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**O R I G I N A L   A R T I C L E**

# Influence of Selected Anthropometric and Socio-Demographic Variables on Pain Intensity and Functioning of Patients with Knee Osteoarthritis

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**A B S T R A C T**

**Background:** Knee osteoarthritis is known to be the commonest joint disorder been strongly associated with ageing; it constitutes a major cause of pain and disability in the elderly population.

**Objectives:** This study assessed the influence of some selected anthropometric variables on pain intensity and functioning in participants with symptomatic knee osteoarthritis (KOA) and compared these variables between participants and apparently healthy individuals.

**Methods:** Seventy individuals (11 males and 59 females) with symptom of knee osteoarthritis and 70 (11 males and 59 females) age matched asymptomatic individual participated in the study. Demographic and anthropometric variables were measured in the participants using standard protocol. Arthritis Impact Measurement Scales 2 (AIMS 2) Short Form was administered to participants with symptom of KOA to examine the impact of KOA on the functioning. Data was analysed using descriptive and inferential statistics.

**Results:** There were significant differences ($p < .001$) in weight, BMI and Frame size (FRS) of symptomatic KOA and asymptomatic individuals. There was a significant relationship between BMI and pain intensity in the symptomatic participants ($r=0.371, p=0.047$). There was also a significant relationship between AIMS score and each of BMI ($r=0.339, p<0.05$), frame size ($r = -0.394, p=0.001$) and each of level of education ($r =-.453, p=.001$), and occupation ($r=.322, p= 0.022$).

**Conclusion:** It was concluded that anthropometric measures such as weight, BMI and FRS are contributory factors to development of knee osteoarthritis. Also, occupation and education were found to affect functioning in patients with knee osteoarthritis.

## INTRODUCTION

Osteoarthritis (OA) is known to be the commonest joint disorder. It is strongly associated with ageing and is a major cause of pain and disability in the elderly population1. Nevitt et al (2) reported that osteoarthritis is a slowly progressive disease characterized clinically by pain, enlargement and deformity of the joints, and limitation of motion.

Osteoarthritis is a degenerative disease that occurs in synovial joint in the body but is most common in the hands, knees and hips (3). African Americans compared to Caucasians had slightly higher prevalence of knee symptoms, radiographic knee OA, and symptomatic knee OA, but significantly higher prevalence of severe radiographic knee OA (4). Increases in life expectancy and ageing populations are expected to make OA the fourth

leading cause of disability by the year 2020 around the world (5). The worldwide prevalence estimate for OA is 9.6% among men and 18% among women and although it occurs all over the world, its pattern of prevalence varies among populations (6). In the United States osteoarthritis is equally prevalent in men and women aged 45-55 years but after age 55 years, the prevalence of osteoarthritis increases in women in comparison with men (6).

A study showed a higher rate of knee osteoarthritis in African American women but not in men compared with their Caucasian counterparts (7); however, another study showed no difference between these groups (8). Researchers showed that African American with hip or knee osteoarthritis have more severe radiographic features of disease and more frequent bilateral involvement and mobility impairment8. These ethnic differences may be related not only by underlying genetic factors but also other variables including variations in body mass index (BMI), nutritional factors, the impact of lifestyle differences and healthcare disparities between populations (9).

In Nigeria, OA is more common in females than males in the ratio of 3.5:1 and the knee joint is more frequently affected (10). Osteoarthritis is a leading cause of pain in the knee which also affects functioning. Pain in the knee leads to physical disability and reduced quality of life (11). Akinpelu et al.,(10) reported that one out of every five adult aged 40 years and above in the Nigerian rural community reported symptomatic knee osteoarthritis. It is a common condition seen in the physiotherapy facilities in Lagos and Ibadan, accounting for 9% of new patients (12). Similarly, Klussmann et al., reported that knee osteoarthritis is one of the frequent and functionally impairing disorders of the musculoskeletal system (13). Knee osteoarthritis is responsible for greater than 10 million physical visits to doctors and is a common condition which represents a major contribution to the burden of physical disability (14,15). Factors associated with disability in persons with KOA include socio-demographic variables such as age, gender, marital status, occupation, and education level (16,17). Specifically, female gender has been reported as a major predisposing factor of knee osteoarthritis and is associated with worse clinical manifestations than in men (18).

Additional factors are anthropometric parameters, co-morbidity and quadriceps muscle weakness (19). Anthropometry is the study of the measurement of the human body in terms of the dimension of bone, muscle and adipose tissue (20). Increasing age and BMI are reported to be associated with pain and function in OA of the knee (21). Osteoarthritis of the knee evolves with increasing levels of pain, mobility restriction, and physical disability (22). Pain is likely to be a central factor in the physical function limitation of knee OA, both due to its direct effects on function and as a route through which other factors operate (23). One of the outcome measures to assess the function of effect of arthritis is Arthritis Impact Measurement Scales (AIMS). It has been widely used in evaluating the impact of several rheumatic diseases, including OA. Arthritis Impact Measurement Scales is a disease-specific measure of physical, social, and emotional well-being designed as a measure of outcome in arthritis (24). This present study was designed to determine the influence of some selected anthropometric and socio-demographic variables on pain perception and functioning of subjects with knee osteoarthritis. And also to compare the participants with symptom of KOA with apparently individuals.

## METHODOLOGY

Participants for this study comprised of 70 (11 males and 59 females) participants diagnosed with symptom of knee osteoarthritis from Obafemi Awolowo University Teaching Hospitals Complex, Ile Ife, Ladoke Akintola University of Technology Teaching Hospitals Osogbo and General Hospital Asubiaro Osogbo, all in Osun State. Seventy (11males and 59 females) age matched apparently healthy individual were also selected from the same locations according to the same number of patients. Patients with knee pain resulting from trauma and surgery were excluded from the study.

**Procedure:**
Ethical approval was obtained from the Ethics and Research Committee of Obafemi Awolowo Teaching Hospital Complex, OAUTHC, Ile-Ife. Also the consent of participants with symptomatic KOA and apparently healthy individuals was obtained. Pain intensity of each participant with symptomatic KOA was assessed using visual analogue scale. The following tests were carried out to confirm osteoarthritis of the knee: Passive and active range of motion which resulted in to pain, crepitus sound and limited range of motion; patellofemoral joint compression test which is painful; grinding test and Apply's compression test all were painful. X- ray report confirm the presence of knee osteoarthritis.

The following anthropometric indices were measured using protocol of International Standard for Anthropometric Assessment (ISAK), (25) height with height meter, weight with weighing scale (the bathroom weighing scale was made by Hanson Ireland with a capacity of measuring 200 kilogram weight), waist and hip circumferences were measured with a cloth tape rule (Inextensible tape rule made of Butterfly Brand from China with the capacity of measuring 150 cm).

A performa type of questionnaire was used to assess the demographic variables of the participants. Arthritis Impact Measurement Scales 2 Short Form (AIMS 2-SF) was administered to each patient to examine the impact of knee joint arthritis on the functioning of the participants. AIMS 2-SF asks questions about the health of participants within the past 4 weeks. It consists of 26 items questions with

numbers 1,-12 on physical, 13- 15 on symptom, 16 – 20 on effect of arthritis, 21-24 on social and 25- 26 on work. Answer to each question varies from "no day or never" to "all days or always". No day or never is 5 marks and all days or always is 1 mark. The total numbers of scores were added together in each section. Range of score varies from 12 – 60 for physical, 3 – 15 for symptom, 5 – 25 for social and 2-10 for work. To normalize the total score, a formula was used as follows: in physical (S- 12)x.209; in symptom (S-3)x0.833; affect (S-25)x 0.5; social (S-4)x0.625 and work (S-2)x 1.25. S = sum of the items score after recording. The total score vary from 0 which is the best health state to 10 which is the worse state of health (26).

### Data analysis
Data was analysed using Statistical Package for Social Sciences (SPSS) and descriptive and inferential statistics was used to summarise the data. Independent t test was used to compare the physical characteristics of symptomatic participants with symptomatic KOA and apparently healthy individuals. Pearson's product moment correlation coefficient was used to find the relationship between age, anthropometric variables and each of pain intensity and AIMS Scores, Spearman Rho was used to examine the relationship between the Socio-demographic variables and each of pain intensity and AIMS scores.

### RESULT

### Physical Characteristics
Shown in table 1 is a comparison of the anthropometric variables for both the knee OA and control groups. There was a significant difference between the weight (t=4.888 p=0.001), wrist cir (t= 58.849, p= 0.001), waist cir (t= 4.234 p= 0.001), hip cir (t= 53.999 p= 0.001), BMI (t= 5.101, p= 0.001) and FRS (t= -3.208 p= 0.002).

**Table 1: Independent t-test comparison of anthropometric variables of the participants**

| Variables | KOA group Mean ± SD | Control group Mean ± SD | t-value | P-Value |
|---|---|---|---|---|
| Age | 56.6 ± 7.63 | 55.6 ± 6.42 | 0.722 | 0.472 |
| Height | 1.62 ± 0. 79 | 1.63 ± 0. 08 | -1.178 | 0.242 |
| Weight | 83.9 ± 17.1 | 69.9 ± 10.8 | 4.888 | 0.001** |
| Wrist circumference | 17.5 ± 4.69 | 103 ± 9.27 | 58.849 | 0.001** |
| Waist circumference | 104 ± 9.26 | 91.6 ± 15.5 | 4.234 | 0.001** |
| Hip circumference | 114 ± 14.0 | 166 ± 1.18 | 53.999 | 0.001** |
| BMI | 32.2 ± 7.39 | 26.2 ± 3. 85 | 5.101 | 0.001** |
| WHR | 0.89 ± 0.91 | 0.86 ± 0.76 | 1.938 | 0.056 |
| FRS | 9.36 ± 0.79 | 9.84 ± 0.69 | -3.28 | 0.002* |

Key - *significant at 0.05 level of significance **significant at 0.001 level of significant

Presented in table 2 is the comparison of the socio-demographic variables of the participants. Eighty four percent (84%) of the participants were female while 16% of the participants were male. Forty eight percent (48%) for knee OA patients and 54% of the control group were not educated, 36% of both OA and control group had tertiary education. Thirty four percent (34%) were civil servants for the OA group while for the control group, there were 49%. Forty two percent of the OA group was traders while 41% were traders for the control group. For both groups majority of the participants were Christians i.e. 70% for the OA group and 82% for the control group. In the OA group, 54% were employed full time and 18% were employed part time while 28% were retired. In the control group however, 88% were employed full time and 4% were retired.

Shown in table 3 is Pearson's Product Moment correlation between anthropometric variables and each of pain intensity and AIMS scores. It is shown that there was a significant but inverse correlation between height and AIMS scores (r= -0.331 p= 0.001).

There was significant correlation between BMI and pain intensity (r= 0.371 p= 0.047) and BMI and AIMS scores (r= 0.267 p= 0.016). There was a significant but inverse relationship between FRS and pain intensity (r= -0.453 p= 0.001) and FRS and AIMS scores (r= -0.394 p= 0.001).

**Table 2: Socio-demographic distribution of the participants**

| Variable | | OA group (%) | Control group (%) |
|---|---|---|---|
| Gender | Male | 11(16) | 11(16) |
| | Female | 59(84) | 59(84) |
| Marital Status | Married | 57(82) | 60(86) |
| | Widowed | 13(18) | 1014) |
| Educational status | None | 33(48) | 39(54) |
| | Primary | 3(4) | 1(2) |
| | Secondary | 8(12) | 6(8) |
| | Tertiary | 25(36) | 25(36) |
| Occupation | Civil servant | 24(34) | 34(49) |
| | Artisans | 4(6) | 3(4) |
| | Farmers | 1(1) | 0(0) |
| | Nurses | 6(8) | 4(6) |
| | Traders | 30(42) | 29(41) |
| Religion | Christianity | 49(70) | 57(82) |
| | Islam | 21(30) | 13(18) |
| | Others | 0(0) | 0(0) |
| Employment status | Full time | 38(54) | 62(88) |
| | Retired | 20(28) | 3(4) |
| | Part time | 13(18) | 6(8) |

**Table 3: Pearson's product moment correlation analysis between age, anthropometric variables and each of pain intensity and AIMS Scores**

| Variable | Pain Intensity | | AIMS Scores | |
|---|---|---|---|---|
| | r | p | r | p |
| Age (years) | 0.005 | 0.974 | 0.043 | 0.764 |
| Height (metres) | -0.204 | 0.156 | -0.331 | 0.019* |
| Weight (kg) | 0.201 | 0.162 | 0.205 | 0.154 |
| Wrist circum (cm) | 0.219 | 0.126 | 0.125 | 0.386 |
| Waist circum (cm) | 0.167 | 0.245 | 0.193 | 0.179 |
| Hip circum (cm) | 0.138 | 0.341 | 0.113 | 0.435 |
| BMI (kg/m²) | 0.371 | 0.047* | 0.339 | 0.016* |
| WHR | 0.164 | 0.255 | 0.267 | 0.060 |
| Frame size | -0.453 | 0.001** | -0.394 | 0.001** |

Table 4 is Spearman Roh correlation analysis between the socio-demographic variables and each of pain intensity and AIMS scores. The table shows a significant but inverse correlation between the level of education and AIMS scores (r= -0.475 p=0.001), and positive correlation between occupation and AIMS scores (r=0.323 p=0.022).

**Table 4: Spearman Rho correlation analysis between the Socio-demographic variables and each of pain intensity and AIMS scores**

| Variables | Pain intensity | | AIMS score | |
|---|---|---|---|---|
| | R | P | R | P |
| Sex | -0.073 | 0.613 | -0.106 | 0.464 |
| Education | -0.104 | 0.472 | -0.475 | .001** |
| Occupation | -0.013 | 0.913 | 0.323 | 0.022* |
| Marital status | -0.256 | 0.073 | 0.081 | 0.575 |
| Religion | -0.142 | 0.325 | 0.079 | 0.587 |
| Employment | -0.119 | 0.412 | 0.089 | 0.540 |

*significant at 0.05 level of significance; **significant at 0.001 level of significance

## DISCUSSION

This study was designed to compare the anthropometric and socio-demographic variables between symptomatic knee osteoarthritis (KOA) patient and age matched apparently healthy individuals and to assess the influence these variables on pain intensity and functioning in patients with symptom of knee osteoarthritis. The result showed that weight, BMI, frame size, wrist circumference and waist circumference of patients with the knee osteoarthritis group are significantly higher than that of the control group. An indication that increases in these anthropometric variables may have contribution to the development of knee osteoarthritis. These findings supported the work of Felson et al., in their study, they evaluated the effect of body weight on progression of KOA among 228 veterans and community recruits with symptomatic KOA, followed up for 30 months (27). The association between BMI and the risk of knee OA progression was assessed after adjusting for age, sex, and limb alignment, using logistic regression and generalized estimating equations. They concluded that the risk of progression increased

with increasing weight for each 2-unit increase in BMI. Researchers (28,29,30) also reported that persons with KOA are, on average, heavier than those without disease, and their studies have shown that being overweight increases the risk of developing disease, which was in consonant with this study. Increase in body mass places chronic stress on joints and eventually leading to arthrtitic changes. A sagging abdomen (increase in waist circumference) which is prominent in obese men increases the risk of low back pain (31). Weak and inflexible abdominal and leg muscles compound the problem of low back and knee joint respectively31. Being overweight increases the load placed on the joints such as the knee, this increases stress and could possibly quicken the breakdown of cartilage16. It is estimated that a force of nearly three to six times one's body weight is exerted across the knee during ambulation; an increase in body weight increases the force by this amount32. However, overweight has also been associated with higher rates of hand OA in some studies33,34 suggesting the involvement of a circulating systemic factor as well (32).

The study observed knee OA with a higher percentage being reported in women than in men. This was supported by the study of Ayis et al.,(11) that there is a strong relationship between knee OA and female gender. Our study also supports previous report by Srikanth (35) that women are more susceptible than men to OA as well as to higher disease severity. Andrianakos et al.,(36) in their study also concluded that female sex and age are risk factors for all sites of OA. The higher incidence of osteoarthritis in women who are postmenopausal suggests that oestrogen deficiency might increase the risk of osteoarthritis. There are evidences that estrogens fulfill a relevant role in maintaining the homeostasis of articular tissues and of the joint itself. The dramatic rise in OA prevalence among postmenopausal women,(35,37) which is associated with the presence of estrogen receptors in joint tissues (38,39) suggests a link between OA and loss of ovarian function.

The result of this study also showed a positive relationship between body mass index of the patients with knee OA and each of pain intensity and AIMS score, but negative relationship between

frame size and each of pain intensity and AIMS score. This is indicating that the higher the body mass index the likehood higher the pain intensity and more functional disability. In addition to this, the larger the frame size (FRS) the less the pain intensity and functional disability. Anthropometric indices such as weight, BMI and FRS are associated with development of knee OA. This study supported a report by Sturmer (40), Messier et al(41) and Abbate et al (42) that increase in BMI and weight have a significant association with occurrence of knee OA, an indication that increase in BMI and weight are a predisposing factor for knee OA. Felson et al (30) reported that overloading the knee and hip joints due to increased BMI could lead to cartilage breakdown and failure of ligamentous and other structural support.

A spearman's correlation analysis between socio-demographic variables and each of pain intensity and AIMS scores also revealed an inverse correlation between education and AIMS and a significant correlation between occupation and AIMS. These mean that the higher the level of education the less the impact of OA on functioning of the patient and vice versa, also certain occupation has influence on the functional disability of patients with KOA. The findings of this study were supported by the work of Andrianakos et al (36). In their study carried out in Greece where they assessed the prevalence of symptomatic knee, hand, and hip osteoarthritis (OA) in the general adult population of 8547 subjects. They concluded that symptomatic knee, hand, and hip OA is common in the general adult population of Greece, showing a female preponderance and a prevalence increasing with age. Female sex and age are risk factors for all sites of OA, obesity for knee and hip OA, and a low level of education for knee OA. The negative relationship between education and AIMS in our study was also in line with earlier study of Hannan et al (43). They examined whether the cross-sectional association between formal education and the disease is due to known risk factors, and also whether educational attainment is more strongly associated with self-reported symptoms or with radiographic change. It was found that there was a univariate association between osteoarthritis and low levels of education. After they have adjusted for major risk factors and the presence of radiographic changes; reporting of knee pain and arthritis at any site still remained significantly associated with low educational attainment, especially for those with less than or equal to 8 years of education.

The positive relationship between occupation and AIMS score in this study supports the report of the study of Anderson et al.(44) They analysed if men and women in farming, construction or healthcare work have increased risk of developing OA of the hip or knee. They found that male floor layers and bricklayers and male and female healthcare assistants had the highest risks of knee OA, and farmers had the highest risk of hip OA. Male

farmers had increased risk of hip OA already after 1-5 years in occupation and the risk of OA increased with cumulative years in the occupation in both men and women. It was then concluded in their study that occupations with heavy physical workload present a strong risk for hip and knee OA in both men and women, and the risks increase with cumulative years in occupation.

## CONCLUSION

Based on the findings, anthropometric measures such as weight, waist circumference BMI, FRS are contributory factors to development of knee osteoarthritis. Furthermore, occupation and education were found to affect functioning in patients with knee osteoarthritis.

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