Quadriceps Angle In Children With And Without Pes Planus

A O, A I.A, O O.O

Citation

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Abstract

Background: Previous studies among Caucasians have made contributions towards recognizing the widespread problems of quadriceps angle (Q angle) and pes planus deformity (PPD) as independent entities among cross-sections of population. There is however, a dearth of studies among children in Nigerian population. This study was therefore designed to investigate the mean Q angle values in children with and without PPD, and to contribute data to this field of study.Design: Purposive sampling technique.

Participants: One hundred and seventy seven apparently healthy, 10-12 year old school children.Method: The Q angles were measured with a goniometer according to the method of Latinghouse and Trimble[20]. Footprints were also taken to determine the presence or absence of PPD.Results: The mean Q angles of children with and without PPD were 13.98±4.0º and 12.17±3.7º respectively in the right, and 13.08±4.1º and 12.64±3.9º in the left lower limb. An independent t-test comparison of mean Q angles in children with and without PPD showed significant difference at alpha level of 0.05 in the right lower limbs. Mean Q angles of females with and without PPD are 14.18±4.1º and 12.77±3.6º respectively while the mean Q angles of males with and without PPD are 12.77±4.0º and 12.00±4.0ºConclusion: Children with PPD had higher mean Q angles than those without PPD and the mean Q angles in the females are higher than those of the males. Recommendation: Children with PPD should be screened for high Q angles, as both have been independently implicated as predisposing factors to several lower limb injuries.

INTRODUCTION

The Quadriceps angle (Q angle) is an important determinant of knee health[1]. The Q angle best describes the lateral tracking or bowstring effect that the quadriceps muscles (primarily the rectus femoris) and patella tendon have on the patella[2]. To this end, a number of clinical problems in the knee such as patellofemoral pain, patella subluxation or dislocation and lower limb overuse injuries[3-7] have been linked to abnormality in Q angle values. Griffin et al[8] and Houston et al[9] have also implicated excessive Q angle as a potential risk factor for non contact anterior cruciate ligament injuries in female athletes. The position of the knee as an intermediate joint between the hip and the foot also makes it vulnerable to problems in these two areas[2]. A problem in the foot, pes planus deformity (PPD) or pronated foot is a common source of parental concern. Although the child is usually asymptomatic, some children complain of leg pain and easy fatigability. This is more frequently seen in obese children. Many children with PPD dislike physical activity and whether this is related to weakness in the foot is uncertain but studies have shown that some children do increase their walking and running limits after successful treatment[10,11]

The values of Q angle documented by various researchers in literature vary, while some consider 10 degrees to be normal and 15 degrees to 20 degrees as abnormal[12], others have suggested that values as low as 10 degrees are problematic[13,14]. These data were mainly obtained from young adult and adult populations[12,15-17]. Common to these are reports of bilateral Q angle asymmetry and females having higher mean Q angle values than their male counterparts. Increase in Q angle values is also suggested to be contributed to by abnormal foot pronation and subsequent rotation of lower extremity[2]. Previous studies [3,4-5,10] among Caucasians have made contributions towards recognizing the widespread problems of Q angle and PPD as independent entities among cross-sections of population. There is however, a dearth of studies among children in Nigerian population. This study was therefore designed to investigate the mean Q angle values in children with and without PPD, and to contribute data to this field of study in Nigeria in particular.

MATERIALS AND METHODS

POPULATION

One hundred and seventy seven pupils of primary schools participated in this study. Subjects were of ages 10 to 12 years. These primary schools were in Ibadan and Lagos metropolis Nigeria. Selection was based on accessibility and cooperation of the management of these schools. Subjects with genu valgus or varus were excluded from the study[2].

PROCEDURE

Ethical approval of the University of Ibadan/University College Hospital Institutional Review Board was obtained before the commencement of the study. All subjects were informed of the protocol, and each gave his/her assent before participating in the study.

MEASUREMENT PROCEDURE

The pupils' gender was recorded, their footprints were obtained and Q angle was measured. Footprints were obtained by placing the clean feet one after the other on an inked sponge and then on white sheets of paper. The presence or absence of a medial longitudinal arch was then used to determine whether the foot is normal or flat[18,19].

The Q angle was measured with a goniometer (manufactured by the Instrument department of the University College Hospital) using the method described by Latinghouse and Trimble[20] with subjects standing in an erect weight bearing position. The feet were in Romberg position[16] in which the medial borders of the feet are placed together with no footwear on. The anatomical landmarks: the anterior superior iliac spine (ASIS), midpoint of the patella, and the tibial tuberosity were palpated and marked with a non-permanent marker. The marked points at the ASIS and the mid patella were (masking tape was used to hold down string at the ASIS and at the mid thigh) linked with a string to ensure accurate alignment of the goniometer[12]. The axis of the goniometer was then placed on the midpoint of the patella, with its stationary arm aligned to the tibial tuberosity and movable arm to the ASIS. The Q angle was then read off as the acute angle formed in the anterior thigh between the two arms of the goniometer.

DATA ANALYSIS

Descriptive statistics of mean and standard deviation were used to summarise the data collected. Independent t-tests were calculated to compare the mean Q angles. The level of significance was set at 0.05

RESULTS

Footprints obtained from one hundred and seventy seven pupils who met the inclusion criteria were analysed. Thus a total of three hundred and fifty three footprints that were either normal or pes planus were therefore used for the analysis.

BASIC DEMOGRAPHICS

The study population consisted of one hundred and seventy seven pupils of primary schools aged from ten to twelve years. Of the 177 pupils, 84 (47.5%) were males and 93 (52.5%) were females (Table 1).

Figure 1

Table 1 Demographic characteristics of participants n= 177

Characteristics	Frequency	%Total
Sex		
Male	84	47.5
Female	93	52.5
Age (years)		
10	88	49.7
11	46	26.0
12	43	24.3

PARTICIPANTS AND PPD

Figure 1 shows that there are more subjects without PPD (126) than those with PPD (51).The presence of PPD was also common in the right than in the left feet of the studied population (figure 2)

Figure 2

Figure 1: Multiple bar charts showing distribution pattern of studied population

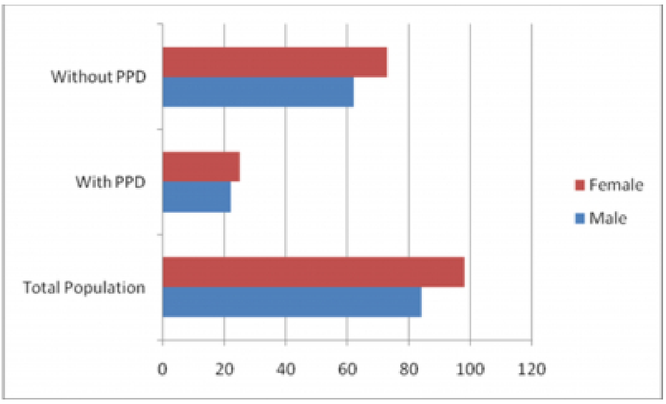
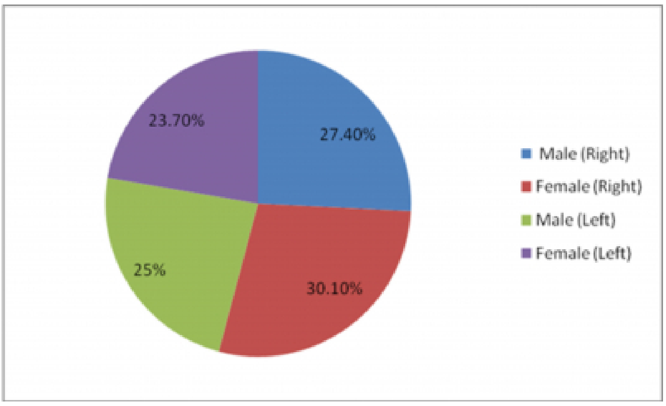


Figure 3

Figure 2: Pie chart showing the distribution pattern of pes planus deformity among studied population



Q ANGLES AND PPD

A between group comparison of mean Q angles of children with and without PPD was carried out. The mean Q angles are higher in limbs of children with PPD than in those without PPD. The difference was however only significant in the right lower limbs (p=0.05) (Table 2). The mean Q angle values of females are generally higher than the males'. None of these differences is however significant (Tables 3&4). A within group comparison of females with and without PPD shows a significant value in the right limbs (Table 4).

Figure 4

Table 2: Independent t-test Comparison of the Mean Q-angles of Children with and without Pes Planus Deformity

	Right Limbs	Left Limbs
	X ± SD	X ± SD
With	13.98 ± 4.01	13.08 ± 4.13
Without	12.17 ± 3.72	12.64 ± 3.87
t – value	-2.87	-0.638
P level	0.005*	0.524

* significant

X -mean

S.D- standard deviation

Figure 5

Table 3: Independent t-test Comparison of the Mean Q-angles of Male Subjects with and without Pes Planus Deformity

	Right Limbs	Left Limbs
	X ± SD	X ± SD
With	13.46 ± 3.96	12.17 ± 4.03
Without	12.03 ± 4.04	11.97 ± 3.99
t- value	-1.449	-0.197
P – level	0.151	0.845

KEY

X -mean

S.D- standard deviation

Figure 6

Table 4: Independent t-test Comparison of the mean Q-angles of Female Subjects with and without Pes Planus Deformity

	Right Limbs	Left Limbs
	X ± SD	X ± SD
With	14.41 ± 4.07	13.95 ± 4.13
Without	12.29 ± 3.43	13.24 ± 3.69
t- value	-2.581	-0.774
P level	0.011*	0.441

KEY

* significant

X -mean

S.D- standard deviation

DISCUSSION

The population of the subjects with PPD among the studied population was 26.6%. This is slightly higher than that of Jerosch and Mamsch[21] who reported an incidence of 19.1%. In this study, more females have PPD than males. This is consistent with the findings of Didia et al[22]. The observed presence of unilateral PPD especially on the right feet in this study is also in line with that reported by the same group of writers. Predisposing factors in children to PPD are shoe-wearing in early childhood and excessive foot mobility[22,23].

Findings of this study indicate that children with PPD have higher mean Q angles in both lower limbs than those without

PPD. This is consistent with that reported by Olerud and Berg[24] that Q angle increases as foot is shifted into pronation and supination. The reason for this observed difference could be explained by the presence of the PPD causing medial rotation of the tibia and an increased bowstring effect on the patella thereby increasing the lateral tracking forces[2]. However, other factors which were not the focus of this study, might have contributed to the higher Q angle values observed in participants with PPD. For example, Colby and Kisner[2] noted that patella alta, increased femoral anteversion, and external tibial torsion are factors that can be associated with high Q angles. These factors were however not considered in this study. It is particularly noteworthy that the difference in Q angles of the right limbs of children with and without PPD was significant. The reason for this observation was not clear.

The results of this study reveal that no significant difference exists between the Q angles of males and females with and without PPD. This is at variance with the findings of Livingston and Mandigo[25] who reported significantly higher Q angles in females than males in the symptomatic young adult population studied. Our finding is however consistent with the earlier finding by Livingston and Madingo[26] on an asymptomatic young adult population where no significant difference was found. Examinations of data on an individual basis however reveal a higher Q angle in females than males. The age difference in the participants sampled in this study and those highlighted may be a factor affecting the findings as age has been found to have effect on the Q angle[27]. Other studies also indicate that females have higher Q angles than males. This could be attributed to the wider pelvis (gynecoid) in females compared to males[17].

CONCLUSIONS

The conclusions drawn based on the findings of this study are: children with pes planus have higher mean Q-angles than children without pes planus; females generally have higher Q-angles than males.

RECOMMENDATIONS

Based on the results of this study, it is recommended that children with PPD should be assessed for high Q angles, as both had been independently implicated as predisposing factors to several lower limb injuries. Similar studies should be conducted among individuals of higher age group.

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Author Information

Ayanniyi O
Department Of Physiotherapy, College Of Medicine, University Of Ibadan

Alonge I.A
Department Of Physiotherapy, College Of Medicine, University Of Ibadan

Ogwumike O.O
Department Of Physiotherapy, College Of Medicine, University Of Ibadan