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## Obesity increases the likelihood of total joint replacement surgery among younger adults

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**Abstract** We conducted a retrospective review of medical charts of patients, aged 18 to 59 years old, who underwent either a total knee replacement (TKR) or total hip replacement (THR) from January 2002 to December 2004. Of the 204 study subjects, 52% had a TKR while 48% had a THR. Obesity was significantly associated with the need for a TKR or THR when comparing the study group to adults of similar age in the general population ( $P < 0.0001$ ). Seventy-two percent (146) of the study group was obese and 21% (42) overweight (BMI 25.0 to 29.9 kg/m<sup>2</sup>) compared to only 26% (596) obese and 34% (732) overweight in the general population. Patients undergoing a TKR were significantly more likely to be obese (BMI > 30 kg/m<sup>2</sup>) than those having a THR, 83% (89) compared to 59% (57) ( $P < .0006$ ). Our findings support those previously observed in the elderly population. Primary and secondary prevention programs aimed at reducing obesity are strongly recommended.

**Résumé** Nous avons réalisé une étude rétrospective chez les patients âgés de 18 à 59 ans et ayant nécessité la mise en place d'une prothèse totale de hanche ou du genou de janvier 2002 à décembre 2004. 204 patients ont été étudiés : 52% pour une prothèse du genou, 48% pour une prothèse

de hanche. L'obésité est un facteur significativement associé à la nécessité de la mise en place d'une prothèse totale du genou ou d'une prothèse de hanche. Si l'on compare ce groupe, à un groupe similaire de personnes du même âge dans la population générale ( $p < 0.001$ ). 70% soit 146 patients du groupe étudié étaient obèses et 21%, soit 42 patients, en surpoids (BMI 25.0–29.9 Kg/m<sup>2</sup>) comparé à 26%, soit 596 patients obèses et 34% soit 732 patients en surpoids de la population générale. Les patients nécessitant un remplacement du genou étaient en surcharge pondérale plus importante que les patients nécessitant une prothèse de hanche (BMI > 30 kg/m<sup>2</sup>) 83% soit 89 patients contre 59% soit 57 patients. Il nous apparaît donc important à la lumière de ces constatations de préconiser une prévention de réduction de l'obésité dans la population.

### Introduction

Obesity has doubled and reached epidemic proportions in the United States over the last 30 years [2]. Recent prevalence data show that 30%, or over 60 million adults, 20 years of age and over are classified as obese [3]. Another 35% of adults are overweight [2]. Obesity has many associated health risks including type 2 diabetes mellitus, hypertension, coronary artery disease, cancer, and destructive arthritis [7]. Men and women from all ethnic, socioeconomic, and age groups are affected.

Osteoarthritis (OA) is the most common joint disease and is one of the most prevalent symptomatic health problems for older individuals. It is well known that age tends to be an overriding risk factor for the development of OA [1]. In a younger age group, one would tend to think of secondary causes, including joint injury, aseptic necrosis, and joint dysplasias [1], contributing to the development of OA.

OA can affect any synovial joint but most commonly occurs in the hand, foot, knee, spine, and hip joints [6]. Several risk factors have been identified for OA including age, obesity, gender, prior joint trauma, and work or sports activity [1, 7, 11–13]. Of the aforementioned, age is the overriding risk factor for OA [1]. Studies have shown that

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OA of the hip or knee affects approx. 5% of the population, with prevalence increasing with age as 9.5% of individuals older than 62 years being affected [1, 13]. Recent literature suggests that as individuals age, the chondrocyte function decreases, affecting the ability to synthesize appropriate aggrecans, leading to irregular proteoglycan aggregates that are less responsive to cytokines and mechanical forces [1].

Obesity has drawn interest in recent studies because of its modifiable status and its association with OA [1, 5, 8, 10–13]. Two dominant theories have been proposed to explain the association between obesity and the onset of OA. The biomechanical theory proposes that obesity leads to repetitive application of increased axial loading forces across the joint surface leading to degeneration of the articular cartilage and sclerosis of the subchondral bone. A second hypothesis is that excess fat may have a direct metabolic effect on cartilage by enhancing irregular growth and inhibiting repair of the articular cartilage [12].

A number of studies have focused on the relationship between obesity, OA, and total joint replacement among the elderly [5, 10, 11]. Marks and Allegante [11] found a correlation between increasing BMI and the need for a THR in males and females age 23 to 94 years [11]. Additionally, Manek et al. [10] found a strong association between high BMI and the presence of knee OA in a study of female twins with a mean age of 54.5 years. Coggon et al. [5] found an increased relative risk of knee OA with increased weight. The relative risk reported for developing OA ranged from 0.1 (95% CI, 0.0 to 0.5) for normal individuals (BMI < 20 kg/m<sup>2</sup>) to 13.6 (95% CI, 5.1 to 36.2) for morbidly obese individuals (BMI > 36 kg/m<sup>2</sup>) [5]. However, few studies have examined the relationship between obesity and total joint replacement among individuals less than 60 years old.

The aim of this study was to investigate whether being overweight or obese is associated with the need for TKR or THR in non-elderly adults, i.e., those less than 60 years old. Also, we studied the relationship between being overweight or obese and the type of procedure performed, TKR or THR.

## Materials and methods

Since studies have shown an increased prevalence of OA and TKR/THR with age, we chose to focus our study on the non-elderly to reduce the impact of age as a causative factor in this study of total joint replacement. A total of 305 patients, aged 18 to 59 years, received a TKR (Current Procedural Terminology Code 27130) or THR (Current Procedural Terminology Code 27447) from 1 January 2002 to 31 December 2004 at MeritCare Medical Center in Fargo, ND or in the outreach facilities of Bemidji and Detroit Lakes, MN. Of these, 204 were included in our study with the remaining 101 patients being excluded because height or weight was missing. A patient's weight was considered valid if measured within 40 days prior to surgery and height was valid if within three years of the surgery date. Age, gender, and procedure performed were also documented.

Individual Body Mass Index (BMI) was calculated by dividing the weight in kilograms by the height in meters squared (kg/m<sup>2</sup>). Individual BMI was categorized according to the Centers for Disease Control and Prevention (CDC) guidelines [4]. Patients were classified as underweight if their BMI was < 18.5, normal weight if it was 18.5 to 24.9, overweight if it was 25.0 to 29.9, and obese if it was > 30.

North Dakota Behavioral Risk Factor Surveillance System (BRFSS) data from 2002 to 2004 was used to generate an age-matched (18 to 59 years old) "general population" sample. BRFSS is an ongoing, state-based, random-digit-dialed telephone survey of the non-institutionalized U.S. population aged 18 years or older. From this sample the annual number and percentage of individuals in each BMI category was used to calculate a three-average with each category, which was used to compare to the study population.

Analyses were performed using SAS software V9.1 (SAS Institute, Cary, NC). A specific SAS procedure (PROC surveymeans) was used for the BRFSS data to compute weighted frequencies by taking into account the complex survey design. The data were compared and analyzed using a chi-square test. A *p*-value of less than 0.05 was considered to be significant.

## Results

The study group consisted of 204 subjects, with 41% (83) male and 59% (121) female. Of these, 52% (107) underwent TKR compared to 48% (97) THR. Males accounted for 29% (31) and females accounted for 71% (76) of the 107 TKR. Of the 97 THR, 54% (52) were male and 46% (45) were female (Table 1).

**Table 1** Age, gender, and BMI comparisons of total knee replacement and total hip replacement patients

	Total knee replacement 52% (n = 107)	Total hip replacement 48% (n = 97)
Age:		
Median (range)	52 (32–59)	51 (18–59)
Gender		
Male	29 (31)	54 (52)
Female	71 (76)	46 (45)
BMI:		
Median (range)	35.4 (21.4–62)	30.4 (22.3–48.4)
BMI*:		
Normal (<24.9)	5 (5)	11 (11)
Overweight (25.0–29.9)	12 (13)	30 (29)
Obese (>30.0)	83 (89)	59 (57)

\**P* < 0.0006

**Table 2** BMI comparison of total knee replacement (TKR) or total hip replacement (THR) patients and general population

BMI (kg/m <sup>2</sup> )	TKR or THR patients 100% (204)	General population 100% (2161)
Normal (<24.9)	8 (16)	40 (833)
Overweight (25.0–29.9)	21 (42)	34 (732)
*Obese (≥30.0)	72 (146)	26 (596)

\**P*<0.0001

Patients undergoing a TKR were significantly more likely to be obese (BMI>30 kg/m<sup>2</sup>) than those having a THR, 83% (89) compared to 59% (57) (*P*<0.0006; Table 1). Obesity was strongly associated with the need for a TKR or THR when comparing the study group to similar-aged non-elderly adults in the general population (*P*<0.0001; Table 2). Seventy-two percent (146) of the study group was obese and 21% (42) overweight (BMI 25.0–29.9 kg/m<sup>2</sup>) compared to only 26% (596) being obese and 34% (732) overweight in the general population (Table 2).

## Discussion

We found that obesity is strongly associated with the need for a total joint replacement among adults less than 60 years old. Seventy-two percent of our study group was classified as obese compared to only 26% of the general population. When analyzing our data specific to the type of procedure, TKR or THR, patients undergoing a TKR were significantly more likely to be obese than those having a THR, 83% compared to 59%. Others have found a similar relationship in elderly populations. Wendelboe et al. found an association between increasing BMI and the need for total joint replacement in elderly patients, aged 55 to 74 years [13]. Coggin et al. [5] studied subjects older than 45 years who had a TKR and found the median BMI to be 28.1 or overweight, whereas our study population showed an obese median BMI of 35.4. Additionally, Manek et al. [10] found a strong association between high BMI and the presence of knee OA in a study of female twins with a mean age of 54.5 years. Previous studies also showed moderate evidence of an association between hip OA and obesity [6, 8, 9, 11, 13]. Wendelboe et al. [13] also found a relationship between increasing BMI and THR surgery. Flugsrud et al. [6] also showed an increasing relative risk with an increasing BMI, both in males and females.

One possible explanation for the discrepancy between the BMI in the THR group when compared to TKR may be due to avascular necrosis of the hip. During data collection, we noted avascular necrosis of the hip to be a fairly

common indication for having THR. Avascular necrosis would be a secondary cause of OA and necessitate the need for joint replacement regardless of their BMI.

We acknowledge some limitations regarding our study. First, all heights and weights were collected from the electronic patient record. We assumed that all heights and weights were measured; however, we cannot rule out the possibility that the person who entered the data chose to enter a patient's self-reported information. Most self-reported weight is noted for being underestimated, especially for females [13]. However, this would likely serve to further corroborate our findings rather than refute them. Secondly, it is possible that individuals in the general population sample could have undergone a total joint replacement at the study hospital and, thus, simultaneously were a part of our study group. Since our general population sample was randomized, this limitation could not be avoided. However, we feel the chance of an individual being included in both the study group and general population is slim, and thus the impact, if there was any, on the study findings is minimal.

In summary, our study found a strong association between obesity and the need for TKR or THR in non-elderly adults. These findings support those previously observed in the elderly population. As the prevalence of overweight and obese individuals continues to rise, an increase in the number of total joint replacements may rise accordingly. Primary and secondary prevention programs aimed at reducing obesity are strongly recommended in light of the continuing rise in the number of adults classified as overweight or obese.

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