systemic diseases at the same time probably makes losing weight more difficult. In the patients who were of normal weight, there was a decrease in body weight, which was not expected and certainly not aimed for in this subcategory. An explanation of this difference in outcome between our study and the study of Dowsey et al. can lie in how comorbidities were measured and defined. Dowsey et al categorized the comorbidities as diabetic, cardiovascular or respiratory types.[20] No information about the severity of these comorbidities at the time of surgery was mentioned. More research would be advisable, especially among patients of normal weight combined with comorbidities at the time of surgery, to gain insight into determinants of this phenomenon and to avoid undesirable weight loss.

Strengths and limitations
The large study group and the long-term follow up of 4.5 years were major strengths of this study. Because of the difficulties in explaining why weight gain or weight loss occur in this type of research, we also consider it a strength to have taken the baseline BMI and comorbidities into account when analysing our results. Another strength was the sourcing of patients from 3 different types of hospitals, which limits the risk of selection bias and improves generalizability of results.
The most prominent limitation of the study was that height and weight — and thus BMI — were self-reported. This limitation probably leads to an underestimation of the problem, as it is known that people tend to underestimate their weight and overestimate their height.[28] This underestimation is a well-described phenomenon in populations with varying characteristics.[29-31] However, it also can be argued that despite the supposed underestimation of weight, this study showed that no clinically relevant changes in body weight occurred except in the long-term follow-up group of patients who were obese. This underestimation could also explain the differences found in the results of this study compared to other studies. Although not clinically relevant (with the exception of the obese group on the long term), the results of this study did show minor reductions in body weight in contrast to earlier studies, in which no changes at all or even increases were reported. [12,18-21] It should be mentioned however, that only Dowsey
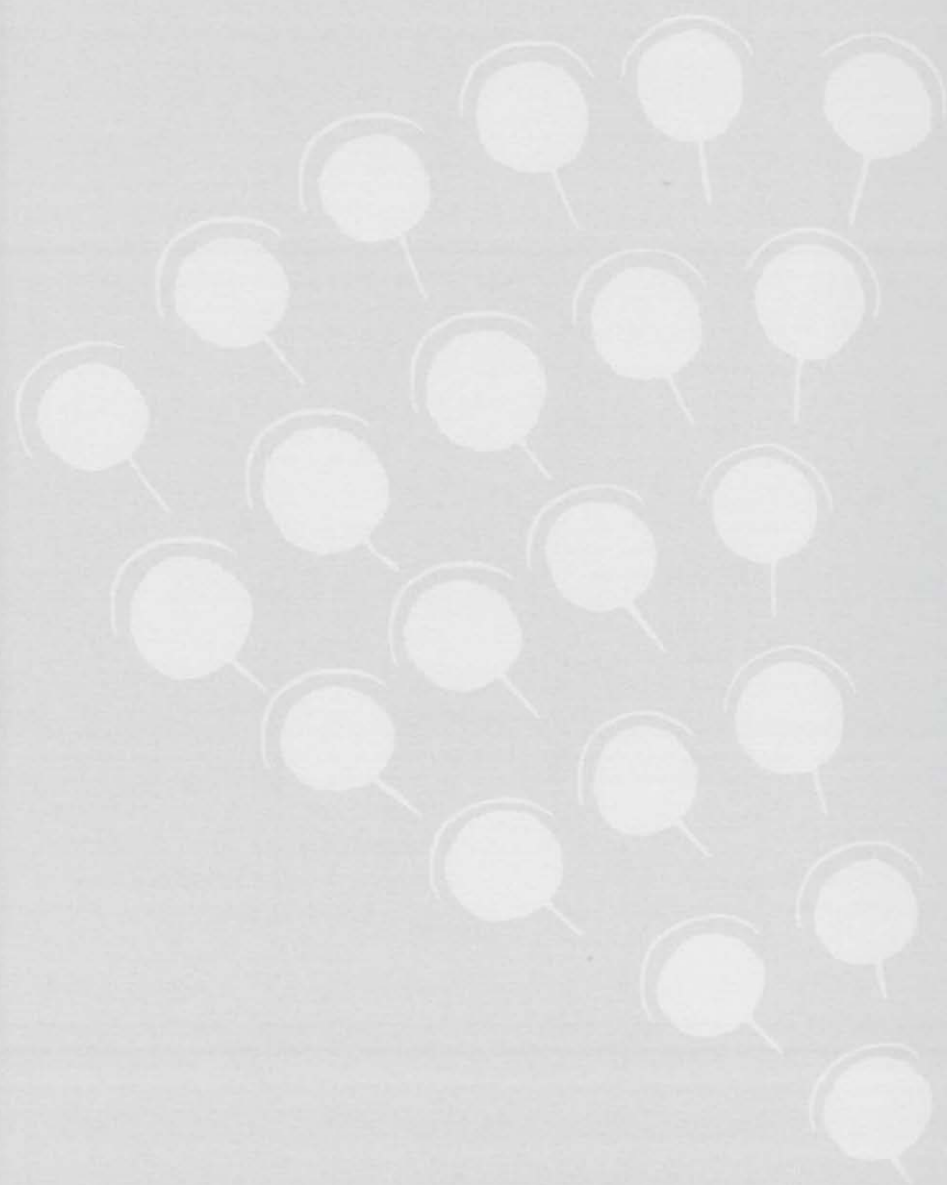
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physically active. In these recommendations it is argued that preventive as well as therapeutic recommendations should be integrated into postoperative rehabilitation programs. As part of the postoperative rehabilitation process both the orthopaedic surgeon and the physical therapist can play an important role. The orthopaedic surgeon can act as a powerful motivational figure in stimulating an active lifestyle.[32,33] As the physical therapist is in charge of the postoperative rehabilitation and most patients visit the therapist frequently, he can play a central role in stimulating an active lifestyle, possibly in cooperation with a dietician to support weight reduction in patients after THA.

et al. (2010) clearly described that a health professional measured weight and height. The other studies report that weight and height were recorded preoperatively, yet do not describe how these data were collected.

A further limitation of this study is the fact that no information was available about the intensity and types of exercise or physical activity or the nutritional changes of the participants. The fact that this study was conducted in the Netherlands can also be considered as a limitation. In contrast to other Western countries (e.g. the United States), in the Netherlands walking and bicycling are widespread methods of transportation, even for persons after a THA. This cultural aspect may limit the generalizability of the results.

Finally, it must be remarked that large standard deviations were evident in body weight in this study. This is illustrated by the fact that the obese subgroup followed over 4.5 years showed a higher baseline body weight (97.3 kg) compared to the entire obese group pre-operatively (93.2 kg). However, the long-term follow-up subgroup was not significantly different regarding preoperative BMI categories compared with the larger group of patients followed up at 1 year. Moreover, if we consider the 93.2 kg baseline weight of the entire obese group (instead of the 97.3 kg recorded by the smaller subgroup of obese people followed long term), we can still see a decline in body weight on the long term and certainly no increase. Overall it can be concluded that more research is needed to gain further insight into the long-term effect of THA on body weight.

Conclusion / Implications

From the results of this study it can be concluded that in the short as well as long term there is no clinically relevant reduction of weight after THA, except for patients who are obese in the long term. Consequently, it can be argued that both for the survival of the prostheses and for general health gains, people after a THA should be encouraged to lose weight. From that perspective it can be suggested that weight management should be included as a component of postoperative rehabilitation if the patient is overweight or obese. This suggestion is in line with the physical activity recommendations by the American College of Sports Medicine (2007) for older adults, which state that older adults suffering from chronic conditions should be encouraged to become

Chapter 8

General Discussion

Introduction

Due to an aging society and the epidemic of overweight/obesity, the incidence of people with hip osteoarthritis (OA) and consequently the number of those who need a total hip replacement (THA) is growing.[1,2] However, earlier research on conservative treatment for OA has focussed primarily on knee OA. In this thesis the focus of research was hip OA, both in the preoperative (conservative treatment) and in the postoperative phase. In both phases the role of physical activity and weight loss were analysed.

The general practitioner (GP) plays an important role in the preoperative phase. Chapters 2 and 3 analysed the time until referral to orthopaedics and the GP's management in this period. As the management of the GP can be mirrored to existing guidelines, an overview will be given of the available national and international recommendations.

Secondly the role of physical activity and exercise will be discussed in the context of 'Exercise is Medicine', a concept that originates from the United States. It conceptualizes a proactive attitude in which sports medicine is introduced into the curriculum of family practice. In Chapters 4 and 5 the role of physical activity/exercise in the conservative treatment of hip OA was analysed, and additionally Chapter 6 presented an analysis of the influence of overweight/obesity on physical functioning and health-related quality of life after THA. The results of these studies are discussed within the context of 'Exercise is Medicine'.

This chapter ends with clinical implications and ideas for future research. In the clinical implications section the results of the studies in this thesis and the thoughts from the discussion are translated into implications for the treatment of hip OA in clinical practice. Ideas are postulated for future research in order to improve both the conservative treatment of hip OA patients by means of physical activity/exercise and diet interventions, and the health and lifestyle of OA patients after THA.

The policy of general practitioners

In the Netherlands, patients with hip OA first go to their general practitioner. Once the symptoms worsen beyond the GP's treatment options, the patient is referred to the orthopaedic surgeon to discuss further treatment. The moment that a patient switches from primary to secondary care is on

average seven years after the diagnosis is set (Chapter 2). This is a considerable amount of time during which a GP manages the complaints and symptoms of the hip OA patient. Our research into GPs' medical care during this primary care period (Chapter 3) showed that the management consists mainly of pain medication or a wait-and-see policy. It is assumed that this policy consists of lifestyle advice. However, because no data on GP-patient communication was available and could therefore not be retrieved, this remains speculative.

Regardless of the fact that no specific OA guidelines for GPs are available in the Netherlands, the GP could base his treatment policy on other national and international recommendations. Recommendations on lower limb OA published by three prominent international bodies can be found in the literature: the EULAR,[3,3,4] ACR,[4] and OARSI[5] guidelines.

The EULAR guideline represents 14 European countries whose development group comprised 18 rheumatologists, 4 orthopaedic surgeons and one epidemiologist. EULAR stands for European League Against Rheumatism and describes the optimal management of hip OA by combining non-pharmacological and pharmacological treatments. According to EULAR, this non-pharmacological treatment should include education, exercise, equipment and weight reduction if necessary. EULAR also states that the treatment must be tailored according to risk factors, level of pain and disabilities, location and structure damage, and the wishes of the patient.

The American College of Rheumatology (ACR) guidelines join in the perspective of combining non-pharmacological interventions with pharmacological ones, but claims that non-pharmacological interventions should be perceived as a base upon which pharmacologic interventions should be built. These ACR guidelines were first presented in 1995 for knee and hip OA separately, with updates following in 1998, 2000 and 2002 which predominantly concerned more insights into pain medication treatment. However knee and hip OA were not discussed separately in these updates.

In 2008 Osteoarthritis Research International (OARSI) produced a recommendation for the management of knee and/or hip OA. Their guideline development committee was composed of 16 experts from four medical disciplines (2 GPs 2, 11 rheumatologists, one orthopaedic surgeon and two evidence-based medical professionals) representing six countries in Europe and North America (France, Netherlands, Sweden, UK, Canada

and USA). OARSI also stresses that the optimal management of OA requires a combination of non-pharmacological and pharmacological modalities, without specifying its recommendations for hip or knee OA. Non-pharmacological modalities in their opinion consist of information access and education for lifestyle changes, exercise, pacing of activities, weight reduction and other measures to unload the damaged joints. OARSI states that the initial focus should be on self-help rather than passively delivered therapies by health care professionals. OARSI also emphasises encouraging adherence to a regimen of non-pharmacological therapy. In 2010 an update of evidence on the benefits and harms of new and existing therapeutic options for the treatment of the hip and knee was published. This update revealed no change in effect size for self-management, education and acupuncture in pain relief, but an increased effect size concerning weight reduction and consequently pain relief for hip and knee OA patients.[6]

In the Netherlands two recommendations are available for the management of lower limb OA: the Dutch Institute for Healthcare Improvement CBO guideline[7] and the Royal Dutch Society for Physical Therapy (KNGF) guideline.[8] The CBO guideline development committee was composed of 2 rheumatologists, 6 orthopaedic surgeons, 2 physiotherapists, 2 radiologists, 2 CBO advisors, one orthopaedic scientist and a general practitioner. The CBO guideline, a document created by the Dutch Orthopaedic Society for patients with knee and/or hip OA, was published in 2007. The KNGF guideline was published in 2001 with the help of 8 physiotherapists, 3 epidemiologists, a movement scientist and a professor of paramedical care, and was developed for knee and/or hip OA. Both these guidelines advocate the prescription of exercise aimed at improving function and decreasing pain symptoms as well as losing weight in case of overweight or obesity. The CBO guidelines however expand this recommendation with the prescription of pain medication.

While Dutch GPs have no specific GP guideline (NHG standaard) for the treatment of OA of the hip, it can be assumed that they use shared knowledge of other disciplines, national and international. Both exercise and weight loss are mentioned in these guidelines. However these treatment mo-dalities were not encountered in our study as presented in Chapter 3. There is a possibility that these treatment modalities were advised to patients rather

than prescribed; although many observations were done by the GPs some of them were not listed in their recording system, like verbal advice, and could therefore not be measured in our study. Specific therapeutic modalities such as dietary guidance or physiotherapy would have been noted, and these were infrequently (like physiotherapy) or never (like dietary guidance) encountered in our observations. In conclusion, there is disagreement between the existing guidelines and the management of Dutch GP. This disagreement could be explained by the possibility that GPs do not consult foreign guidelines or do not consider national guidelines of other disciplines, which in their opinion are not applicable for their own discipline. Another explanation could be unfamiliarity with the notion of exercise as a medical treatment. These factors underline the importance of developing Dutch GP guidelines (NHG standaard) in which such exercise as a medical treatment should be described.

Exercise is Medicine

Physical activity, as shown in this thesis, can play an important role both in the conservative treatment of hip OA as well as after a THA in maintaining a healthy lifestyle and more particularly a healthy weight. The beneficial effects of physical activity have been described elaborately in past decades, with an increasing understanding of how physical activity can affect the physiological function of the body and of how it can cause a number of health benefits. As a consequence of this knowledge, the concept 'Exercise is Medicine' evolved in which the beneficial effects of integrating physical activity as a treatment modality in a diversity of diseases is described.[9-11]

Physical activity, health and physical fitness are related concepts, a connection that is well presented in the Toronto model of Bouchard.[12,13] *Physical activity* in this model is defined as bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above basal level.[14] A subcategory of physical activity is exercise, which is a 'physical activity that is planned, structured, repetitive, and purposive in the sense that improvements of physical fitness is the objective'. Considering *physical fitness* the general accepted definition is 'the ability to carry out daily tasks with vigour and alertness, without undue fatigue, and with ample energy to enjoy leisure-time pursuits and to meet unforeseen emergencies'. In the

literature the terms 'health-related fitness' and 'performance-related fitness' can be encountered, both of which should be seen as subcategories of physical fitness. The first, 'health-related fitness', refers to those fitness components that are affected favourably or unfavourably by physical activity and relate to health status. It includes cardiorespiratory fitness, muscular strength and endurance, body composition and flexibility. The second, 'performance-related fitness', comprises fitness components that are necessary for optimal work or sports activity.[15] *Health* is defined by Bouchard as a human condition with physical, social and psychological dimensions, each characterised on a continuum with positive and negative poles. Positive health is associated with a capacity to enjoy life and withstand challenges, and not merely the absence of disease.[13]

Based on the Toronto model it can be argued that both health and fitness benefits can be achieved by means of physical activity. The health benefits can be shown in primary (reducing the development of disease), secondary (early detection and treatment to minimise morbidity) and tertiary (reduction of disease-related complications and restoration of function) effects.[11] For example, regular physical activity can reduce the risk of developing Alzheimer's disease, reduce the incidence of heart disease and high blood pressure, lower the risk of stroke and of developing type-II diabetes, and possibly lower the risk of colon cancer by over 60% and reduce mortality and the risk of recurrent breast cancer by approximately 50%.[16] In addition, exercise is one of the best stress relievers,[17] and greatly reduces a patient's reliance on antidepressant medication.[18] The benefits of physical activity in primary, secondary and tertiary disease effects aside, the benefits of regular physical activity are also shown at the physical fitness level, in the increase of older adults' ability to perform their daily activities, thereby promoting independence and enhancing their quality of life.[19]

On the other hand, physical inactivity is associated with a negative effect on health and fitness. It is linked to premature death overall as a result of specific chronic diseases such as coronary heart disease, colon cancer and non-insulin dependent diabetes.[20,21] Physical inactivity was classified in 2000 as the second cause of death within the modifiable behavioural risk factors as causes of mortality (400,000 deaths; 16.6%) in the United States.[21] In 2008 the estimates of age-adjusted rates of leisure-time physical inactivity in the

United States ranged from 10.1% to 43.0%.[22] In the Netherlands 44% of the population aged 12 and older was insufficiently active in 2007.[23]

An additional effect of an increasingly physically inactive lifestyle in Western society is the higher numbers of people with overweight or obesity. While since the 1970s the amount of energy consumed through food has not changed considerably, energy expenditure in terms of exercise and physical activity has decreased, parallel to an increase in obesity. This low daily energy expenditure in Western culture can be explained by the characteristics of modern living,[24] less occupational energy expenditure,[25] and the increasing popularity of leisure-time computer usage.[26,27] In OA, a high BMI is considered a risk factor in the development of the disease.[28]

Exercise is Medicine in the conservative treatment of hip OA

Physical activity can play an important role both in the conservative treatment of hip OA and after a THA in maintaining a healthy lifestyle and more particularly a healthy weight. Exercise is safe and well tolerated by most patients with lower limb OA, and is proven to be effective in the conservative treatment of knee and hip OA for decreasing pain and increasing physical function.[29] In a review of Bennell and Hinman in 2011 it was concluded that exercise is a key component in the management of symptoms of knee and hip OA, and that encouraging exercise adherence behaviours and reinforcing healthy lifestyle habits will assist in optimising outcomes from treatment.[30] A study of Swank et al.[31] also stressed the benefits of exercise for knee OA patients who are awaiting surgery, in order to improve their recovery in terms of postoperative performance of functional tasks.[32-34]

Weight loss can also play an important role in the conservative treatment of OA of the hip. From a general health perspective it is known that weight loss imbedded in a lifestyle change markedly improves cardiovascular risk and the metabolic profile, and this improvement can be sustainable in hypertensive, coronary heart disease and diabetic patients. Weight loss interventions in overweight/obese older subjects led to significant benefits for those with coronary heart disease, and those with type-2 diabetes mellitus.[20,35-37] Modest weight loss (5–10% of initial weight) has positive effects on BP, cholesterol and glucose levels.[38-40] Substantial weight loss

(15–20% of initial weight) can reverse type-2 diabetes risk within one year of diagnosis.[40,41] Even for persons with serious mental illness there are indications that they can benefit from short-term behavioural weight loss interventions.[42,43] Weight loss is proven to be effective in knee OA patients before joint replacement by improving physical function;[44 46] a weight reduction of 10% leading to an improvement of function of 28% has been reported.

The combination of physical activity/exercise and diet in order to lose weight is often advised to maximise the effect. The literature shows how this combination is effectively applied in healthy obese men, leading to improved breathing mechanics during submaximal exercise,[47] and in infertile and overweight women who increased their ovulation rates and chances of pregnancy.[48] In the orthopaedic setting obese patients with knee OA showed, after a combined therapy of exercise and weight loss, better overall improvements in physical function, pain and mobility compared to either therapy separately.[49] Additionally, in Chapter 5 of this thesis an indication is given of the positive effect of this combined therapy in hip OA patients: the effect on self-reported physical function showed an improvement of 32%, measured with the WOMAC questionnaire; and objective physical function, measured with the 6-minute walking test, showed an improvement of 11.1% compared to baseline after 8 months of exercise by strengthening the muscle power of the damaged joint and training stability, and losing weight by means of aerobic exercise and diet. These outcomes together with the aforementioned benefits of exercise or physical activity on other diseases and on overall well-being by increasing health and fitness should elicit health care specialist like orthopaedic surgeons, GPs and physiotherapists to include these treatment modalities more often, and to increase chances on an optimal result, to combine both exercise and weight loss.

Exercise is Medicine after a THA
After arthroplastic surgery it is agreed on that immediate but gradual weight bearing on the operated joint is necessary for improvement of bone quality and prosthetic fixation[50] and also to motivate patients to remain physically active after joint replacement. Additional benefits of physical activity are recognised for achieving general health, and in particular creating or

maintaining a healthy body weight. Such a healthy body weight after arthroplastic surgery is essential for implant stability.[51,52] Furthermore, Roder et al.[53] showed that each extra unit of BMI increases stem loosening odds. In this case, losing weight after hip surgery would imply better survival odds of the implant. Obese patients tend to claim that the OA in their joints limits their ability to perform physical activities and consequently to lose weight, but that they will become physically active again once they have a prosthesis, which restores function and reduces the pain. This was also assumed in our study as described in Chapter 7. Although there was weight loss, it was limited and not clinically relevant. Especially in overweight/obese patients with preoperative comorbidities, the amount of weight loss after surgery was minimal. It can be concluded that these results are in line with earlier research on this issue, which shows an increase or no change at all.[54-58] However, as shown in Chapter 6 of this thesis it is of great importance to account for complications and comorbidities, as the impact of these factors on physical functioning is considerable.

As a higher BMI has shown to be associated with lower physical activity in patients after total hip arthroplasty,[59] physical activity programs are needed for overweight and obese patients following total joint arthroplasty. Such programs should aim at increasing energy expenditure and lowering body weight, but preferably be applicable to each specific patient, with or without complications or comorbidities.

Exercise is Medicine initiatives
The concept of 'Exercise is Medicine' originates from the United States, where a proactive attitude is conceptualised by introducing sports medicine into the curriculum of family practice residencies and by launching an 'Exercise is Medicine' program (and a website) for senior health care providers.[60] In the Netherlands there is also a growing awareness of the concept of 'Exercise is Medicine', which can be exemplified by the PACE project. PACE stands for Physician-based Assessment and Counselling for Exercise.[61,62] Originally developed in the United States, it was designed to be incorporated into general practices within diverse patient populations. PACE aims at promoting the adoption of long-term participation in regular physical activity and assists providers in overcoming barriers to counselling patients

about physical activity. Research into the practical application of this program in adults with hypertension and/or hypercholesterolaemia and/or non-insulin-dependent diabetes in the Netherlands[62] has shown that the program was acceptable and feasible for a selected number of general practices. Based on these outcomes adaptations will be made in order to implement it success-fully on a wider scale.

Beweegkuur (Dutch for 'Exercise Therapy') is a more recent development.[63] This lifestyle intervention was initially developed for diabetic and prediabetic patients, but later on expanded into an intervention for all those patients who have a high BMI with an additional weight-related health risk. The intervention aims at both physical activity and dietary behaviour changes, and includes multiple health disciplines to achieve this. It is structured as an organised interaction between GP, practice nurse, physiotherapist and dietician; however, the role of the physiotherapist in this intervention can also be taken over by a lifestyle advisor or an exercise coach. Results after one year showed that patients were motivated by Beweegkuur to increase their physical activity or to maintain their activity level. The most mentioned reason to join Beweegkuur was to lose body weight; additionally the secure exercise environment was mentioned because of the professional guidance to exercise safely. Results concerning the national implementation of the program showed some practical points on the specific role of each health professional and time management in general practice. Regardless of these practical points, in this first year of Beweegkuur seven regions of the Netherlands were involved; the aim of Beweegkuur Is to implement this com-bined intervention throughout the country by 2012.

Within orthopaedics a lifestyle intervention was developed at the Department of Orthopaedics of UMCG, called Orthopaedic Physical Activity Counselling (OPAC). In this intervention patients were counselled multiple times postoperatively about their physically active lifestyle and their body weight. A pilot study was conducted to get an impression of the feasibility of incorporating this counselling into regular postoperative medical consultations. This study showed a positive attitude toward OPAC by both medical staff and patients; the clinical feasibility of the intervention was questioned because of time constraints though.

These three Dutch initiatives show the growing awareness of exercise as medicine. The results of this thesis emphasise that this awareness should also be applied to hip OA and THA patients.

Clinical implications

From the results of this thesis it can be concluded that Dutch GPs should be supported in their treatment policy of hip OA by a national hip OA guideline for GPs (NHG standaard) that should include exercise and weight loss. Is therefore it is important that this development is given priority. Once this guideline is at GPs' disposal it is also critical to stimulate its use, particularly the prescription of weight loss for overweight or obese patients and the prescription of exercise as medicine.

Based on the 'Exercise is Medicine' concept integration should be promoted of rehabilitation and preventive recommendations for health-enhancing physical activity after a THA, in which rehabilitation advice should turn gradually into a tailored lifestyle advice. This suggestion is in line with the latest recommendations for health-enhancing physical activity for older adults,[64] which recommend that older adults should perform moderate-intensity aerobic (endurance) physical activity for 30 minutes or more at least 5 days per week, or vigorous-intensity aerobic physical activity for a minimum of 20 minutes at least 3 days per week, in addition to muscle-strengthening activity, This integration of recommendations is important because after a THA it is not only essential for patients to restore their physical function but also to adopt a physically active lifestyle, from a health perspective as well as from a physical fitness perspective. Older adults are not only faced with the occurrence of chronic conditions but also with a decline of a number of functions associated with aging that can threaten their independent performance of activities of daily living and consequently their quality of life.

Future research

To build on the results of the cohort study of our thesis, additional research about the clinical effects of exercise combined with weight loss interventions in hip OA patients should be conducted in a randomised controlled trial (RCT). In addition, more research is needed on both the optimal content of the exercise and weight-loss program and on the

combination of programs.

Research is also needed into the development of rehabilitation programs for THA patients. In addition to already existing programs, new programs should include weight loss and take into account pre-existing comorbidities, while until now rehabilitation programs for hip arthroplasty only focus on accelerating the restoration of physical function by passive or active mobilisation.

More insight is also needed into the long-term effects of a THA on weight loss. While the first indications shown in this thesis are promising, the long-term effects of a THA on weight are still not clear and should be studied more thoroughly.

Finally, the implementation of rehabilitation programs and the 'Exercise is Medicine' concept should be investigated more deeply. Although the clinical feasibility of OPAC was questioned, it was evaluated positively within the orthopaedic setting. Continuous monitoring of hip OA patient by a health care professional seems advisable and should be the object of further study. Although performed in another setting, the study of Barte et al.,[66] in which the study participants in the intervention group had lifestyle counselling by nurse practitioners, showed that this concept can be successful.

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Appendices

Appendix 1

WOMAC

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).

Pijn en Lichamelijk Functioneren

PIJN
De volgende vragen gaan over de hoeveelheid pijn die u **op dit moment** ondervindt als gevolg van de artrose in uw heup. Voor ieder van de onderstaande vragen moet u aangeven hoeveel pijn u recent heeft ondervonden.

KRUIS ÉÉN RONDJE PER VRAAG AAN

Hoeveel pijn heeft u bij:	geen	gering	matig	ernstig	zeer ernstig
Lopen op een vlakke ondergrond	O	O	O	O	O
Trap op of af lopen	O	O	O	O	O
Gedurende de nacht in bed	O	O	O	O	O
Bij zitten of liggen	O	O	O	O	O
Het recht op staan	O	O	O	O	O

GEWRICHTSSTIJFHEID
De volgende vragen hebben betrekking op de hoeveelheid gewrichtsstijfheid die **u op dit moment** ondervindt. Stijfheid is een gevoel van beperking of vertraging in het gemak waarmee u uw gewrichten beweegt.

KRUIS ÉÉN RONDJE PER VRAAG AAN

	geen	gering	matig	ernstig	zeer ernstig
Hoe stijf bent u 's ochtends bij het opstaan?	O	O	O	O	O
Hoe stijf bent u later op de dag nadat u heeft gelegen, gezeten of gerust?	O	O	O	O	O

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FYSIEKE GESTELDHEID
De volgende vragen hebben betrekking op uw lichamelijk functioneren. Hiermee wordt het gemak bedoeld waarmee u zich voortbeweegt en de mate waarin u voor zichzelf kunt zorgen. Voor elk van de volgende vragen verzoeken wij u aan te geven in welke mate u wordt beperkt als gevolg van de artrose in uw heup.

KRUIS ÉÉN RONDJE PER VRAAG AAN

Hoeveel moeite heeft u bij:	geen	gering	matig	veel	erg veel
De trap aflopen	O	O	O	O	O
De trap oplopen	O	O	O	O	O
Opstaan vanuit een stoel	O	O	O	O	O
Staan	O	O	O	O	O
Voorover buigen naar de vloer	O	O	O	O	O
Lopen op een vlakke ondergrond	O	O	O	O	O
In en uit de auto stappen	O	O	O	O	O
Het gaan winkelen	O	O	O	O	O
Sokken of panty's aantrekken	O	O	O	O	O
Het uit bed opstaan	O	O	O	O	O
Sokken of panty's uittrekken	O	O	O	O	O
In bed liggen	O	O	O	O	O
In of uit bad stappen	O	O	O	O	O
Zitten	O	O	O	O	O
Op een toilet gaan zitten en weer opstaan	O	O	O	O	O
Zwaar huishoudelijk werk	O	O	O	O	O
Licht huishoudelijk werk	O	O	O	O	O

Appendix 2

Summary

Summary

Osteoarthritis (OA) is a chronic musculoskeletal disease that predominantly affects weight-bearing joints such as knees and hips. As for hip OA, it is recognised as a substantial source of disability, with pain and loss of function as principal symptoms. In addition to an aging society, the increasing number of overweight and obese persons will also give rise to a higher prevalence of hip OA. This thesis focuses on the role of physical activity and losing weight in hip OA, in the preoperative phase (conservative treatment) as well as in the postoperative phase (after hip replacement).

Chapter 1 is the general introduction of this thesis, describing four objectives. The first objective of this thesis is to study the treatment policy of the general practitioner, and more specifically to what extent weight loss and/or exercise play a role in the conservative treatment of OA of the hip. The second objective is to study the effect of a combination treatment of weight loss and exercise in hip OA patients. The third objective is to analyse the effect of overweight/obesity on patient-perceived physical functioning and health-related quality of life one year after THA, taking into account the influence of co morbidity and preoperative complications. The final objective of this thesis is to determine to what extent a THA leads to weight loss in hip OA patients categorised into normal weight, overweight and obese, as well as to determine the long-term effect of a THA on body weight.

Chapter 2 presents the time a hip OA patient spends at the GP's practice before the patient is referred to an orthopaedic specialist. Patients aged 18 or older with the diagnosis of hip OA were included, and analysed in a prospective observational study based on data over a 10-year period from a general practice-based registration network (17 GPs, >30,000 patients registered yearly). Of 391 patients diagnosed with hip OA, 121 (31%) were referred. The average survival time until referral was 82.0 months.

Chapter 3 focuses on the description of the frequency and nature of GP medical care, and the establishment whether this care meets national and international guidelines for treatment of hip OA. The same registration network as mentioned in Chapter 2 is used. Patients aged 18 years and older who were diagnosed with hip OA in the period between January 1999 and December 2007 were selected. GP contact data was gathered 1 year before

and 1 year after diagnosis (total follow-up (TFU)). During the TFU the GP intervened in almost half of the patients. About a third had no contact with the GP at all. Of the 192 patients who received an intervention, 26% had a referral to orthopaedics. The combination of pain medication and physical therapy or the combination of physical therapy and a diet, as proposed by the guidelines, was applied in 9.9% of the cases.

In order to get a first impression of the potential effectiveness of a combination program of exercise and weight loss on overweight and obese patients suffering from hip OA, the design of a cohort study is presented in *Chapter 4*. Patients aged 25 or older, overweight (BMI > 25 kg/m^2) or obese (BMI > 30 kg/m^2), with clinical and radiographic evidence of OA of the hip, and able to attend exercise sessions, were included. Primary outcome was self-reported physical functioning. Patients were also evaluated using objective measurements, which included the 6-Minute Walk Test (6MWT). Additionally, weight loss in kilograms and percentage of fat-free mass were measured. Treatment effects were compared at all measurement points (baseline, after 3 months and after 8 months when the intervention program was finished).

Chapter 5 presents the outcomes of the cohort study. Thirty patients with hip OA aged 25 years or older were analysed. Participation in the combination program resulted in a clinically relevant improvement of self-reported physical function. In addition, significant improvement was seen in walking ability as an objective measure of physical function. There was a significant decrease in body mass of 2.8 kg (3 months) and 5.6 kg (8 months) compared to baseline. Body fat was 41.0% at baseline and showed a significant reduction of 3.3% in 8 months. The results of this study show that exercise and weight loss as a combination treatment seem to be effective in hip OA patients.

In *Chapter 6* a retrospective analysis of prospectively collected data from 653 patients who had undergone a primary THA was conducted, to determine to what extent overweight/obesity is associated with physical functioning and health-related quality of life after a THA. Physical functioning, health-related quality of life, body mass index (BMI), co morbidity and postoperative complications were assessed by means of a questionnaire and from medical records. The results show that the influence of overweight/obesity on physical functioning and health-related quality of life is low. The impact of

complications and co morbidity however is considerable. Especially the combination of factors can rapidly lead to clinically relevant differences. Therefore it does not seem justified to refuse a patient a THA solely on the basis of overweight or obesity.

Chapter 7 presents the analyses of the short- (1-year) and long-term (4.5-year) effects of a THA on body weight. For the short-term effect all patients (N=618) were analysed, for the long term a random subgroup (N=100). Pre- and postoperative body weight and height were self-reported. The mean age of the study group was 70 years (SD 8), 74% were women, mean preoperative body mass 79 kg (SD 14). Overweight and obese patients showed a significant decrease in body weight after 1 year, which was however not clinically relevant. After 4.5 years a clinically relevant decrease was observed in obese patients. From the results of this study it can be concluded that in the short as well as long term there is no clinically relevant reduction of weight after THA, except for obese patients on the long term.

Finally, *Chapter 8* contains the general discussion in which the preceded studies were evaluated. It stipulates that the general practitioner (GP) still plays an important role in the preoperative phase of hip OA patients, and that Dutch GPs should be supported in their treatment policy of hip OA by the development and implementation of a national hip OA guideline for GPs (NHG standaard) that should include exercise and weight loss. It is therefore important that this development is given high priority. Additionally the general discussion focuses on the 'Exercise is Medicine' concept in which the integration of rehabilitation and preventive recommendations for health-enhancing physical activity after a THA should be promoted, and rehabilitation advice should turn gradually into a tailored lifestyle advice.

Appendix 3

Samenvatting

Samenvatting

Artrose is een chronische aan veroudering gerelateerde musculoskeletale aandoening die zich voornamelijk manifesteert in de gewicht dragende gewrichten zoals van de knie en de heup. Met betrekking tot artrose van de heup wordt deze aandoening gezien als sterk invaliderend, met pijn en functieverlies als primaire symptomen. Naast de vergrijzing is ook het toenemende aantal mensen met overgewicht en obesitas verantwoordelijk voor de stijgende prevalentie van artrose van de heup. Dit proefschrift richt zich op de rol van lichamelijke activiteit en gewichtsverlies bij artrose van de heup in de preoperatieve fase (conservatief behandelen) evenals in de postoperatieve fase (na heupvervanging).

Hoofdstuk 1 is de algemene introductie van dit proefschrift, waarin 4 doelen worden beschreven. Het eerste doel van dit proefschrift is het bestuderen van het behandelbeleid van de huisarts, en meer specifiek in welke mate gewichtverlies en/of bewegen een rol speelt in de conservatieve behandeling van artrose van de heup. Het tweede doel is het bestuderen van het effect van een gecombineerde behandeling van afvallen en bewegen in patiënten met heup artrose. Het derde doel is het effect te analyseren van overgewicht of obesitas op zelf gerapporteerd lichamelijk functioneren en gezondheidsgerelateerde kwaliteit van leven één jaar na heupvervanging, waarbij rekening wordt gehouden met de invloed van co morbiditeit en perioperatieve complicaties. Tenslotte wordt in dit proefschrift bepaald in welke mate een heupvervanging leidt tot gewichtsverlies bij heup artrose patiënten, zowel op de korte (1 jaar) als op de lange termijn (4,5 jaar).

In *Hoofdstuk 2* is gekeken hoeveel tijd een patiënt met heup artrose onder behandeling is bij een huisarts totdat deze wordt doorgestuurd naar een orthopedisch specialist. Patiënten van 18 jaar en ouder met de diagnose heup artrose werden geïncludeerd en geanalyseerd in een prospectief observationeel onderzoek. Data waren afkomstig van een medisch registratie netwerk van huisartsen over een periode van tien jaar (17 huisartsen, > 30.000 patiënten werden jaarlijks geregistreerd). Van de 391 patiënten gediagnosticeerd met heup artrose werden 121 (31%) doorgestuurd. De gemiddelde tijd tot aan de verwijzing was 82.0 maanden.

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In *Hoofdstuk 3* ligt de focus het beschrijven van de frequentie en inhoud van de medische zorg die de huisarts verleent aan zijn of haar patiënten met heup artrose, en wordt gekeken of deze zorg overeenkomt met de nationale en internationale richtlijnen voor de behandeling van heup artrose. Hetzelfde medische registratie netwerk als genoemd in hoofdstuk 2 werd gebruikt. Patiënten van 18 jaar en ouder bij wie heupartrose werd gediagnosticeerd in de periode tussen januari 1999 en december 2007 werden geselecteerd. Gegevens over het aantal contacten met de huisarts werden verzameld één jaar voor en één jaar na diagnose (totale follow up tijd (TFU)). Tijdens de TFU stelde de huisarts een behandeling voor bij bijna de helft van de patiënten. Ongeveer één derde van de patiënten had geen contact gehad met de huisarts. Van de 192 patiënten die een behandeling kregen, had 26% een verwijzing een orthopedisch chirurg. De combinatiebehandeling pijnmedicatie en fysiotherapie, of de combinatiebehandeling fysiotherapie en diëtiek, zoals aanbevolen in de richtlijnen, werd toegepast bij 9,9% van de patiënten.

Om een eerste indruk te krijgen van het potentiële effect van een combinatie programma bestaande uit afvallen en bewegen bij heupartrose patiënten met overgewicht of obesitas, werd een cohort studie opgezet waarvan het design wordt gepresenteerd in *Hoofdstuk 4.* Patiënten van 25 jaar en ouder, met overgewicht (BMI > 25 kg/m^2) of obesitas (BMI > 30 25 kg/m^2) en klinisch en radiologisch bewezen heup artrose, die in staat waren een beweegprogramma te volgen werden geïncludeerd. De primaire uitkomstmaat was zelf gerapporteerd lichamelijk functioneren. Daarnaast werden patiënten ook beoordeeld met behulp van objectieve metingen, waaronder de 6-minuten looptest (6MWT). Tenslotte werd het gewichtsverlies in kilogrammen en in percentage vetvrije massa gemeten. De behandelingseffecten werden vergeleken op alle meetpunten (baseline, na 3 maanden en aan het einde van het combinatie programma (8 maanden)).

In *Hoofdstuk 5* worden de resultaten van de cohort studie gepresenteerd. Dertig patiënten van 25 jaar en ouder met heup artrose werden geanalyseerd. Het deelnemen aan het combinatieprogramma resulteerde in een verbetering van het zelf gerapporteerd lichamelijk functioneren. Daarnaast werd een significante verbetering gezien in het loopvermogen als een objectieve maat van lichamelijk functioneren. Er was een significante afname in lichaamsgewicht van 2,8 kg (na 3 maanden) en 5,6 kg (na 8 maanden) ten

opzichte van baseline. Bij de baseline meting was het lichaamsvet 41% en was er na 8 maanden een afname van 3,3%. De resultaten van deze studie laten zien dat afvallen en bewegen als een combinatiebehandeling effectief lijkt te zijn bij heupartrose patiënten.

Hoofdstuk 6 laat een retrospectieve analyse zien van prospectief verzamelde data van 653 patiënten bij wie een primaire heupvervanging heeft plaatsgevonden. Bepaald werd in welke mate overgewicht of obesitas was geassocieerd met fysiek functioneren en gezondheidsgerelateerde kwaliteit van leven na een heupvervanging. Fysiek functioneren, gezondheidsgerelateerde kwaliteit van leven, body mass index (BMI), co morbiditeit en postoperatieve complicaties werden bepaald met behulp van een vragenlijst en medische statussen. De uitkomsten laten zien dat de invloed van overgewicht of obesitas op het lichamelijk functioneren en de gezondheidsgerelateerde kwaliteit van leven laag is. De impact van complicaties en co morbiditeit daarentegen is aanzienlijk. Met name bij een combinatie van factoren kan dit snel leiden tot klinisch relevante verschillen. Daarom lijkt het niet terecht een patiënt een heupvervanging te weigeren enkel op basis van overgewicht of obesitas.

In *Hoofdstuk 7* worden de uitkomsten gepresenteerd van de korte termijn (1 jaar) effecten en de lange termijn (4,5 jaar) effecten van heupvervanging op lichaamsgewicht. Voor het korte termijn effect werden 618 patiënten geanalyseerd, voor het lange termijn effect een at random subgroep (N=100). Lengte en lichaamsgewicht werden pre- en postoperatief aan de patiënt gevraagd. De gemiddelde leeftijd van de korte termijn groep was 70 jaar (SD 8), 74% was vrouw en het gemiddelde gewicht was preoperatief 79 kg (SD 14). Patiënten met overgewicht of obesitas lieten na 1 jaar een significante afname in gewicht zien, echter dit was geen klinisch relevante afname. Na 4,5 jaar was er wel een klinisch relevante afname te zien in de groep patiënten met obesitas. Uit de resultaten van deze studie kan worden geconcludeerd dat er zowel op de korte als op de lange termijn na heupvervanging geen klinisch relevante afname van gewicht is, behalve op de lange termijn voor de groep patiënten die preoperatief obees zijn.

Tot slot worden in *Hoofdstuk 8* de resultaten van de voorafgaande hoofdstukken bediscussieerd. Hierin ligt de focus op de rol van de huisarts in de behandeling van patiënten met heup artrose in de preoperatieve fase. Er wordt

geconcludeerd dat de Nederlandse huisartsen beter ondersteund zouden moeten worden in hun heupartrose beleid door de ontwikkeling en implementatie van nationale heupartrose richtlijnen voor huisartsen (NHG standaard). Bewegen en afvallen zouden een belangrijke plaats moeten innemen in deze richtlijnen. Het is daarom van belang dat aan deze ontwikkeling prioriteit wordt gegeven. Tenslotte wordt ingegaan op het "Exercise is Medicine" concept, waarbij de integratie van revalidatie en preventieve aanbevelingen voor gezondheidsbevorderende lichamelijke activiteit na een heupvervanging zou moeten worden gepromoot, en revalidatie adviezen langzaam zouden moeten overgaan in een op maat gesneden leefstijladvies.

Appendix 4

Dankwoord

Ik zou graag op deze plek iedereen persoonlijk willen bedanken voor zijn of haar rol in het gereed komen van mijn proefschrift, maar het is onmogelijk om iedereen bij naam te noemen. Daarom wil ik graag, voordat ik enkele mensen persoonlijk ga bedanken, iedereen die interesse toonde en mij, wanneer dat nodig bleek, 'een hart onder de riem stak' ontzettend bedanken! Zonder jullie was het nooit gelukt!

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Appendix 5

Curriculum Vitae

Nienke Paans was born on April 25th, 1974 in IJsselstein, Utrecht, The Netherlands. After graduating from high school (Atheneum, Dingstede Meppel), she began studying Psychology at the Radboud University Nijmegen (RU). After receiving her propaedeutic degree (1996), she enrolled to study Medicine at the same university. Once completing her research assignment within the framework of developing research skills as medical doctor she decided to continue in the field and complete her medical study career as a Biomedical Researcher, specialised in Movement Science, in which she received her Master of Science degree in June 19th 2003. In 2005 she assisted in medical science projects of the department of Sports Medicine at the University Medical Center Groningen and subsequently started as a research assistant at the department of Orthopaedic surgery in 2006. In 2008 she began her PhD studies at the same department under the supervision of Prof. Dr. S. K. Bulstra, Prof. Dr. K. van der Meer, Dr. M. Stevens and Dr. I van den Akker.

Appendix 6

SHARE research and previous dissertations

Research Institute for Health Research SHARE

This thesis is published within the Research Institute SHARE of the Graduate School of Medical Sciences (embedded in the University Medical Center Groningen / University of Groningen). More recent theses can be found in the list below.

Further information regarding the institute and its research can be obtained from our internet site: www.rug.nl/share.

((co-)supervisors are between brackets)

2012

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