*IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*
*e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 23, Issue 4 Ser. 1 (April. 2024), PP 38-43*
*www.iosrjournals.org*

# Is There a Link Between The ABO Blood Group And The Development Of Severe Osteoarthritis Of The Knee In Blacks?

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***Abstract***
***Introduction*** *Osteoarthritis presents significant challenges to individuals, particularly in countries like Nigeria, where it is a prevalent orthopaedic condition. This study aimed to investigate the relationship between abo blood groups and the severity of osteoarthritis, focusing on knee pain patients at a tertiary orthopaedic centre in Awka, Nigeria.*
***Methodology*** *The study encompassed 135 patients who underwent clinical examinations, knee X-rays, blood grouping, and histological analysis of removed knee surface cartilage. While certain blood groups have been linked to various health risks, including cardiovascular diseases and cancer, this study sought to uncover any association with osteoarthritis severity.*
***Result*** *Analysis revealed weak associations between blood groups, occupation, hypertension, diabetes, transfusions, and osteoarthritis severity. Despite a notable proportion of patients with severe osteoarthritis belonging to the O+ and A+ blood groups, regression analysis showed minimal impact of blood groups on diagnosis outcome*
***Conclusion****. The ABO blood group insignificantly influences the diagnosis of severe osteoarthritis in the Nigerian black population.*

Date of Submission: 23-03-2024 Date of Acceptance: 03-04-2024

## I. Introduction

Osteoarthritis, the second most common presentation to orthopaedic surgeons after low back pain, primarily affects individuals in their fifth decade of life and has significant physical, social, and psychological impacts on those affected. The cause of primary osteoarthritis is unknown, but factors such as increased body weight, old age, weightlifting, and genetic predispositions contribute to its development. Additionally, osteoarthritis can develop as a secondary condition following joint trauma or certain joint diseases. These factors predispose individuals to secondary osteoarthritis. The pathogenesis of osteoarthritis involves the degradation of articular cartilage due to the release of enzymes and pro-inflammatory cytokines. This leads to cartilage swelling, fragmentation, and subsequent disintegration underweight and pressure, exposing the subchondral bones and causing joint erosion and deformity. Osteophytes may form at the joint edges, occasionally causing fractures and increased joint pain. Average symptoms and signs of osteoarthritis include pain, stiffness, progressive deformities, difficulty walking, muscle atrophy, joint effusion, crepitus, and tenderness.

Treatment approaches for osteoarthritis encompass both non-pharmacologic and pharmacologic measures. Non-pharmacologic interventions focus on non-weight-bearing exercises that improve muscle bulk and reduce wasting, such as swimming, cycling in the air, and walking. Additionally, reducing the load on the knee joints by using walking aids like sticks, crutches, or walkers can be beneficial. Pharmacologic treatments include analgesics, non-steroidal anti-inflammatory drugs (NSAIDs), opioids, intra-articular hydrostatic drug administration, and steroid injections. When conservative treatments fail, surgery becomes necessary. Total knee replacement, involving the replacement of natural knee surfaces with artificial implants, is performed for patients with severe knee osteoarthritis.

Surgery for severe knee osteoarthritis is costly and carries various risks, including deep venous thrombosis, infection, and implant failure. Psychological and social issues also arise due to the disease. These factors make total knee replacement in Nigeria a significant endeavour. Understanding the aetiology and associations of osteoarthritis can lead to preventive measures, improving the quality of life and reducing the burden imposed by the disease, such as cost, decreased quality of life, difficulty walking, and physical and social challenges caused by the deformity.

One particular aspect worth investigating is the association between the ABO blood grouping system and the severity of knee osteoarthritis in black individuals, using Nigeria as the study site.

Osteoarthritis is the second most common presentation to the Orthopaedic surgeon besides low back pain.[1] It is seen mainly amongst men and women from their fifth decade. It has a lot of physical, social, and psychological effects on those affected. [2]

The aetiology of osteoarthritis is idiopathic, but Increased body weight, old age, weightlifting, and genetic predispositions are risks to the development of osteoarthritis. Osteoarthritis could develop secondarily following trauma to the joint and some joint diseases like hemarthrosis, Paget's disease, septic arthritis, and acromegaly. These predispose to secondary osteoarthritis.[3]

The pathogenesis of osteoarthritis starts from articular cartilage degradation following the release of enzymes and pro-inflammatory cytokines.

The cartilage swells and fragments with subsequent weight and pressure, leading to further disintegration. The subchondral bones are exposed, leading to erosion and deformity of the joints. Osteophytes develop at the edges of the joints and occasionally fracture and cause pain. Those that find their way into the cavity also increase joint pains.[3,4]

The symptoms and signs are pain, stiffness, progressive deformities with difficulty walking, muscle atrophy, joint effusion, inability to walk, crepitus, and tenderness.

Non-pharmacologic and pharmacologic are used to treat osteoarthritis.

Non-pharmacologic means include non-weight bearing exercises that improve muscle bulk and reduce muscle wasting, like swimming, cycling in the air, and walking, and also, reduction of load to the weight knee joints, use of walking sticks, crutches, and walker.[4]

Pharmacologic treatments include the use of analgesics, non-steroidal anti-inflammatory drugs, opioids, intra-articular hydrostatic drugs, and steroids.

Surgery is resorted to when all these fail. Total knee replacement is done for this group of patients, which involves the replacement of the natural knee surfaces with artificial implants.[5]

Surgery for severe knee osteoarthritis is costly [6,7] and associated with lots of risks, which include deep venous thrombosis, infection, and failed implant.[8]

There are also psychological and social issues.[9]

All these make total knee in Nigeria a major undertaking.[7]

It is hoped that finding more clues and knowledge of the aetiology and associations would possibly help in finding the preventive tips for the severity of osteoarthritis and will go a long way in improving quality of life and also reduce the burden imposed by the disease viz a viz the cost, the decreased quality of life due to pain, difficulty in walking, the physical and social difficulties caused by the deformity.[10]

One aspect to look at in this study is the association between the ABO blood grouping system and the severity of osteoarthritis of the knee in blacks using Nigeria as the study site.

Landsteiner discovered the ABO blood group system in 1901. This is an important haematological system in human blood transfusion. It is not only present in erythrocytes but also in platelets, epithelium, and other cells. AB antigens can elicit an adverse immune response during organ transplantation. The associated anti-A and anti-B antibodies are typically IgM antibodies produced early in life due to sensitisation to environmental substances like food, bacteria, and viruses. The ABO system is of utmost importance in transfusion practice as it is the only blood group system where individuals possess antibodies in their serum against antigens absent from their red blood cells (RBCs).[173]

Blood group antigens on the surface of red blood cells correspond with specific antibodies present in the plasma. The classification is as follows: Group A possesses A antigens and Anti-B antibodies, Group B has B antigens and Anti-A antibodies, Group AB carries both A and B antigens but lacks corresponding antibodies, and Group O lacks A and B antigens while containing both Anti-A and Anti-B antibodies.[11,12]

A single gene determines the ABO blood type, the ABO gene is located on chromosome 9q34. This gene has three alleles: I, IA, and IB, where "I" signifies isoagglutinogen or antigen. IA encodes type A, IB encodes type B, and I results in type O. IA and IB alleles dominate over i. The combination and expression of these alleles determine blood group types: O (ii), AB (IA IB), A (IA IA or IA i), and B (IB IB or IB i). Individuals with IA IB alleles express both A and B antigens due to codominance, allowing type A and B parents to have an AB child. The ABO blood group has been associated with disease prediction, supported by various studies and review articles.[13,14]

There are associations found between ABO blood groups and susceptibility to certain infectious diseases.[15,16] For example, individuals with blood type O may have an increased risk of severe malaria, while blood type A has been associated with an increased risk

blood group system has been investigated for its potential associations with cancer susceptibility and prognosis. Numerous studies have examined the relationship between ABO blood groups and various types of cancer, including gastric cancer, pancreatic cancer, colorectal cancer, and breast cancer, among others. The

findings have revealed diverse associations, with some cancers showing an increased risk in specific blood types and others showing a protective effect.[18,19] For instance, individuals with blood type A have been found to have an increased risk of gastric cancer, while blood type O has been linked with a reduced risk of pancreatic and ovarian cancers. The exact mechanisms underlying these associations are still under investigation.[22]

The ABO blood group has also been implicated in the development of cardiovascular diseases. Numerous studies have reported associations between specific blood types and the risk of cardiovascular conditions such as coronary artery disease, myocardial infarction, stroke, and venous thromboembolism.[20,26]

The presence of specific ABO antigens, particularly blood type A, has been associated with an increased risk of developing cardiovascular diseases.[20,26] Individuals with blood type A may exhibit higher levels of von Willebrand factor, a glycoprotein involved in platelet adhesion and clot formation, which could contribute to a prothrombotic state. In contrast, individuals with blood type O, lacking A and B antigens, have been found to have a lower risk of cardiovascular diseases, possibly due to the decreased levels of von Willebrand factor and altered coagulation properties.[21]

The ABO blood groups have also been studied concerning other diseases and conditions, such as peptic ulcers, kidney disease, and infertility. Associations between ABO blood groups and these conditions are complex and multifactorial, involving various genetic and environmental factors. Research has suggested potential associations between ABO blood types and conditions such as kidney disease, autoimmune disorders, venous thromboembolism, and asthma.[23,24,25,28]

The ABO blood group system has been associated with susceptibility to various infectious diseases. Several studies have suggested that individuals with certain blood types may have an increased or decreased risk of acquiring certain infections. For example, individuals with blood type O have been found to have a higher susceptibility to severe malaria caused by Plasmodium falciparum.[26] while individuals with blood type A are more susceptible to Helicobacter pylori infection, a bacterium associated with peptic ulcers and gastric cancer.[27]

The ABO blood group and its association with the development of severe osteoarthritis of the knee has been poorly studied in Europe, America and Australia.[33,34] The available data come mainly from the Asian region, where Li and Wang et al have shown a strong association between blood group AB and the development of severe primary knee osteoarthritis,[29] and showed a significant relationship between Blood group A and the severe primary osteoarthritis.[30, 31, 32] No study has been done so far in the black race, therefore, necessitating this study.

## II. Patients And Methods

The Patients presenting with knee pain in a tertiary Orthopaedic centre in Awka, Nigeria, were interviewed on the onset, course, and cause of their pain to rule out secondary causes of knee osteoarthritis. One hundred and thirty-five patients who presented to our facility between 2016 and 2021 and who were diagnosed with severe primary knee osteoarthritis were recruited into the study. The sample size was determined with Lesle and Kisch's formular. They underwent clinical examination and radiological investigation (x-ray) of the affected knee/knees. The primary severe osteoarthritis of the knee was diagnosed using the findings on clinical examination and x-ray of the knee(s). Kellgren and Lawrence's classification of knee osteoarthritis helped assess the X-ray and confirm the diagnosis of severe knee osteoarthritis.

Each of the patients underwent a blood grouping test to ascertain their blood groups.

Samples were also collected from a control group of equivalent numbers.

The findings underwent statistical tests for significance and associations with the ABO blood group.

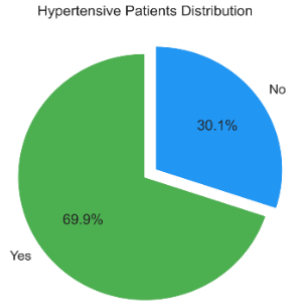
The results were presented with appropriate statistical tables.

## III. Result

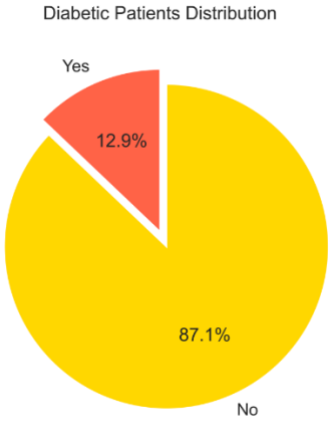
The result of this study is presented with appropriate charts and tables below:

**Table 1: Sex(Gender)**

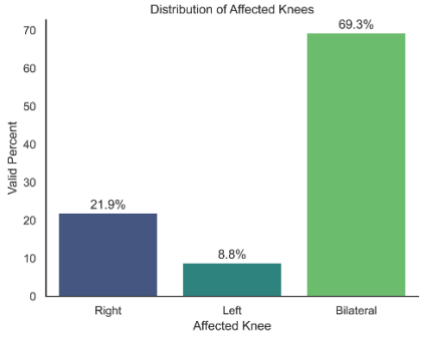
| **Gender** | Frequency | Valid Percent |
|---|---|---|
| Male | 26 | 22.4 |
| **Female** | 90 | 77.6 |
| **Total** | 116 | 100.0 |



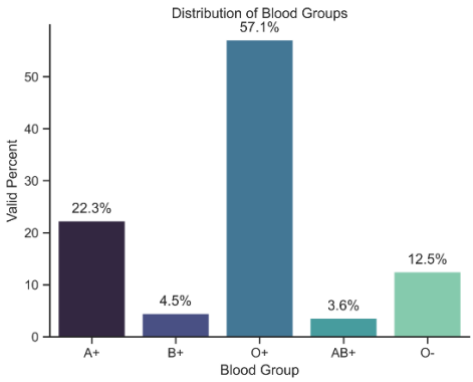

69.9% of the diagnosed patients with severe osteoarthritis in the study population are hypertensive, while 30.1% are not.




A smaller percentage (12.9%) of patients with severe osteoarthritis of the knee in the study population are diabetic, while a greater percentage (87.1%) are not.




For the affected knee, 69.3% are bilateral, 21.9% are on the right knee, and 8.8% are on the left knee.



Based on this study, 57.1% of the diagnosed patients belong to blood group $O^+$, 22.3% belong to blood group $A^+$, 12.5% belong to blood group $O^-$, 4.5% belong to blood group $B^+$ while 3.6% belong to blood group $AB^+$

**Regression analysis to check the effect of blood group on diagnosis outcome (severe osteoarthritis).**

**Table 2: Variables for blood group on Osteoarthritis**

| **Variables Entered/Removed[a]** | | | |
|---|---|---|---|
| **Model** | Variables Entered | Variables Removed | Method |
| **1** | Blood Group[b] | . | Enter |
| **a. Dependent Variable: Diagnosis** | | | |
| **b. All requested variables entered.** | | | |

**Table 3 Model summary for blood group on Osteoarthritis**

| **Model Summary** | | | | |
|---|---|---|---|---|
| **Model** | R | R Square | Adjusted R Square | Std. Error of the Estimate |
| **1** | .030[a] | .001 | -.008 | .212 |
| **a. Predictors: (Constant), Blood Group** | | | | |

**Table 4 ANOVA for blood group on Osteoarthritis**

| **ANOVA[a]** | | | | | | |
|---|---|---|---|---|---|---|
| **Model** | | Sum of Squares | df | Mean Square | F | Sig. |
| **1** | Regression | .004 | 1 | .004 | .095 | .758[b] |
| | Residual | 4.915 | 109 | .045 | | |
| | Total | 4.919 | 110 | | | |
| **a. Dependent Variable: Diagnosis** | | | | | | |
| **b. Predictors: (Constant), Blood Group** | | | | | | |

**Table 5 Coefficient for blood group on Osteoarthritis**

| **Coefficients [a]** | | | | | | |
|---|---|---|---|---|---|---|
| **Model** | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
| | | B | Std. Error | Beta | | |
| **1** | (Constant) | 1.038 | .041 | | 25.224 | .000 |
| | Blood Group | -.004 | .012 | -.030 | -.309 | .758 |
| **a. Dependent Variable: Diagnosis** | | | | | | |

## IV. Discussion

This study was conducted in Awka, Nigeria. One hundred and thirty-five patients who were diagnosed with severe primary knee osteoarthritis were recruited into the study. reveals that a significant proportion of patients diagnosed with severe osteoarthritis belongs to the O+ blood group (56%), followed by the A+ blood group (20.7%). This suggests that there may be a potential link between blood groups and the risk of developing severe knee osteoarthritis in blacks. However, the regression analysis explicitly examining the effect of the blood group on the diagnosis outcome of severe osteoarthritis shows a negligible R2 value. This indicates that the ABO blood group does not significantly account for the observed variations in the outcome: the diagnosis of severe osteoarthritis. The analysis of variance further supports this finding by indicating that there is no significant relationship between the ABO blood group and the development of severe osteoarthritis. This means that the actual number of people diagnosed with severe osteoarthritis who underwent total knee replacement follows the pattern of the average population. This is further supported by the distribution of blood groups of those with severe osteoarthritis and that of the average population.

From the analysis carried out to check the effect of the ABO blood group on diagnosis outcome (severe osteoarthritis), R2 value of 0.001 shows that the ABO blood group does not significantly account for variations observed in the outcome of diagnosis

In testing the hypothesis which states that:

H0: There is a relationship between the ABO blood group and the development of severe osteoarthritis versus H1: There is no relationship between the ABO blood group and the development of severe osteoarthritis

From the ANOVA table 4 above, an F-ratio of .095 with a P-value of 0.758 indicates that the test is not significant; hence we reject H0 and conclude that there is no relationship between the ABO blood group and the development of severe osteoarthritis.

Li and Wang et al. (2020) the study revealed a significant association between ABO blood groups and knee osteoarthritis. Specifically, individuals with blood group AB had a higher risk of knee osteoarthritis.[29]

Vishwakarma conducted a study in Pradesh and found a strong relationship between blood group A and the development of severe osteoarthritis.[30]

Also, in Pakistan, Shaikh et al. found that blood group A has a strong association with the severity of primary knee osteoarthritis.[31]

In Turkey, Yaradılmış also found a strong association between blood group A and the development of severe primary osteoarthritis.[32] These findings in the Asian region are at variance with the findings in the black Nigerian community of Awka,

This study, which was conducted in the Nigerian black population in Awka, showed that 97.4% of the patients were diagnosed with severe osteoarthritis, 56% of them belong to the O+ blood group. In comparison, 20.7% belong to the A+ blood group. Some relationship analyses and regression were carried out. This was to check the effect of gender on occupation, blood group, and diagnosis outcome (Severe osteoarthritis). The correlation analysis shows a negative association between sex and occupation with a correlation coefficient of -20.4% with a P-value of 0.035, Gender and ABO blood group with a correlation coefficient of -4.8% with a P-value of 0.337. In comparison, the result shows a positive association between gender and diagnosis of osteoarthritis with a correlation coefficient of 8.2% with a P-value of 0.235. From the analysis carried out to check the effect of the ABO blood group on diagnosis outcome (severe osteoarthritis), an R2 value of 0.001 shows that the ABO blood group does not significantly account for the development of severe osteoarthritis. In testing the hypothesis: Analysis of variance carried out to test for multiple comparisons gave an F-ratio of .095 with a P-value of 0.758, indicating that the test is not significant and that there is no relationship between the ABO blood group and the development of severe osteoarthritis. From the correlation analysis carried out, there is a weak and negative association between some attributable factors, such as blood group, occupation, hypertensive patients, diabetic patients, patients transfused, and diagnosis outcome (osteoarthritis), with a correlation coefficient of 0.4%, -15.2%, -8.0%, -25,5% and -11.0% respectively. This implies that in as much as there appears to be a relationship among the variables considered, the extent of these relationships, as measured by correlation analysis, indicates a weak association with severe osteoarthritis development. This is inconsistent with findings from the Asian population. The ABO blood group in patients diagnosed with severe osteoarthritis in Nigeria followed the same pattern as the ABO group of the normal population.

## V. Conclusion:

The study explored the link between blood groups and severe knee osteoarthritis in the black population. We found that significant proportions of patients with severe osteoarthritis have O+ (56%) and A+ (20.7%) blood groups. The regression analysis focused on the impact of the blood groups on severe osteoarthritis diagnosis, revealing a minimal R2 value. This finding suggests that the ABO blood group insignificantly influences the diagnosis outcome. Additionally, the analysis of variance corroborated this, indicating no significant link between the ABO blood group and severe osteoarthritis development.

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