



**Original Article**

# **Cause and Effect Relationship of Body Weight and Knee Osteoarthritis: Experience from a Tertiary Institution in South-Eastern Nigeria**

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## **ABSTRACT**

It is well established that obesity is related to osteoarthritis of the knees. The aim of this study was to investigate the risk of knee osteoarthritis in relation to body mass index (BMI) and specifically, to assess the risk of knee osteoarthritis (OA) attributable to obesity. We also aimed to determine if there is a higher risk with an increase in BMI. This is an observational case-referent study of patients with knee pain. Patients were recruited from the orthopaedics clinic. The cases were patients that presented with radiologically diagnosed knee osteoarthritis, while the referents were other patients that also attended the orthopedic clinic at the same time. The referents were randomly selected. Body Mass Index was calculated and classified based on the WHO international classification. Data were analyzed using SPSS version 21. A total of 152 patients were included in the study and 67.1% were females while 32.9% were males giving a ratio of 2:1. The mean age was 57.72 $\pm$ 12.5 years, the mean weight was 79.47 $\pm$ 13.41kg (95% CI 77.32 – 81.62) and the mean BMI was 27.80 $\pm$ 6.2kg/m<sup>2</sup>. 56.6% had knee osteoarthritis. 8.6% (n = 13) were bilateral, 18.4% (n = 28) in the left knee and 29.6% (n = 45) in the right knee. The relationship between obesity and the presence of knee osteoarthritis was statistically significant (p 0.047). A Chi-squared test for trend also did not show an increased risk for knee osteoarthritis with increasing BMI (p 0.105). In conclusion, knee osteoarthritis is a degenerative joint disease that mostly affects the elderly. Our findings give strong support to the already existing knowledge of the positive relationship between obesity and knee osteoarthritis; however, increasing BMI did not increase the risk of knee OA.

**Keywords:** *Body weight; knee joint; Obesity; Osteoarthritis.*

## **INTRODUCTION**

Osteoarthritis (OA) is the most common joint disorder with symptoms in the hands, knees, hips, back, and neck. It is unclear exactly how excess weight influences osteoarthritis; undoubtedly, being overweight increases the load sited on the joints such as the knee, which increases stress and could possibly hasten the collapse of the cartilage.<sup>1</sup> OA mostly affects middle-aged and elderly people but may be seen in the younger age. As the prevalence of OA is expected to increase substantially in the near future with increasing life expectancy, a better understanding of the risk factors for the development and progression of the disease is desirable.<sup>2</sup>

There is increasing evidence that physical workload in knee OA, high-intensity sporting activities and being overweight are risk factors for OA.<sup>2</sup> In fact, recent studies have shown that with increase in body weight, there is an increase in force on the knee.<sup>3,4</sup> Therefore, further increase in weight will constitute a higher risk. Some studies have shown that overweight women have nearly 4 times the risk of knee OA and for overweight men the risk is 5 times greater.<sup>1</sup> The purpose of this study, therefore, is to determine the risk of knee osteoarthritis in relation to body mass index (BMI) and specifically, to assess the risk of knee osteoarthritis (OA) attributable to obesity. It

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also hopes to ascertain if there is a higher risk with increase in BMI.

## PATIENTS AND METHOD

A prospective study of patients with knee osteoarthritis and was done for randomly selected patients that presented to the orthopaedic outpatient from 1<sup>st</sup> of August 2013 to 31<sup>st</sup> July 2014. This study was done at the Federal Medical Centre Owerri, Nigeria. Federal Medical Centre Owerri is a tertiary healthcare institution in Imo state, Nigeria and serves as the major referral Centre in the State for orthopaedic patients. At the time of this study, there were 3 orthopaedic teams with 5 orthopaedic surgeons in the center.

### Inclusion Criteria

Patients diagnosed with knee osteoarthritis during the period of this study were included in the study. As control, other patients that also attended the orthopaedics clinic at the same time were randomly selected as the control group. A total of 152 patients were included in the study: 86 had osteoarthritis and 66 did not.

### Case Definition

All the cases with knee osteoarthritis had X-ray confirmation. The x-rays were evaluated by the researchers and confirmed by the radiologist. Knee OA was defined as the presence of any clinical features of osteoarthritis with radiologic confirmation.

### Data Extraction

Patients' consents were obtained, and demographic profiles collected. Weight and height of these patients were measured in kilogram and meters respectively. Body Mass Index was calculated using the formula:

$$BMI = \frac{wt(kg)}{ht^2}$$

### Outcome Examined

BMI was classified into obesity (BMI > 30) and No Obesity (BMI < 30). It was also further classified based on the WHO international classification as Underweight (BMI < 18.5), Normal weight (BMI 18.5 -24.99), Overweight (BMI 25 – 29.99), Class I obesity (BMI 30 – 34.99), Class II obesity (BMI 35 – 39.99) and Class III obesity (BMI > 40).

## Statistical Analysis

The data were analyzed using SPSS version 21. The distribution of categorical variables was represented in percentages, while means and confidence intervals (CI) were used to represent ordinal and nominal variables. Independent t tests were used to compare means, while Chi squared test was used to compare categorical variables. The Chi – squared test for trends was used to assess for trends in knee osteoarthritis with increasing BMI.

## RESULTS

A total of 152 patients were included in the study and 67.1% were females while 32.9% were males giving a ratio of 2:1. The mean age was 57.72±12.5 years, the mean weight was 79.47±13.41kg (95% CI 77.32 – 81.62) and the mean BMI was 27.80±6.2(95% CI 26.81 – 28.80).

56.6% had knee osteoarthritis. 8.6% (n = 13) were bilateral, 18.4% (n = 28) in the left knee and 29.6% (n = 45) in the right knee. 67.1% had a BMI of greater than 30 while 32.9% had BMIs less than 30. The characteristics of the patients are shown in table 1.

Comparing both case and control group, the average ages were 57.3 years ±12.7 and 58.2 years ±12.4 years respectively. Mean BMI in both groups were 28.6kg/m<sup>2</sup> ±6.5 and 26.7kg/m<sup>2</sup> ±5.7 respectively. The mean weights were 81.1kg ±14 and 77.4kg ±12.4. The control group made up 43.4%. Table 2 shows the characteristics of the case -control groups and age distribution by groups shown in Figure 4.

The average age in the patients with obesity was 59.1years ±10.7 while that in the non – obese patients was 57.1years ±13.3. This relationship was not statistically significant (p = 0.348). The mean BMI in the obese group was 35.4kg/m<sup>2</sup> ±3.1 and 24.1kg/m<sup>2</sup> ±3.2 in the non - obese group. There was no statistically significant relationship between obesity and the limb(s) affected (p = 0.207). However, the relationship between obesity and presence of knee osteoarthritis was statistically significant (p 0.047, OR = 2.04 CI = 1.00 – 4.2, df = 1).

With BMI further classified into detailed categories (Figure 5), there was still no statistically significant relationship between BMI and age or knee affected. A chi squared test for trend also did not show an increasing risk of knee osteoarthritis with increasing BMI (p 0.105). Figure 1 is a bar chart showing the age distribution of the subjects. Figure 2 shows the BMI classes of the respondents with the majority 29% in the overweight group. The pie chart showing the limbs affected with right upper limb predominance 52% in figure 3.

**Table 1:** The characteristics of the patients

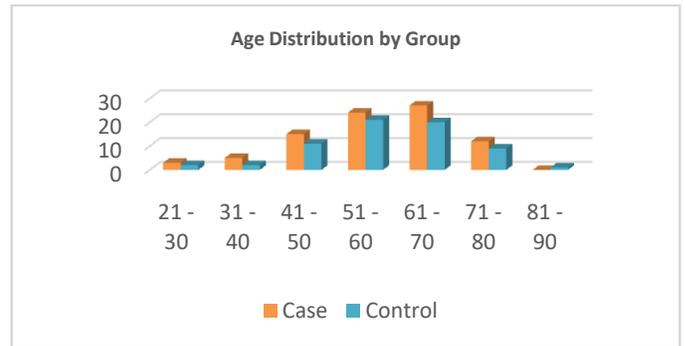
100% (n = 152)	
Age	57.7 years +/- 12.5
Weight	79.48kg +/- 13.4
BMI	27.80kg/m <sup>2</sup> +/- 6.2
Sex : Male	32.9% (n = 50)
Female	67.9% (n = 102)

**Table 2:** Showing Characteristics of the Case and Control Groups

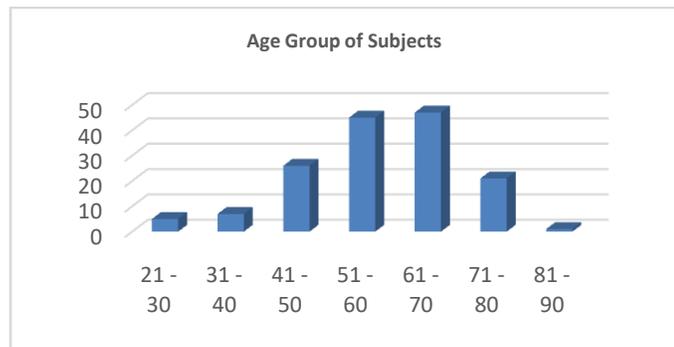
	Case %(n)	Control %(n)
Age	57.31 years +/- 12.67	58.24 years +/- 12.35
Weight	81.1kg +/- 14	77.4 kg +/- 12.4
BMI	28.63 kg/m <sup>2</sup> +/- 6.46	26.72 kg/m <sup>2</sup> +/- 5.71
Sex		
Male	34.9% (n = 30)	30.3%(n = 20)
Female	65.1% (n = 56)	69.7% (n = 46)
Knee affected:		
Right	52.3% (n = 45)	
Left	32.6%(n = 28)	
Both	15.1%(n = 13)	



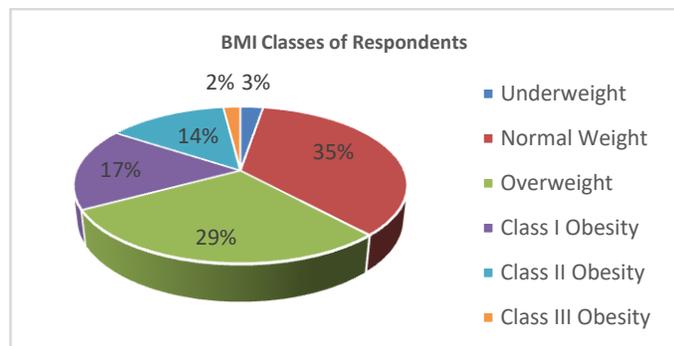
**Figure 3:** Limb Affected



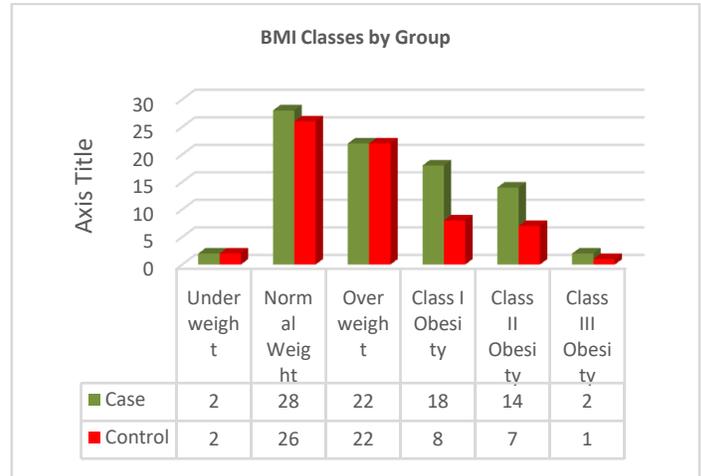
**Figure 4:** Age Distribution by Group



**Figure 1:** Age Distribution of the Subjects



**Figure 2:** BMI Classes of Respondents



**Figure 5:** Showing the BMI classes in the case and control groups.

## DISCUSSION

Understanding the risk factors associated with knee osteoarthritis is a crucial area of interest for physicians especially with the postulated increase in its prevalence in the near future. Various studies have shown that there is an increase in the rate of osteoarthritis in females; this was shown in our study with a Male-to-Female ratio of 1:2. Although we

had a higher number of females, this finding was not statistically significant. Another important risk factor for OA is age. Our experience showed that Knee OA is a primary disease of the middle age population with the mean age of 57.72±12.5 years. This supports the reports that OA occurs more with increasing age. The increase prevalence might be related to changes in collagen, and hence a change in tensile strength of cartilages of the joint.<sup>5</sup>

Our study also noted that obesity was indeed a risk factor ( $p = 0.047$ , OR = 2.04 CI = 1.00 – 4.2). This is similar to the results that were observed in other studies.<sup>5,6</sup> Currently being overweight is a cogent risk factor for developing OA. In a study by Felson *et al*, overweight individuals in their thirties who did not have knee OA were at greater risk of later developing the disease.<sup>7</sup> Data from the first National Health and Nutrition Examination Survey (NHANES I) and other studies also show that there is an increased risk of OA in obese patients.<sup>8,9,10</sup>

The relationship between BMI and OA of the knee is largely linear, and duration of increased joint loading or gaining weight is also significant.<sup>11</sup> It has been estimated that persons in the highest class of body weight have up to 10 times the risk of knee OA than those in the lowest quartile.<sup>12</sup> With this in mind, we attempted to determine if higher grades of obesity was associated with a higher risk for OA. Our analysis however failed to reveal this. This result should, however, be viewed with caution as the number of cases with high class of obesity was very small. Further studies with a larger sample population might reveal a different result and should be considered.

As several studies point towards the role of obesity in knee OA, it becomes logical to inquire of the reverse role weight loss would have. In the Framingham study, Felson and colleagues noted that among women with a baseline body mass index (BMI) greater than or equal to 25, weight loss was associated with a significantly lower risk of knee OA.<sup>13</sup> On the other hand, a comparable gain in weight was associated with an increased risk developing knee OA.<sup>13</sup> Similar results were also noted by other investigators in their studies; hence, weight loss potentially is an important modifiable factor in the treatment of knee OA.<sup>14</sup>

In our study, majority of our patients had mono-articular OA with only 8.6% (n = 13) being bilateral. Most were 18.4% (n = 28) in the left knee and 29.6% (n = 45) in the right knee. 67.1% had a BMI of greater than 30 while 32.9% had BMIs less than 30. There was no significant relationship between the number of joints involved and obesity ( $p = 0.207$ ). With BMI further

classified into detailed categories, there was still no statistically significant relationship between BMI and number of joints affected.

## CONCLUSION

Knee osteoarthritis contributes significantly to the number of cases seen in orthopaedic clinics especially in the elderly. Though an important risk factor, obesity does not determine the number of joints involved. Also, reduction in weight would constitute an important behavioural option for treatment.

## RECOMMENDATION

As several studies point towards the role of obesity in knee OA, it becomes logical to state that reduction in weight constitute a vital behavioural option for treatment.

Further studies with a larger sample population might reveal a different result and should be considered.

## LIMITATION

We had limitation in the population of patients with higher grades of obesity.

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## Conflict of interest

None declared.

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