

Childhood Knee Problem as a Risk Factor for Adulthood Knee Osteoarthritis: A Case-Control Study

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Abstract

Knee osteoarthritis (OA) is the most common joint affected with osteoarthritis. It has multifactorial causative factors including childhood knee problems and disorders. The study aimed to investigate childhood-specific knee problems as risk factors for knee Osteoarthritis in adulthood. This case-control study was conducted at an Orthopaedic Hospital Wamakko, Sokoto, North-Western Nigeria between January 2022 and December 2022. 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. The inclusion criteria were adult patients aged >40 years with knee OA. The data collected was 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 15 (4.03%) patients with previous childhood knee problems and 357 (95.97%) no history of previous childhood knee problems. Among the cases group, there were 13 (10.5%) cases with previous childhood knee problems and among them, there were 8 males and 7 females; childhood history of injury (6), patella instability (3), unspecific knee pains (2), peri-articular fracture (1), and knee infection (1). There was a statistically significant result between childhood knee problems and Adulthood knee OA (OR=14.405, CI=3.197-64.915, and P<0.001). The study findings have shown childhood knee problems to be risk factors for adulthood knee osteoarthritis.

Keywords: Childhood Knee Problems, Case-Control Study, Knee Injuries, Knee Osteoarthritis.

Introduction

Osteoarthritis (OA) is a chronic non-communicable disease presenting with pain and joint stiffness that result from the gradual loss of articular cartilage and other structural damage [1]. It affects the whole joint with subsequent loss of function, disability and reduced overall quality-adjusted life years (DALYs). The OA global prevalence of 16% is a concern to the socio-economic and job-

related performance [2]. Among the OA diseases, Knee osteoarthritis (OA) is the most common and is equally associated with chronic and discomforting symptoms that may warrant total joint replacement [3]. Knee OA has multifactorial causative factors and most importantly are age, female gender, genetic predisposition, increased body weight and obesity, occupation, and previous knee injury among others [2, 4]. Of particular importance is the predisposing factor for risk of knee OA

during childhood because problems or disorders that arose during the young age period may contribute to the pathogenesis of knee OA during adulthood [5, 6]. These knee disorders include knee trauma, congenital and developmental diseases like Blount disease, metabolic bone disorders, patella instability, and knee ligament injuries. With the need for more research that produces innovative and cost-effective methods of preventing or slowing down the advancement of knee OA, identifying and dealing with these factors, particularly at a young age is crucial to the public health approach in the management of knee OA [7]. As knee OA is largely a disease of the older population, the influence of early age factors in its aetiology could not be underestimated because of the chronicity and disease course before its clinical manifestation. This caused some difficulties in conducting longitudinal research relating early age factors in causing old age osteoarthritis due to a need for long-term follow-up and challenges in identifying the early factors [5, 8]. With these background facts, only a few studies are now available relating childhood knee problems with adulthood knee OA.

The study's aim was to investigate childhood-specific knee problems as risk factors for knee Osteoarthritis in adulthood by conducting a hospital-based case-control study.

Materials and Methods

This case-control study was conducted at a major Orthopaedic referral Hospital, Wamakko, located in Sokoto, North-Western Nigeria for a period between January 2022 and December 2022. The study was conducted following ethical approval from the Ministry of Health Sokoto with Ref no. SMH/1580/V.IV. The cases with knee OA and unmatched controls were randomly selected during the clinic 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 [9]. The inclusion criteria were adult patients aged >40 years with knee OA, and the exclusion criteria were knee infection, post-peri-articular fracture and postoperative knees. The data collection was made via participants' interviews with the use of a reliable questionnaire. Questions regarding demographic features, childhood knee problems and other associated risk factors for knee OA were asked. This was followed by Knee joint clinical presentations and detail of radiological findings. The knee clinical examination focussed on the evidence of knee deformity and previous scar.

Data were analysed using SPSS version 26 and categorical variables were presented in form of frequency and percentages. 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 the knee was considered positive if the exposure variables were significant at a 5% level.

Results

Tables 1 to 3 showed some important aspects of 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 15 (4.03%) patients with previous childhood knee problems and 357 (95.97%) with no history of previous childhood knee problems. Among the cases group, there were 13 (10.5%) cases with previous childhood knee problems and among them, there was a childhood history of injury (6), patella instability (3), unspecific knee pains (2), peri-articular fracture (1), and knee

infection (1) (Figure 1). There were 8 men and 7 females with childhood knee problems in the study.

There was a statistically significance result between childhood knee problems and Adulthood knee OA (OR=14.405, CI=3.197-

64.915, and $P<0.001$) (Table 2). Table 3 provides results for logistics regression of all factors taken into consideration in this study, and for the childhood knee problems, the OR=9.474 (CI=2.560-69.115; $p<0.002$).

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)

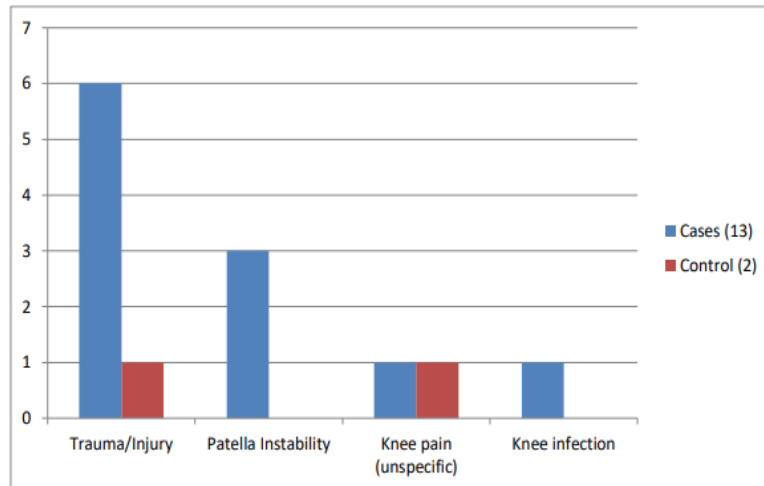


Figure 1. Various Childhood Problems in both Cases and Controls

Table 2. Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Childhood knee problem (Yes / No)	14.405	3.197	64.915
For cohort Patient Category = Case	2.787	2.168	3.584
For cohort Patient Category = 2.00	.193	.053	.704
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	Childhood Knee Problems	2.588	.841	9.474	1	.002	13.301	2.560	69.115
	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
	Obesity	1.775	.271	42.773	1	.000	5.899	3.466	10.040
Constant	.546	.850	.412	1	.521	1.726			

Discussion

The risk of developing Knee OA is multifactorial and these include modifiable and non-modifiable risk factors [10]. Among the latter group, childhood knee problems present various modifiable and preventable risk factors because preventing or treating such disorders at an early age can greatly reduce the prevalence of knee OA and Knee OA-related morbidities during adulthood [11]. This study presented 13 (10.5%) patients with childhood knee problems among the 124 knee OA cases. The knee problems recorded include knee trauma, patella instability, unspecific knee pain, peri-articular fracture and knee joint infections.

Children and young adults are known to be involved in both indoor and outdoor play [12]. The frequent involvement in school physical activities exposed them to easy sustainability to physical injuries that comprised knee ligaments and meniscal tear, simple strains and sprains, Osgood Schlatter disease (OSD), fracture around the knee and knee dislocations [13]. Other childhood problems including mal-alignment disorders like Blount disease, infections such as septic arthritis and osteomyelitis, and unspecific anterior knee pain especially the one arising from Osteochondritis dissecans (OCD) and bursitis all contribute as predisposing factors for adulthood knee OA [14].

The current study did not take other childhood factors like obesity, socioeconomic factors, and child abuse into consideration. Other studies considered multiple factors but have acknowledged the challenge of measuring the long-term effects of childhood factors on knee OA [5, 15]. While research by Snoeker B et al explicitly looked at different types of knee injuries sustained by young adults in a population-based cohort study reported 6 times the risk of future knee OA with the highest risk associated with cruciate ligament injury, meniscal tear and intra-articular fractures [16]. Recurrent patella

dislocation that occurs commonly at a young age has been linked with the risk of adulthood knee OA specifically the patella-femoral osteoarthritis (PFOA). A case-control study to determine the effect of adolescent knee pain and patella dislocation on adulthood PFOA reported that young patients with anterior knee pain are 7.5 times more likely to have patella dislocation and this has a strong risk for knee OA later in life [17]. Peri-articular and intra-articular fractures occurring at an early age serve as a major risk factor for adulthood knee OA due to early articular cartilage biomechanical damage and prolonged wear and tear from knee joint mal-alignments [12, 18].

Childhood knee septic arthritis if not diagnosed early and promptly treated could lead to accelerated cartilage breakdown with subsequent predisposition to various joint complications including adulthood knee OA [19]. It may be difficult to ascertain this diagnosis in retrospect by patients who are affected by knee OA in adulthood. However, a history of febrile illness, joint pain and swelling may provide useful hints on the likelihood of joint infection as being the offending factor. Many joints, post-septic arthritis were likely ankylosed or if treated early may have undergone one of the knee joint procedures including knee arthroplasty [20].

The limitations of the study include a lack of consideration for other childhood knee problems as risk factors for knee OA later in life such as obesity and other socioeconomic factors, and this may have contributed to the lower positive response among the study subjects. The facts that recall bias exists especially on the knee problems that were completely treated or the problems went unnoticed were there to be factored in. However, the use of specific knee factors such as trauma, patella dislocation and infections have narrowed down the question and findings to be easily evaluated and validly reported.

Conclusion

These study findings have shown that childhood knee problems such as knee injuries, and patella instability are independent risk factors for adulthood knee osteoarthritis. Prevention and early treatment of these problems may remarkably reduce the current high prevalence of knee OA in adulthood.

References

- [1]. Geyer M, Schönfeld C. J., Novel insights into the pathogenesis of osteoarthritis. *Current rheumatology reviews*. 2018 Aug 1;14(2):98-107.
- [2]. Cui A, Li H, Wang D, Zhong J, Chen Y, Lu H., Global, regional prevalence, incidence and risk factors of knee osteoarthritis in population-based studies. *EClinicalMedicine*. 2020 Dec 1;29.
- [3]. Murphy B. P., Dowsey M. M., Choong P. F., The impact of advanced age on the outcomes of primary total hip and knee arthroplasty for osteoarthritis: a systematic review. *JBJS reviews*. 2018 Feb 1;6(2): e6.
- [4]. Georgiev T, Angelov A. K., Modifiable risk factors in knee osteoarthritis: treatment implications. *Rheumatology international*. 2019 Jul 1;39(7):1145-57.
- [5]. Antony B, Jones G, Jin X, Ding C. Do early life factors affect the development of knee osteoarthritis in later life: a narrative review. *Arthritis research & therapy*. 2016 Dec; 18:1-8.
- [6]. Snoeker B., Turkiewicz A., Magnusson K., Frobell R., Yu D., Peat G., Englund M. Risk of knee osteoarthritis after different types of knee injuries in young adults: a population-based cohort study. *British journal of sports medicine*. 2020 Jun 1;54(12):725-30.
- [7]. Roos E. M., Arden N. K., Strategies for the prevention of knee osteoarthritis. *Nature*

Competing Interests

The author declared no known competing interests

Funding

None.

Acknowledgements

I would like to appreciate the Texila American University for an opportunity to publish from a section of my PhD thesis work.

Reviews Rheumatology. 2016 Feb;12(2):92-101.

[8]. Thomas M. J., Wood L., Selfe J., Peat G., Anterior knee pain in younger adults as a precursor to subsequent patellofemoral osteoarthritis: a systematic review. *BMC musculoskeletal disorders*. 2010 Dec; 11:1-8.

[9]. Belo, J. N., Berger, M. Y., Koes, B. W., & Bierma-Zeinstra, S. M. A., (2009). The prognostic value of the clinical ACR classification criteria of knee osteoarthritis for persisting knee complaints and increase of disability in general practice. *Osteoarthritis and cartilage*, 17(10), 1288-1292.

[10]. Musumeci G., Aiello F. C., Szychlinska M. A., Di Rosa M., Castrogiovanni P., Mobasher A., Osteoarthritis in the XXIst century: risk factors and behaviours that influence disease onset and progression. *International journal of molecular sciences*. 2015 Mar 16;16(3):6093-112.

[11]. Roos E. M., Arden N. K., Strategies for the prevention of knee osteoarthritis. *Nature Reviews Rheumatology*. 2016 Feb;12(2):92-101.

[12]. Whittaker J. L., Woodhouse L. J., Nettel-Aguirre A., Emery C. A., Outcomes associated with early post-traumatic osteoarthritis and other negative health consequences 3–10 years following knee joint injury in youth sport. *Osteoarthritis and cartilage*. 2015 Jul 1;23(7):1122-9.

- [13]. MacDonald J., Rodenberg R., Sweeney E., Acute knee injuries in children and adolescents: a review. *JAMA pediatrics*. 2021 Jun 1;175(6):624-30.
- [14]. Kastelein, M., Luijsterburg, P. A. J., Heintjes, E. M., van Middelkoop, M., Verhaar, J. A. N., Koes, B. W., and Bierma-Zeinstra, S.M.A., 2015. The 6-year trajectory of non-traumatic knee symptoms (including patellofemoral pain) in adolescents and young adults in general practice: a study of clinical predictors. *British Journal of Sports Medicine*, 49(6), pp.400-405.
- [15]. Murphy L., Schwartz T. A., Helmick C. G., Renner J. B., Tudor G., Koch G., Dragomir A., Kalsbeek W. D., Luta G., Jordan J. M., Lifetime risk of symptomatic knee osteoarthritis. *Arthritis Care & Research: Official Journal of the American College of Rheumatology*. 2008 Sep 15;59(9):1207-13.
- [16]. Snoeker B., Turkiewicz A., Magnusson K., Frobell R., Yu D., Peat G., Englund M. Risk of knee osteoarthritis after different types of knee injuries in young adults: a population-based cohort study. *British journal of sports medicine*. 2020 Jun 1;54(12):725-30.
- [17]. Conchie H., Clark D., Metcalfe A., Eldridge J., Whitehouse M., Adolescent knee pain and patellar dislocations are associated with patellofemoral osteoarthritis in adulthood: a case control study. *The Knee*. 2016 Aug 1;23(4):708-11.
- [18]. Ezzat A. M., Whittaker J. L., Toomey C., Doyle-Baker P. K., Brussoni M., Emery C. A., Knee confidence in youth and young adults at risk of post-traumatic osteoarthritis 3–10 years following intra-articular knee injury. *Journal of Science and Medicine in Sport*. 2018 Jul 1;21(7):671-5.
- [19]. Rego de Figueiredo I., Vieira Alves R., Guerreiro Castro S., Antunes A. M., Gruner H., Panarra A. Septic arthritis incidence and risk factors: a 5-year cross-sectional study. *Infectious Diseases*. 2019 Aug 3;51(8):635-7.
- [20]. Abram S. G., Alvand A., Judge A., Beard D. J., Price A. J., Mortality and adverse joint outcomes following septic arthritis of the native knee: a longitudinal cohort study of patients receiving arthroscopic washout. *The Lancet Infectious Diseases*. 2020 Mar 1;20(3):341-9.