Tibiofemoral Angle and Its Correlate in a Cohort of Nigerian Children

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Citation

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Abstract

Background: Previous studies from Nigeria on factors influencing the development of Tibio-Femoral Angle (TFA) have focused on height and weight. The present study was undertaken to investigate additional factors that might influence development of TFA in a cohort of Nigerian children.

Methods: One hundred and fifty two apparently healthy (71males, 81females) new born babies without any obvious musculoskeletal or neurological deformity were recruited consecutively into the study. Each participant was follow up in at monthly interval until three years of age. During each visit, their TFA, weight, length/height, lower limb length, and trunk length were taken. A structured questionnaire was designed to obtain information about duration of dependent walking; age at which independent walking was attained and age at which the use of walking chair was commenced.

Results: Weight, height, lower limb length, trunk length, trunk to limb ratio and age at which walking chair was introduced significantly correlated with TFA. Age of attainment of independent walking or duration of dependent walking did not correlate significantly with TFA. There was no significant association between TFA pattern and family history of bow/knock-leg or use of walking chair.

Conclusion: The findings of this study suggest that weight, height, lower limb length, trunk length, trunk to limb length ratio and the age at which the use of walking chair was commenced are the correlates of TFA development.

INTRODUCTION

Many studies have reported patterns and values of Tibio-Femoral Angle (TFA) for various populations [1-5]. These studies established physiologic pattern in axial alignment i.e. genu varus, neutral, and genu valgus, during normal development. Tibiofemoral angle norms have been established to assess pathology in lower limb mal-alignment by some of these studies [1, 3-5]. However, only few studies, including two from Nigeria have investigated factors that might influence development of TFA in childhood. One study reported significant relationship between the occurrence of physiological knock knee and each of the factors such as the age walking chair was introduced to the children and the age at which independent walking was attained, as well as the period of dependent walking [6]. A significant negative correlation between TFA, body weight and height in children aged between zero and 17 years was reported by previous studies [3, 7-8]. However, Cahuzac et al [9] reported no significant correlation between TFA, body weight and height and leg length in 10 to 16 years of age, while Arazi et al [7] found significant correlation between 3 and 17 years of age.

The two studies from Nigeria focused on influence of weight and height on TFA. One of the studies who recruited representative sample of 2,036 children aged between 2 months and 12 years found significant correlation only in the first 6 months of life [3]. The other study examined 471 normal Nigerian elementary school children whose ages ranged from three to ten years and found negative correlation between TFA and each of weight and body mass index [8]. The aim of the present study was to find out whether or notweight, height, lower limb length, trunk length, trunk to limb length ratio, duration of dependent walking, age attaining independent walking, family history of bow/knock-leg and use of walking chairwould influence TFA development in a cohort of Nigerian children

METHODS

This study was approved by the University of Ibadan and University College Hospital Research Ethics Committee.

Participants for the study were apparently healthy 152 (71males, 81females) new born babies without any obvious musculoskeletal or neurological deformity. They were recruited consecutively into the study within three weeks of life from three infant welfare clinics in Sagamu, south west Nigeria. For each child, parent consent was obtained. Each participant was follow up at monthly interval until three years of age. During each visit, TFA, weight, length/height, lower limb length, and trunk length were measured. A structured questionnaire was administered on every visit to collect information on duration of dependent walking, age of attainment of independent walking and age at which the use of walking chair was commenced, if it was introduced to the child at all. Family history of bow/knock-leg was also obtained.

Measurements

Weight: A weighing scale (Docbel Industries, 3/17, Asaf Ali Road, New Delhi-110002) with bowl was used to measure the weight of the participants who are unable to stand independently with minimal clothing lying inside the scale. When were old enough to stand independently, weight was measured using a weight meter, (Hardik Medi-Tech, Nirankari Colony, Delhi-110 009) with minimal clothing standing on the scale. The weight was recorded in kilogramme to nearest 0.01kg. The accuracy of the scale was checked regularly with known weight.

Length/Height: The length of children who were not independent in standing was measured in supine position with infantometer (Schafer, D-77656 Offenburg NR 120301). When participant could stand independently, their height was measured using a height meter (Hardik Medi-Tech, Nirankari Colony, Delhi-110 009). The length/height was recorded in meter and to the nearest 0.001 meter.

Trunk length: This was measured in prone position for children <1year from 7th cervical spine to sacrum and in standing (holding to a support or not) for children ≥1year with non-elastic tape ruler (Butterfly brand, China). This was recorded in centimeter to the nearest 0.1 centimeter.

Lower Limb length: This was measured from anterior superior iliac spine (ASIS) to base of medial malleoli with non-elastic tape ruler (Butterfly brand, China) in supine for children <1year and in standing for children ≥1year. This was recorded in centimeter to the nearest 0.1 centimeter. The two limbs' length was measured and the average was used in the computation.

Tibiofemoral angle: This was measured with each child in supine using a small pliable plastic goniometer. On each lower limb, the anterior superior iliac spine, the centre of patella and the midpoint between the malleoli were identified. A line was drawn to join the anterior superior iliac spine to the centre of patella and another line was drawn to join the middle of the patella to the middle of the ankle (centre point between medial and lateral malleolar) using a marker. One arm of the goniometer was aligned to the line drawn joining the anterior superior iliac spine to the middle of the patella (femoral alignment) and the second arm was aligned to a line joining the middle of the patella to the middle of the ankle (centre point between medial and lateral malleoli), tibia alignment. The centre of patella served as fulcrum for the goniometer. The acute angle sustained between the femoral shaft and the tibia shaft on the goniometer was recorded as the tibiofemoral angle in degree [5]. Both limbs were taken and the average was used in the computation. A positive and negative value was assigned to varus and valgus pattern respectively. All measurements were taken by one of the authors (OOO)

RESULTS

The anthropometric and physical characteristics of participants are presented in table 1. There was no significant difference in TFA and any of the anthropometric variables of male and female participants, except in the trunk length to limb length ratio, which was higher in boys. Also, there was no significant sex difference in other physical characteristics except that walking chair use was commenced earlier in girls. The children attained independent walking at average age of 12 months and commenced dependent walking at age of 9 months. The children walked dependently for duration of 3 months and use of walking chair was commenced at average age of 5 months.

Table 1

Participants' Mean Tibiofemoral Angle and Selected Variables

	Boys	Girls	t-value	p-value	All participants
TFA (0^0)	0.38±7.09	0.19±7.14	0.88	0.38	0.27±7.12
Weight (kg)	9.14±2.49	9.08±2.57	0.843	0.40	9.10±2.54
Height (m)	0.76±0.11	0.76±0.12	0.226	0.82	0.76±0.11
Limb length (cm)	35.03±8.47	35.35±8.68	-1.252	0.21	35.21±8.59
Trunk length (cm)	34.79±8.20	34.92±8.39	-0.510	0.61	34.86±8.31
Trunk limb ratio	1.00±0.03	0.99±0.03	6.785	0.01	0.99±0.03
Age attaining independent walking (months)	12.10±2.16	11.69±2.05	1.09	0.28	11.87±2.10
Age starting dependent walking (months)	8.84±2.02	8.56±2.16	0.76	0.45	8.68±2.10
Duration of dependent walking (months)	3.26±2.07	3.14±1.76	0.37	0.71	3.19±1.90
Age walking chair used Commenced (months)	5.74±2.77	4.53±1.39	2.07	0.04	4.98±2.07

All the anthropometric variables studied correlated significantly with TFA (Table 2). There was high inverse correlation between TFA and each of weight, height, lower limb length and trunk length. The correlation between TFA and trunk to limb trunk ratio was low. However, age attaining independent walking and duration of dependent walking was not significantly correlated with TFA. There was no significant association between TFA pattern and family history of bow/knock knee, type of knee deformity in the family or the use of walking chair (Table 3).

Table 2

Correlation between Tibiofemoral Angle and Selected Variables

	Tibiofemoral Angle	
	r	p
Weight	-0.77	0.01
Height	-0.84	0.01
Limb Length	-0.88	0.01
Trunk Length	-0.88	0.01
Trunk-Limb Length Ratio	0.18	0.01
Age attaining independent walking	0.02	0.20
Duration of dependent walking	0.01	0.51
Age introducing walking chair	0.06	0.01

Table 3

Tibiofemoral Angle Pattern and Its Associating Factors

	Tibiofemoral Angle Pattern	
	X^2	p-value
Family history of bow/knock leg	2.50	0.29
Type of knee deformity	2.75	0.60
Using of walking chair/not	1.01	0.60

DISCUSSION

This study investigated the factors that influence tibiofemoral angle in a cohort of normal Nigerian children. We found that the anthropometric measures were correlated with the TFA. More especially, the weight, height, lower limb length and trunk length were significantly highly correlated with TFA and low for trunk-limb length ratio. The two previous studies from Nigeria also found significant correlation between TFA and anthropometric variables (weight and height) [3, 8]. Our correlation coefficient was as high as that of Bafor et al [8] study while Oginni et al [3] only found small correlation in the younger children. Studies from other part of the world also found correlation between TFA and anthropometric variables [7, 10]. These findings suggest that anthropometric variables with respect to weight, height, lower limb and trunk length may be better indices for angular deformities like Intercondylar and Intermalleolar distances. However, two studies found no significant correlation between TFA and anthropometric variables [9, 11]. The inverse correlation of these anthropometric variables with TFA in the present study implies that the higher the weight, height, lower limb length, trunk length and trunk-limb length the lower the TFA. This suggest that these anthropometric variables does not exaggerate or worsening the knee alignment in a normal children. Previous study reported that tibiofemoral angle measurements showed greater malalignment in overweight compared with none overweight children [12]. Most of the children in this study had normal weight and this made it difficult to determine the association between overweight and knee mal-alignment.However, it has been suggested that weight, height and knee angle are all changing rapidly with age in young children [3]. It is likely that the correlation observed might be due to correlation with age in this cohort.

The age the use of walking chair commenced was correlated with knee angle in this study. The children commenced the use of walking chair at average age of five months in this study which was similar for normal children from other part of the world [6]. The age walking chair was introduced to the children and time the children gain independent walking, as well as the period of dependent walking, has been reported to be significantly related to the occurrence of physiological knock knee [6]. The influence of using a walking chair for a long time on the stability and balance of knee joint might be subtle has been noted, but it does appear to be clinically significant. Hence, high suspicion should be kept in mind concerning the abnormally high stress on the knee before it is strong enough to support the body weight.

CONCLUSION

The findings of this study suggest that weight, height, lower limb length, trunk length, trunk to limb length ratio and the age at which the use of walking chair was commenced are the correlates of TFA development.

References

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