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Patterns of Lower Extremity Injuries and Its Association with Q-Angle among Amateur Footballers in North-Western Nigeria

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Abstract

Background: *Football is the most populous sporting activity worldwide, despite the availability of research in its prevention, the rate of injury is high especially among amateur players. However, the actual association between the patterns of injuries and Quadriceps angle (Q-angle) among amateur footballers has not been documented in Northern Nigeria.* **Objective and method**: *This cross-sectional survey study investigated the patterns of lower extremity injuries and its association with Q-angle among amateur footballers in North-Western Nigeria. The Q-angle of 165 male amateur footballers was measured using goniometer in lying and standing positions, with the quadriceps muscles relaxed. The data were analysed using descriptive statistics of percentage, mean and standard deviation as well as Chi-Square.* **Results**: *Footballers with higher Q-angle (≥ 20°) had a high rate (69.7%) of injuries compared with low (< 10°) and normal range (10° to 15°) mostly occurring at the dominant limb. There was a high rate of lower extremity injuries, mostly around the midfield and defensive zones of the pitch. There was also a significant association between Q-angle and patterns of injuries. There was also a higher rate of recurrence injuries among footballers with greater (≥20°) and low Q-angle (<10°).* **Conclusion**: *The study identified a change in Q-angle as a predisposing factor to lower extremity injuries amateur footballers with greater or asymmetrical Q-angle are at risk of lower extremity injuries and its recurrence. The study suggests that Q-angle measurement should be included as part of pre and post-season assessment.*

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Keywords: *quadriceps angle (Q-angle), lower extremity injuries, pattern of injury, amateur footballers.*

Introduction

Football has been considered the most populous sport worldwide, with an estimated 265 million people across different gender, age and professional level.[1] Despite its relative safety in both match and training sessions, it is still considered as the most common cause of injuries, which is an unfortunate consequence of participation, especially to amateurs and

professionals. The injuries can have a personal and economic burden on the individual playing the game and the team managers,[2] leading to high medical cost, absenteeism, and reduced performance of the team (Letsellast model, 2008). Furthermore, it has been reported that football players are twice more prone to sustain a severe injury than those engaging in wrestling.[3] It has earlier been reported that the incidence of injuries to football players is low at a professional level and high at the amateur level.[4] They also reported that the overall injury rate was 62 per 1000 hours of participation, which included both training and competitive situations. Lower limb injuries in football are increasingly prevalent and responsible for large economic as well as personal burdens to the player and the team in general.[5] In a study of a Greek professional team, 86.2% of the injuries reported involved the lower extremity with knee and ankle as the most frequently injured joints.[6]

A study of a 1-year prevalence rate of injuries in 103 first-team high school female football players from nine schools in Johannesburg was 46.1% and the point prevalence was 37.8%. The main sites of injury were the knee (18.6%) and the ankle (17.6%).[7] However, a study from Benin City of Nigeria, reported an epidemiology of football-related injuries, and found that a total of 196 players sustained 204 injuries with a prevalence rate of 81.6% and the ankle (25%) was the most affected site, followed by the knee (20.1%) then the thigh (13.2%).[8]

Most football-related injuries are relatively minor in terms of the degree of the resultant disability, more serious injuries often result through the execution of hard sliding tackle or other sudden physical collisions between players.[3] Akinbo, Odebiyi, and Adebayo[9] reported that football injuries are expected consequences of athletic competitions and are not generally as a result of a single causative factor, but are associated with various factors interacting at a given time. Most authors believed that the predictors or determinants of

sports injuries include, gender, age, psychological distress or mood, body anthropometry, history of previous injuries, Q-angle and players' physical fitness and skill level.[9]

The Q-angle is the angle subtended by the intersection of a line drawn from the anterior superior iliac spine to the centre of the patella and another line connecting the centre of the patella to the centre of the tibial tuberosity. One of the functions of Q-angle is to provide bowstring effect, which enables the patella to move laterally as the Quadriceps contract.[10] It is considered as the determinant of injuries in athletic sports, mostly affecting the lower extremity.[11] Rauh, Koepsell, Rivara, Rice and Margherita[12] reported that the Q-angle should be included in a preseason examination because larger or asymmetric Q-angle is related to the occurrence of lower extremity injuries among high school cross country runners. The lower extremity alignment has been proposed as a risk factor for acute and chronic lower extremity injuries, including patella-femoral syndrome,[13] anterior cruciate ligament injuries,[14,15,16] medial tibia stress syndrome, stress fractures and patella fascitis.[17]

Despite numerous established preventive measures implemented in football to reduce injury rates, the epidemiology of injury remains higher, especially among amateur footballers. Studies have been carried on professional footballers in Nigeria[8,18] at the neglect of the amateur footballers because of the belief that they (amateur footballers) are at the beginning of professional carrier. Furthermore, previous studies did not investigate the relationship between patterns of injuries and mechanical factors such as Q-angle which is a limitation of their findings. Research has yet also determined the association of Q-angle and patterns of lower extremity injuries among amateur footballers in North-Western Nigeria, hence the need for this current study. Determining the anatomical factors that have the potential to impact the magnitude of the Q-angle may allow clinicians and researchers to better determine its role in dynamic motion and risk of lower extremity injuries. Thus, the

purpose of this study was to determine the association of Q-angle and patterns of lower extremity injuries among amateur footballers in North-Western Nigeria.

Methods

A total of one hundred and sixty five (165) male amateur footballers from North-Western Nigeria (age 23.25±2.75 years) with at least 3 years playing experience volunteered to participate in this cross-sectional survey study. The study involved only male amateur football players actively participating in a registered amateur team, in either division 1 or 2 in Nigerian amateur football league. A total number of one hundred and sixty five (165) players constituted the sample size, which was statistically determined using Yaro Yamane formula for a finite population.[19] Participants were conveniently selected from ten (10) registered clubs of twenty three (23) players. The clubs were also conveniently selected from three (3) different North-Western States of Nigeria (3 from Katsina State, 2 from Jigawa State and 5 from Kano State).

Ethical approval was obtained Aminu Kano Teaching Hospital Research and Ethical Committee (AKTH/MAC/SUB/12A/P-3/VI/1698) and also from sports councils of the respective States involved in the study (Jigawa, Kano and Katsina States). The researcher recruited and trained some of the club officials and some medical officials attached to the clubs as research assistants (two from each club). The purpose, procedures, and ethical components of the study were duly explained to the research assistants and the participants. The consent form was explained and given to the participants to sign. The UEFA Injury report forms (reliability= 0.80; validity= 0.89) were distributed to the members by the researcher and the research assistants. The form consisted of demographic details, the part of the body injured, the playing position, playing ground, the nature of the injury and the

protective device used (If any). A researcher proforma was designed to record the Q-angle of the participants.

Measurement

The Q-angle was measured with the subject in either standing or lying supine on levelled ground and relaxed position (both standing and supine positions were adopted in this study based on participant's convenience). Using a calibrated Goniometer and a marker, the Q-Angle was determined by locating and marking the center of the patella, locating and marking anterior superior iliac spine (ASIS), and locating and marking the tibia tuberosity.[20] The Q-Angle was taken by measuring the angle of intersection of a line drawn from the anterior superior iliac spine (ASIS) to the centre of the patella and another line connecting the centre of the patella to the centre of the tibial tuberosity. The angle was then recorded in degrees.[21]

Data Analysis

Descriptive statistics of mean, standard deviation, frequency, and percentages were used to describe the footballer's demographic and anthropometric variables. The inferential statistics of Chi-square were used to determine the association between Q-angle and patterns of injuries, while an independent t-test was used to determine the difference in the variables between one group and another. SPSS Version 20 (SPSS, Inc., Chicago, Illinois, United States of America) was used for the data analysis. The alpha level was set at 0.05.

Result

A total of one hundred and sixty five (165) footballers participated in the study with the mean age of 23.25±2.75 years, age range 17-31 years. The mean Q-angle was 16.64±2.99 degrees, this showed that the majority of the participants had either higher Q-angle or lower

than the normal range (7.6-21.3). Furthermore, the mean height and weight of the participants were 1.63±0.07 and 56.8±5.43 respectively. (Table 1)

Table 1: Q-angle and demographic variables of the participants (N=165)

Variables	Minimum	Maximum	Mean±Sd
AGE (yrs)	17.00	31.00	23.25±2.75
Q-Angle(Degrees)	7.60	21.30	16.64±2.99
Height (m)	1.45	1.74	1.63±0.07
Weight(Kg)	43.00	70.0	56.8±5.43

In this study, there was a high frequency of injuries among the participants, with 69.7% of participants being injured, as against 30.3% of uninjured players (table 2), The injuries occurred predominantly on sandy playing ground 106 (64.2%), and less on grass 32(19.4), while 27(16.4%) occurred on artificial grass as shown in Table 2. The distribution of injuries across playing positions showed that midfielders sustained more injuries 57(34.5%), followed by the strikers 48(29.1%), goalkeepers 32(19.4%) and defenders 27(16.4%) as shown in Table 2. In this study, most of the injuries were recurrent 41(24.8%) while some were aggravated 29 (17.6%) and fewer new injuries 27(16%) were reported. The injuries occurred predominantly on the right side of the body 76 (46.1%) than the left 39 (23.6%). Furthermore, the injuries occurred more on the calf 33 (20%), than on knee 32(19.4%) and ankle 28(17%) and less on the shin 3(1.8%) (Table 2). The predominant types of injury among the amateur footballers in the North-Western Nigerian included sprain injury 18(10.9%), strain 15(9.1%) and dislocation 3(1.8%). Most of the injured players used football boot as the main protective gadget, which constituted 112 (67.9%) Table 2.

Table 2: Prevalence of injuries among amateur footballers by injury status, playing ground, the playing position, type of injury, injury site, body part injured, injury mechanism, symptom of injury, nature of playing ground, marital status, body mass index. (N=165)

Variable	Frequency (n)	Percentage (%)
INJURY STATUS		
Presence of injury	115	69.70
Absence of injury	50	30.30
PLAYING GROUND		
Grass	32	19.40
Artificial grass	27	16.40
Gravel	106	64.20
PLAYING POSITION		
Midfielder	57	34.50
Striker	48	29.10
Defender	27	16.40
Goalkeeper	32	19.40
NATURE OF INJURY		
New	27	16.00
Recurrent	41	24.80
Aggravated	29	17.60
Other	18	10.90
INJURY SITE		
Left	39	23.60
Right	76	46.10
BODY PART INJURED		
Hip/buttocks	5	3.00
Thigh	9	5.50
Calf	33	20.00
Knee	32	19.40
Ankle	28	17.00
Foot	4	2.40
Shin	3	1.800
INJURY MECHANISM		
Tackling	22	13.30
Sprinting	26	15.80
Passing	18	10.90
Pushing	18	10.90
Other	30	18.20
SYMPTOM OF INJURY		
Blister	6	3.60
Sprain	18	10.90
Strain	15	9.10
Swelling	53	32.1
Dislocation	4	2.40
Fracture	4	2.40
MARITAL STATUS		
Single	142	86.10
Married	23	13.90
BODY MASS INDEX		
Underweight	18	10.90
Normal	142	86.10
Overweight	5	3.00

Key: n=frequency; %=percentage

From the result presented in Table 3 below, there was no significant association between playing ground and patterns of injury among amateur footballers. However, there was a significant association between the playing position and patterns of injury among amateur footballers. There was a significant association among the nature of injury and injury patterns among amateur footballers.

Table 3: Association of Playing Ground, Playing Position, Nature of Injury and Patterns of Lower Extremity Injuries among Amateur Footballers in North-Western Nigeria. (N=165)

Variable		Playing Surface				Total	X^2	Df	P-value
	Grass	Artificial Grass	Sand						
Injury Status									
Injured	23	19	73			115			
Uninjured	9	8	33			50	0.112	2	0.945
Total	32	27	106			165			
	Midfielder	Striker	Defender	Goalkeeper	Other				
Injured	43	41	23	8	0	115	42.142	4	0.000*
Uninjured	14	7	4	24	1	50			
Total	57	48	27	32	1	165			
		New	**Recurrent**	**Aggravated**	**Other**				
Injured	0	27	41	29	18	115	165.0	4	0.000*
Uninjured	50	0	0	0	0	50			
Total	50	27	41	29	18	165			

*Key: *=Significant; X^2=Chi square value; P=P-value*

The study showed that there was an association of Q-angle and patterns of lower extremity injuries, Table 4 shows that the higher the change in Q-angle, the higher the rate of lower extremity injuries among the participants.

Table 4: Association of Q-angle and Patterns of Injury among Amateur Footballers (N=165)

Injury Status	Q-Angle			Total	X^2	P-value
	Low	Normal	High		49.95	0.000*
Injured	5	37	73	115		
Uninjured	0	46	4	50		
Total	5	83	77	165		

*Q-angle =Quadriceps angle; *=Significant; X^2=Chi square value; P=P-value*

Discussion

This study aimed to investigate the association of Q-angle as a mechanical factor to lower extremity injuries and patterns of lower extremity injuries among amateur footballers. The study found that there was an increased rate of injury occurrence among amateur footballers in North-Western Nigeria, with 69.7% sustained injury. The study also showed a significant association between Q-angle, injury occurrence, and its patterns. Moreover, the study showed a high prevalence of injury around the midfield and defensive zone of the pitch.

There exists consistency with the finding of this study and that of Ani, Ibikunle, Akosile, and Useh[22] who found a high prevalence of injury among professional football players that participated in 2011/2012 Nigeria premier league. Other studies that are consistent with the finding of this study are Azubuike and Okojie[8] and Akinbo et al.,[18]. However, the finding of this study is at variance with the studies of Emery, Meeuwisse, and Hartman[23], Ekstrand and Vogel[24] and Faude, Junge, Kindermann, and Dvorak[25]. They

reported lower prevalence rates of injuries among the football players in European leagues. This high injury rate among amateur football players in North-Western Nigeria may be associated with some extrinsic and intrinsic factors.[26] The intrinsic factors are player's mentality and player's experience, while the extrinsic factors are the nature of playing ground, the nature and type of protective gadget used (shin guards and shoes) and poor playing condition. Another reason for the high injury rate might be the so-called "win at all cost mentality".[8]

This study showed that the majority of the injured amateur players that participated in the study were found to have a high Q-angle, with 37 (32.2%) were found to have a normal Q - angle while 5 (4.3%) were found to have a low Q - angle. This means that lower extremity injuries among amateur footballers were associated with high Q-Angle and that the rate of injury occurrence reduces with low or normal Q-angle. The Q-Angle is an important indicator of biomechanical function and normal alignment of the lower leg, providing useful information on the functional ability of the lower extremity.[11] The result is also in accordance with the study of Emami, Ghahramani, Abdinejad, and Namazi[27] study where it was reported that anterior knee pain is strongly associated with the larger Q-angle among healthy individuals. Furthermore, the study of Daneshmandi and Saki[14] revealed that excessive Q-angle has been found to influence lower extremity kinematics. Alteration in the Q-Angle changes the pattern of stress experienced by the patella cartilage, hence it is the precursor to many knee injuries and is identified as a risk factor for knee injuries. In most of the above-cited studies that are in line with the finding of this study, knee and ankle injuries are the most common sports-related injuries that are associated with elevated Q-Angle. Contrary to the finding of those studies, Q-angle has been suggested as risk factors

for injuries.[28,13] However, retrospective risk factors studies have failed to confirm this relationship.[13,14] The reason for the inconsistent findings may be in part due to the multiple anatomical factors that may influence the magnitude of the Q-Angle which may differently impact how the Q-angle relates to dynamic joint function.

Biomechanically, the reason for the association of Q-angle and lower extremity injuries in footballers may be because Q-Angle represents the direction of the quadriceps muscle force vector in the frontal plane, excessive angulation is thought to predispose individuals to injuries caused by abnormal Quadriceps forces acting at the knee and patellofemoral joints. Theoretically, tibiofemoral angle was found to be associated with Q-Angle and that Increased tibiofemoral angle represents the valgus angle formed by the anatomical axes of the femur and tibia, would move the patella medially relative to the anterior superior iliac spine and tibia tuberosity[13] (Powers, Maffucci & Hampton, 1995) thus increasing the Q-Angle and predisposing the individual amateur player to lower extremity injuries.[13]

We observed that the most common injury sites in lower extremity were the ankle and knee joints. A possible reason for the vulnerability of the ankle joint to injury is its proximity to the ball. Thus, the observation is supported with the finding of Wang and Hong,[29] who reported that the chances of ankle injury are highest when dribbling, kicking and tackling. Hawkins and Fuller (1999) suggested that the knee is very susceptible to injury from large forces produced by kicking the ball.[30] It is also the center of the lever arm of the leg, so it is susceptible to greater forces being transmitted from the trunk through the hip and from the ground through the foot and ankle.[31]

A limitation of this study that might hinder its generalizability is the fact that the participants were from North Western Nigeria as well as the sample size used across the

states as it did not consider the female gender. Future studies should consider both gender and professional players should also be considered. Future studies should focus on other biomechanical factors that may influence the change in Q-Angle, the sample size of this study was relatively small, so future studies should consider the use of large sample size to allow generalization of findings.

Conclusion

In conclusion, abnormal Q-angle was found to be associated with the occurrence of lower extremity injuries among amateur footballers in selected States in North Western Nigeria. Future research should look into the measurement of Q-angle for preseason screening in the Nigeria amateur league and/or similar athletic population. Established preventive methods to injuries and/or supportive devices that have shown to reduce structural differences may be implemented to reduce the risk of injury. The principle of fair play should be emphasized during both training and match situations. Further studies and investigation into the relations of Q-angle and other athletic sports across both gender and professional levels are needed, especially sporting activities associated with dynamic motions. Finally, larger sample size and determination of predictive factors using more advanced analytic procedures are suggested in future studies.

Conflict of interest Statement

No potential conflict of interest relevant to this article was reported.

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References

1. *FIFA (2007), Big Count 2006. Zurich: Federation Internationale de Football Association.*

2. *Grelsamer GP, Weinstein CH. Applied biomechanics of the patella. Clin. Orthop. 2001; 389: 9-14. PMID: 11501829*

3. *Herman K, Barton C, Malliaras P, Morrissey D. The effectiveness of neuromuscular warm-up strategies that require no additional equipment, for preventing lower limb injuries during sports participation: a systematic review. BMC Medicine, 2012; 10:75. doi:10.1186/1741-7015-10-75*

4. *McGinity MJ, Grandhi R, Michalek JE, Rodriguez JS, Trevino AM, McGinity AC. et al. The impact of tackle football injuries on the American healthcare system with a neurological focus. PLoS One, 2018; 13(5):e0195827. doi:10.1371/journal.pone.0201273.s002*

5. *Morgan BE, Oberlander MA. An examination of injuries in major league soccer: the inaugural season. Am J Sports Med, 2001; 29(4): 426-430. Doi.org/10.1177/03635465010290040701*

6. *Papacostas M, Pafis G, Bikos Ch, Porfiriadou A. Athletic injuries in soccer: Three-year study of a Greek professional team. Physical Training, Mar 2009 (https://ejmas.com/pt/2009pt/ptart_papacostas_0903.html. Accessed 24/12/2018)*

7. *Constantinou D. Football injuries-surveillance, incidence and prevention. CME, 2010; 28(5): 220-225.*

8. *Azubuike SO, Okojie OH. An Epidemiological Study of Football (Soccer) Injuries in Benin City, Nigeria. Br J Sports Med, 2009; 43 (5):382 386. DOI:10.1136/bjsm.2008.051565*

9. *Akinbo SR, Odebiyi DO, Adebayo AO. Pattern of Musculoskeletal Injuries in Professional Basketball League in Nigeria. The Internet Journal of Rheumatology, 2008; 5 (1).40 (9):785-790.*

10. *Grelsamer RP, Dubey A, Weinstein CH. Men and women have similar Q angles: a clinical and trigonometric evaluation. J Bone Joint Surg Br. 2005;87:1498–501*

11. *Daneshmandi H, Saki F, Shahheidari S, Khoori A. Lower extremity malalignment and its linear relation with Q angle in female athletes. Procedia Social and Behavioral Sciences, 2011; 15: 3349–3354. Doi.org/10.1016/j.sbspro.2011.04.298*

12. *Rauh MJ, Koepsell TD, Rivara FP, Rice SG, Margherita AJ. Quadriceps Angle and Risk of Injury among High School Cross-Country Runners. J Orthop Sports Phys Ther, 2007; 37(12): 725-733. doi:10.2519/jospt.2007.2453*

13. *Powers CM, Maffucci R, Hampton S. Rearfoot posture in subjects with patellofemoral pain. J Orthop Sports Phys Ther, 1995; 22(4): 150-160. Doi:10.2519/jospt.1995.22.4.155*

14. *Daneshmandi H, Saki F. The study of static lower extremity posture in female athletes with ACL injuries. Harkat Sports Medicine, 2009; 1: 75-91.*

15. *Griffin LY, Albohm MJ, Arendt EA, Bahr R, Beynnon BD, Demaio M. et al. Understanding and preventing noncontact anterior cruciate ligament injuries: a review of the Hunt Valley II meeting, January 2005. Am J Sports Med, 2006; 34 (9): 1512-1531. doi:10.1177/0363546506286866*

16. *Myer GD, Ford KR, Paterno MV, Nick TG, Hewett TE. The effect of generalized joint laxity on the risk of anterior cruciate ligament injury in young female athletes. Am. J. Sports Med, 2008; 36 (6):1073-1080. doi: 10.1177/0363546507313572*

17. *Hintermann B, Nigg BM. Pronation in runners: implications for injuries. Sports Med, 1998; 26(3): 169-176. doi:10.2165/00007256-199826030-00003*

18. *Akinbo SR, Salau MA, Odebiyi DO, Ibeabuchi NM. Video analysis of musculoskeletal injuries in Nigeria and English professional soccer leagues. Nigerian Journal of Health and Biomedical Sciences, 2007; 6(2): 85-89. doi.org/10.4314/njhbs.v6i2.11650*

19. *Uzoagulu AE. Practical Guide to Writing Research Project Reports in Tertiary Institutions; New Edition, Enugu: Cheston Ltd. Pp: 26-29; 2011*

20. *Shultz SJ, Nguyen AD, Schmitz RJ. Differences in lower extremity anatomical alignment and postural characteristics in males and females between maturation groups. J Orthop Sports Phys Ther, 2008; 38 (3): 137-149. DOI:10.2519/jospt.2008.2645*

21. *Livingston LA, Mandigo JL. (1999). Bilateral Q angle asymmetry and anterior knee pain syndrome. Clin Biomech, 1999; 14 (1): 7-13. PMID: 10619085*

22. *Ani U K, Ibikunle P O, Akosile C O, Useh U. The UEFA model in the identification of types, severity, and mechanism of injuries among professional footballers in the Nigerian Premier League. SA J. Sports Med. [Internet]. 2015 [cited 2019 Jan 24] ; 27(1): 12-15.*

23. *Emery CA, Meeuwisse WH, Hartmann S. Comparison of risk factors for injury in indoor and outdoor soccer. Br J Sports Med, 2005; 39(6): 375-408.*

24. *Ekstrand J, Vogel U. (2005). Euro 2004 Injury Study. In: 1st World Congress of Sports Injury Prevention. Br J Sports Med, 2005; 39 (6): 373-408.*

25. *Faude O, Junge A, Kindermann W, Dvorak J. Ligament injuries in elite female soccer players. In: 1st World Congress of Sports Injury Prevention. Br J Sports Med, 2005; 39(6): 375-408.*

26. *Bahr R, Krosshaug T. Understanding injury mechanisms: a key component of preventing injuries in sports. Br J Sports Med, 2005; 39(6):324-329.*

27. *Emami MJ, Ghahramani MH, Abdinejad F, Namazi H. Q-angle: An invaluable parameter for evaluation of anterior knee pain. Arch Iranian Med, 2007; 10 (1): 24 – 26. Doi: 07101/AIM.007*

28. *Pefanis N, Papaharalampous X, Tsiganos G, Papadakou E, Baltopoulos P. The effect of Q angle on ankle sprain occurrence. Foot Ankle Spec, 2008; 2(1): 22-26. Doi:10.1177/1938640008330769*

29. *Wong P, Hong Y. Soccer injury in the lower extremities. British Journal of Sports Medicine 2005;39:473-482*

30. *Hawkins RD, Fuller CW. A prospective epidemiological study of injuries in four English professional football clubs. Br J Sports Med, 1999; 33:196-203.*

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