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Obesity and Risk of Knee Osteoarthritis: A Case-Control Hospital-based Study of 372 Patients

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Abstract

This hospital-based case-control study explored whether the association between obesity and the risk of knee osteoarthritis (knee OA) exists. The study was conducted at an Orthopaedic Hospital Wamakko, a referral centre located in Sokoto, North-Western Nigeria for a period between January 2021 and December 2021. The cases with knee OA and unmatched controls were randomly selected. The inclusion criteria were adult patients aged >40 years with knee OA. The data was collected including the body mass index (BMI) in kg/m2 of each patient. Obesity was defined as BMI>29.9 kg/m2. Data were analysed using SPSS version 26. There were a total of 372 patients in the study with 124 cases and 248 controls in a ratio of 1:2. The average age was 53.7±10.8 (range 40 to 88 years). There were 165 (44.4%) males and 207 (55.6%) females. Among all the patients, there were 115 (30.9%) obese with 47 (40.9%) males and 68 (59.1%) females. Of the 257 (69.1%) non-obese patients, 118 (45.9%) were males and 139 (54.1%) were females. Among the 124 cases, there were 69 (55.6%) obese patients with 25 (36.2%) males and 44 (63.8%) females. The 55 (44.4%) non-obese patients among the cases were 24 (43.6%) males and 31 (56.4%) females. There was a statistical significance result between obesity and knee OA (OR=5.509, CI=3.417-8.881, and P<0.0001). The study showed obese individuals have 5.509 times more risk of having knee OA compared with non-obese individuals indicating weight reduction as a key to prevention and treatment of knee OA.

Keywords: *Body Mass Index, Case-control Study, knee Osteoarthritis, Obesity.*

Introduction

Osteoarthritis (OA) is the most common chronic joint disease globally causing pain, disability and loss of function [1]. Knee Osteoarthritis (Knee OA) is the most commonly affected joint in arthritis, followed by the hands [1, 2]. It is a debilitating disease with chronic causes giving rise to serious morbidity if the management has not been promptly and adequately approached and appropriately treated [3]. The initial and the most constant symptom is pain, followed by stiffness, swelling and difficulty walking with subsequent impact on the individuals' quality of life [4]. The aetiology is unknown but the major risk factors have been studied and identified in literature. Increasing age, female sex, certain occupations, genetic factors, obesity, previous knee trauma and certain knee joint pathologies all contribute to the aetiopathogenesis of this chronic condition [5]. Obesity as a risk factor has been widely known and reported in many studies stating that a steady increase in body mass index

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(BMI) above the normal value was associated with the risk of knee OA largely due to mechanical effects and other means related to the obesity disease [6]. The rising worldwide prevalence of obesity in which 1 in 8 individuals is affected poses serious concern in the health sector that deals with various non---communicable diseases and the effect on other disease development for effective prevention and treatment [7]. As one of the established and major risk factors for knee OA, obesity prevention could drastically reduce the incidence of knee OA and its associated morbidities among vulnerable groups, thereby decreasing huge spending by the government on the socioeconomic and health burden associated with obesity [8]. Many public health programs that deal with obesity prevention can be employed to impact significant changes in the trend of overweight and obesity disease occurrence [9]. Most research that relate to obesity and the risk of knee OA were cross-sectional studies. On this background of growing concern and the rising number of obese patients with knee OA, this study is intended to investigate the relationship and further add to the numerous studies and existing literature on obesity and knee OA.

This case-control hospital-based study of 372 subjects aims to determine an association between obesity and the risk of knee OA.

Materials and Methods

This case-control study was conducted at an Orthopaedic Hospital Wamakko, a referral centre located in Sokoto, North-Western Nigeria between January 2022 and December 2022. Ethical approval was obtained at the Ministry of Health Sokoto with Ref no. SMH/1580/V.IV before the study begins. The cases with knee OA and unmatched controls were randomly selected during the outpatient department (OPD) visits within the study period. Cases with knee OA were diagnosed using the American College of Rheumatology (ACR) criteria which include knee pain with at least three out of six criteria in the case group [10]. The inclusion criteria were adult patients aged >40 years with knee OA, and the exclusion criteria were infected knee, associated peri-articular fracture and postoperative knee disease. The method of data collection was by interviewing participants via the use of a reliable questionnaire. Questions regarding demographic features, other risk factors, Knee joint clinical presentations (Figure 1), and radiological features (Figure 2) were taken. Each patient's weight and height were recorded to calculate their body mass index (BMI) in kg/m2. The BMI result was classified into normal (BMI=18.5 to 24.9 kg/m2), overweight (BMI=25 to 29.9 kg/m2) and obese (BMI>29.9 kg/m2).

Categorical variables were presented in the form of frequency and percentages. Data were analysed using SPSS version 26. Initially, univariate analysis was used to compute p-values through chi-square for the categorical variables and student t-test for the numerical variables. Then multivariate logistic regression model was used to assess the association between the various risk factors and knee OA. The independent association with the risk of knee OA was considered positive if the exposure variables were significant at a 5% level.

Figure 1. Bilateral Knee OA in a 56-Year-Old Woman with a BMI of 41.2kg/m2

Figure 2. Radiograph of Right Knee Showing OA Features in an Obese Female Patient

Results

Tables 1 to 3 summarise the results. There were a total of 372 patients in the study with 124 cases and 248 controls in a ratio of 1:2. The average age was 53.7±10.8 (range 40 to 88 years). There were 165 (44.4%) males and 207 (55.6%) females. Among all the patients, there were 115 (30.9%) obese with 47 (40.9%) males and 68 (59.1%) females. Of the 257 (69.1%) non-obese patients there were 118 (45.9%) males and 139 (54.1%) females. Among the 124 cases, there were 69 (55.6%) obese patients with 25 (36.2%) males and 44 (63.8%) females. The 55 (44.4%) non-obese patients among the cases were 24 (43.6%) males and 31 (56.4%) females.

There was a statistical significance result between obesity and knee OA (OR=5.509, CI=3.417-8.881, and P<0.0001) (Table 2). Table 3 provides results for logistics regression of all factors taken into consideration in this study and for obesity OR=42.773 (CI=3.466-10.040 and p<0.0001).

Table 1. Socio-demographic Characteristics of Respondents

Variable	**Patient Category n (%)**		
	Case	**Control**	**Total**
Age (in years)			
40.00 - 49.00	50(35.2)	92(64.8)	142(100.0)
50.00 - 59.00	41(35.3)	75(64.7)	116(100.0)
60.00 - 69.00	20(27)	54(73)	74(100.0)
70.00 - 79.00	8(25.8)	23(74.2)	31(100.0)

80.00+	5(55.6)	4(44.4)	9(2.100.0)
Gender			
Male	49(29.7)	116(70.3)	165(100.0)
Female	75(36.2)	132(63.8)	207(100.0)
Ethnic Group			
Hausa Fulani	116(33.2)	233(66.8)	349(100.0)
Others	8(34.8)	15(65.2)	23(100.0)
Occupation			
No occupation	63(31.3)	138(68.7)	201(100.0)
Business	26(43.3)	34(56.7)	60(100.0)
Civil servant	19(31.1)	42(68.9)	61(100.0)
Farmer	16(32)	34(68)	50(100.0)
Education			
Non-formal education	89(35.6)	161(64.4)	250(100.0)
Formal education	35(28.7)	87(71.3)	122(100.0)
Marital Status			
Married	104(31.9)	222(68.1)	326(100.0)
Single	17(42.5)	23(57.5)	40(100.0)
Divorced/widowed	3(50)	3(50)	6(100.0)

Table 2. Risk Estimate

Measure	**Value**	**95% Confidence Interval**	
		Lower	**Upper**
Odds Ratio for Obesity (Obese / Non-Obese)	5.509	3.417	8.881
For cohort Patient Category = Case	2.804	2.124	3.701
For cohort Patient Category = 2.00	.509	.403	.642
N of Valid Cases	372		

Table 3. Potential Risk Factors Related to Knee OA (Logistic Regression Results)

Independent Variables		**B**	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**	**95% C.I.for EXP(B)**	
								Lower	**Upper**
Step 1[a]	Obesity	1.775	.271	42.773	1	.000	5.899	3.466	10.040
	Age (Years)	-.004	.012	.103	1	.749	.996	.973	1.020
	Gender	-.633	.284	4.962	1	.026	.531	.304	.927
	Smoking	.619	.509	1.481	1	.224	1.857	.685	5.034
	Alcohol	-19.975	22109.226	.000	1	.999	.000	.000	.
	Exercise	1.497	.416	12.985	1	.000	4.470	1.980	10.092
	Education	.064	.290	.049	1	.824	1.067	.604	1.884

	Family History Knee OA	-1.919	.494	15.058	1	.000	.147	.056	.387
	Childhood Knee Problems	2.588	.841	9.474	1	.002	13.301	2.560	69.115
	Constant	.546	.850	.412	1	.521	1.726		

Discussion

This study showed that the risk of developing knee osteoarthritis (Knee OA) was 5.5 times higher in obese than in non-obese individuals. This is consistent with many studies relating the effect of obesity on knee OA occurrence [11]. Several mechanisms, by which obesity influences knee OA development and progression have been theorized and were explained in detail. Excessive and repeated loads to the knee subchondral bone following an increase in size and surface area as a result of an increase in BMI have been one of the explanations for the susceptibility among those with obesity [12]. Additionally, denser subchondral bones are likely to exert more mechanical stresses on the weight-bearing joint surfaces leading to narrow joint space. Report by Lee. et al. stated that the incidence of knee OA was approximately 12 times higher in obese individuals than in individuals with normal BMI [13]. The effects of weight gain on the pathogenesis of knee OA are further evidenced by the impact of weight reduction rehabilitation programmes on symptom reduction and knee OA prevention [14]. Other mechanisms including metabolic activities and joint biomechanics may also play a significant role in obese patients with knee OA [15].

Although there was no significant difference in obesity among the female and male genders (OR 1.2) in the study findings, several research findings have made solid conclusions that obesity is a more prevalent factor in females than in males, and this may have contributed to the higher prevalence of knee OA among females because of the higher level of leptin in their body [16]. Furthermore, there is effect of reduced oestrogen levels on increased cartilage degradation following menopause in ageing women has further contributed to the gender difference in knee OA prevalence [17].

There have been several studies that showed a relationship between obesity and progressive radiological knee osteoarthritis. Such studies provided evidence of the effect of increasing an individual's BMI on the knee biomechanical changes with subsequent OA changes that become visible on plain radiographs [18]. The degree of changes closely correlated with a progressive increase in BMI value and severity and grades as classified by Kellgren and Lawrence [19].

Obesity, as a preventable morbidity and a well-established factor that is associated with knee OA, a lot can be done to deal with its rising incidence and comorbidity if proper policy, awareness campaigns and educative programmes were put into consideration and fully implemented. The lack of full awareness especially among the vulnerable youth and school children has contributed immensely to the high number of obese children [20]. Adopting a healthy lifestyle, affordability for the recommended diet, exercise facility and easy access to healthcare services is vital to the effective reduction of obesity and obesity-related diseases [21]. Although adequate sample size and randomisation have been used in the study, its limitation as a case-control study including recall and classification biases may not be ruled out. The study findings have however added to the literature pool and have strengthened the positive association that exists between overweight, obesity and knee OA. The unmatched study has also provided the chance to compute other variables into consideration as possible risk factors for knee OA (Table 3).

Conclusion

This case-control study showed obesity is an independent risk factor for knee OA and is 5.5 times more likely to occur than in non-obese individuals. The findings further reiterated the role of weight reduction among obese individuals in the prevention and treatment of knee osteoarthritis.

Competing Interests

The author declared no known competing interests.

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