Original Research Article

TITLE: LEG LENGTH DISCREPANCIES IN NIGERIAN CHILDREN WITH SICKLE CELL ANAEMIA

Abstract:

Background: Sickle cell anaemia exerts adverse effects on growth and linear body proportions. In Nigeria, these changes in the lower extremity are scarcely documented.

Objectives: To evaluate the differences between the real leg lengths and apparent leg lengths determined by tape measure among children with SCA.

Methods: A clinic-based, cross-sectional, comparative study with due ethical considerations. The real leg lengths, anterior superior iliac spine to medial malleolus and to the heel were measured with a plastic tape and recorded. The apparent leg length, umbilicus to the medial malleolus was recorded.

LLD, the arithmetric differences between corresponding leg lengths were recorded and classified into nil (0), mild (<2cm), moderate (2-5cm) severe (>5cm).

Result: The subjects had more mild and moderate Real LLD than controls while more controls than subjects had nil Real LLD ($p = .033$). Both right and left real leg lengths at the medial malleolus were significantly shorter in the 6-9 year old subjects especially the males, all female subjects, all 10-13 year olds subjects more so the females than their respective counterparts.(All p values < 0.05) Similarly, the right and left leg lengths at the heel were significantly shorter subjects of the same age and sex groups as above than all their respective counterparts. (p values < 0.05). However, male subjects, had only the right real leg length significantly shorter than those of the controls.

Real LLD: ASIS-MM was significantly higher in 10-13 year old female subjects, real LLD: ASIS-HEEL in14-18 year old subjects than the controls. The right and left apparent leg length

were significantly lower in all 10-13 year old subjects and10-13 year old female subjects than the respective matches. All p values were < 0.05. No significant difference existed in the apparent LLD comparisons.

Keywords: Real leg length, Apparent leg length, Leg length discrepancy(LLD), Sickle cell anaemia.

INTRODUCTION:

Sickle cell anaemia (SCA) is one of the commonest single gene disorders with abnormal haemoglobin and variable clinical manifestations. It is known to adversely affect growth leading to abnormalities in linear body proportions[1-4]. Leg length discrepancy (LLD) commonly may be a shortening and rarely lengthening of one leg or issues above the legs such as a tilt in the pelvis (functional LLD). Length discrepancies in the femur, tibia or both are common in paediatric with variable causesc[5,6], a significant proportion of the population also has mild limb-length discrepancy[6].

Well documented complications of SCA associated with disproportionate leg growth include avascular necrosis (AVN) [7-9], osteomyelitis[9], septic arthritis, bone infarcts, growth retardation and atypical skeletal development[10-13]. These complications are related to infarction of articular surfaces of long bone due to compromised blood supply[14,15], decreased blood flow to the bone in combination with repeated infection involving the growth plate, bone marrow hyperplasia and subsequent ischemia as well as localized anoxic events that precede epiphysiseal closure.

Leg length discrepancy is evaluated using the difference between the true leg lengths of both legs as well as the difference between the apparent leg lengths of both legs[16].

The use of accurate and reliable clinical and imaging modalities for quantifying leg-length discrepancy (LLD) is vital for planning appropriate treatment[17]. On a supine patient, a tape measure[5,16-19] is used to measure the true/real leg length as the distance between the anterior superior iliac spine (ASIS) and the medial malleolus or the heel[16] (which is more accurate and compensates for limb shortening distal to the ankle mortise)[18] . An apparent leg length is measured from the umbilicus to the medial malleoli of the ankle accounting for shortening due to pelvic obliquity or contractures around the hip and knee joints when appendicular skeleton is

equal[16]. Using the average of two separate tape measurements to assess LLD is encouraged[18]. The use of tape measure is called the “direct” clinical method for measuring LLD[18].

An “indirect” clinical method of measuring LLD is by placing wooden boards/blocks of known height under the short limb to level the pelvis of the erect patient[5,16-18,20-21] . This establishes the additional length required for the patient to feel level. The difference between both limbs is called 'functional LLD' since LLD caused by fixed deformity of knee or ankle is measured as well. The clinical measurements are however less accurate than radiological techniques[5] and therefore find more usefulness as screening tools[17].

Roentgenographic[16] evaluations include teleoroentgenogram, orthoroentgenogram, scanogram**,** computed radiographs and MRI. Bone length is measured directly on the roentgenograph[6]. In conjunction with graphs such as Moseley’s ‘straight line graph’, periodic radiographic measurements may give an estimate of leg-length discrepancy at skeletal maturity[6].

The treatment of LLD depends on the cause, the age of the patient, and the severity of the discrepancy.

Management principles[20] for LLD include shoe lift or no treatment for values 0-2 cm which based on growth rate estimates are predicted to lessen in the future. Shoe lift and/or surgical closure of physes (epiphysiodesis) for values 2-6 cm, this aims to stop or slow the growth of the longer leg. Leg lengthening for values 6-20 cm. Limb shortening (osteotomy) or prosthetic fitting for differences >20cm[5,6,20,22] .This would result in the child being as tall as their shortest side. Uncorrected, limb-length discrepancy could result in lifelong deformities thereby worsening the psychosocial burden[23] and overall morbidity in SCA[6,24].

Previous studies of LLD examined the reliability and accuracy of measurement methods[18]as well as treatment options[20,25-26]. Sanjeev et al[17] in a systematic review of 42 articles concluded that while the less accurate clinical methods were useful for screening, among the more accurate imaging modalities the teleoroentgenogram was considered a more comprehensive, cost-effective, safer but less reliable assessment tool than the scanogram and MRI.

Previous Nigerian studies[27-29] were reports on aetiology and management options for LLD in children. There is paucity of data on types and severities of LLD in African children with SCA

and to the investigator's knowledge none is in existent in Nigeria. The present study was carried out to examine these reports in Enugu, South-East Nigeria, hopefully to support routine screening for LLD in SCA.

The general objective of the study is to evaluate the differences between the real leg lengths and apparent leg lengths determined by tape measure among children with SCA.

The specific objectives of the study are to evaluate the real and apparent LLD in children with SCA, compare the real and apparent LLD of children with SCA with those of their unaffected peers and ascertain the prevalence of LLD in children with SCA.

Methods: The cross-sectional, comparative study was conducted between June and August 2020 among children with SCA attending the sickle cell disease clinic of the Department of Paediatrics of Enugu State University Teaching Hospital, Enugu. The institution's ethical committee approved the study. Written and informed consent were obtained from each accompanying care-givers and assent from patients of appropriate age. Sickle cell anaemia patients who came for routine follow up clinic and who satisfied the study criteria were consecutively recruited. Healthy controls were children with haemoglobin genotype "AA" consecutively enrolled from the Children Outpatient clinics. Controls were matched with subjects for age and sex. There were 140 children 70 each with haemoglobin genotype AA and SS. The study population was stratified into age groups 1to 5 years, 6 to 9 years, 10 to 13 years and 14 to 18 years for a fairly even representation. Included were children 1 to 18 years old, in steady state (crisis free for 4 weeks, no recent drop in the haemoglobin level and no symptoms or signs of acute illness)[30], confirmed HbSS by electrophoresis and on regular follow-up, who consented to the study. Children on chronic blood transfusion or with chronic renal, respiratory or cardiac diseases, with history of cerebro-vascular accident, on prolonged steroid therapy or who denied consent were excluded. The exclusion criteria for the controls were the same as for subjects except that the haemoglobin genotype was AA.

Measurement of the real/true leg length

The real leg length was measured from the anterior superior iliac spine (ASIS) to the distal tip of the medial malleolus (MM). The right (RRLL: ASIS-MM) and the left (LRLL: ASIS-MM) real leg lengths at the medial malleolus were measured and recorded.

The real leg length was also measured from the anterior superior iliac spine (ASIS) to the heel/floor and recorded as the right (RRLL: ASIS-HEEL) and the left (LRLL: ASIS-HEEL) real leg lengths at the heel.

Measurement of the apparent leg length

The apparent leg length was measured from umbilicus to the medial malleolus and was recorded as the right (RALL: UMB-MM) and left (LALL: UMB-MM) apparent leg lengths.

Measurement of Leg length discrepancy (LLD)

LLD was defined as the arithmetric difference between the right and left real leg length at the medial malleolus (Real LLD: ASIS-MM), between the right and left real leg length at the heel (Real LLD: ASIS-HEEL) and between the right and left apparent leg lengths (ALLD: UMB-MM). LLD values were classified into mild (<2cm), moderate (2-5cm) severe (>5cm).

The various linear measurements were taken twice on each occasion at two consecutive times and their means were recorded. Measurements were made by the same examiner and variation among measurements was not more than 0.5 cm. The children were examined in the supine position on a firm examination couch. The measurements were done using a single inelastic plastic tape whose zero point and readings were easily discernible. The tape was stretched firmly and straight between the two end points, measurements were rounded to the nearest 0.5 cm. Social classification was done using the scheme proposed by Oyedeji[31] into socioeconomic classes (SEC) I – V based on the occupational and educational levels of parents. Staistical analysis

RESULTS:

Demographic characteristics of study population: A total of 140 children, 70 each with genotype SS and AA, who met the study criteria, were recruited over a study period of three months (June 2020 through August 2020).Males were 58.6% while females were 41.4%. Age distribution for males were: 1-5 (22.0%), 6-9 years (24.4%), 10-13 years (24.4%) and 14-18 years (29.3%) while the distribution for females were: 1-5 years (20.7%), 6-9 years (24.1%), 10-13 years (34.5%) and 14-18 years (20.7%). The SEC for both subjects and control were thus:

Class I [SS (4.3%), AA (22.9%); Class II [SS (38.6%), AA (41.4%)]; Class III [SS (32.9%), AA (27.1%)]; Class IV [SS (24.3%), AA (8.6%)].

Mild and moderate Real LLD: ASIS-MM were significantly more in subjects than controls while more controls had no Real LLD: ASIS-MM (p = .033) (Table 1).

Both RRLL: ASIS-MM and LRLL: ASIS-MM were significantly shorter in the 6-9 year old subjects (p =.046; p = .045) especially the males (p = .008; p = .007), all female subjects (p = .003; p = .004), all 10-13 year olds subjects (p = .001; p = .001) more so the females (p = .002; p = 0.002)] than all their respective counterparts. Real LLD: ASIS-MM was significantly higher only in 10-13 year old female subjects (p = .039) (Table 2).

Similarly, both RRLL: ASIS-HEEL and LRLL: ASIS-HEEL were significantly shorter in 6-9 year old subjects (p =.027; p = .023) especially the males (p = .002; p = .002), all female subjects(p = .003; p = .001), all 10-13 year olds subjects (p = <.001; p = .001), more so the females, (p = .001; p = < 0.001)] than all their respective counterparts. However male subjects had only the RRLL: ASIS-HEEL significantly shorter than those of the controls. Real LLD: ASIS-HEEL was significantly higher in14-18 year old subjects (p = .047) than the controls (Table 3).

The RALL: UMB-MM and LALL: UMB-MM were significantly lower in all 10-13 year old subjects (p = .031)(p = .048) and10-13 year old female subjects (p = .004)(p = .010)] than the respective matches. No significance was found in the ALLD comparisons.

Table 1: Prevalence of Real LLD:ASIS- MM, Real LLD:ASIS- HEEL and ALLD:UMB-MM

	Subject n(%)	Control n(%)	Chi-Square	p-value
Real LLD:ASIS-MM			6.819	**.033**
- Nil	5(7.1)	16(22.9)		
- Mild	57(81.4)	48(68.6)		
- Moderate	8(11.4)	6(8.6)		

Real LLD:ASIS-HEEL			3.397	.183
- Nil	5(7.1)	12(17.1)		
- Mild	57(81.4)	52(74.3)		
- Moderate	8(11.4)	6(8.6)		
ALLD: UMB-MM			5.544	.0504
- Nil	10(14.3)	14(20.0)		
- Mild	55(78.6)	56(80.0)		
- [+]Moderate & Severe	5(7.1)	-		
Total	70	70		

+ Moderate & Severe = 5(7.1%); Moderate = 4(5.7%); Severe = 1(1.4%)

LLD was absent in more controls (22.9%, 17.1% and 20%) than subjects(7.1%, 7.1%,14.3) at all points of measurement but only for Real LLD:ASIS-MM was this relationship statistically significant. Conversely, only mild and moderate Real LLD: ASIS-MM were significantly more in subjects than controls (p = .033).

Table 2: RRLL: ASIS-MM, LRLL: ASIS-MM & Real LLD: ASIS-MM of Subjects & Controls

RRLL: ASIS-MM Age group – Sex	SS Mean (SD)	AA Mean (SD)	t (p-value)
1-5 years	53.91 (5.01)	54.53 (6.98)	-.405 (.691)
- Male	52.64 (5.24)	52.54 (7.26)	.042 (.968)
- Female	55.80 (4.37)	57.52 (5.84)	-1.058 (.338)
6-9 years	69.32 (4.86)	72.05 (5.59)	-2.167 (.046)*
- Male	69.70 (3.54)	74.39 (3.92)	-3.428 (.008)*
- Female	68.79 (6.60)	68.70 (6.16)	.043 (.967)
10-13 years	78.93 (4.13)	84.30 (7.02)	-4.168 (.001)*
- Male	80.32 (3.94)	84.40(6.61)	-2.011 (.075)

- Female	77.54 (4.03)	84.19 (7.76)	-4.197 (.002) *
14-18 years	91.40 (8.97)	93.33 (5.07)	-.751 (.463)
- Male	92.48 (8.52)	91.79 (5.36)	.229 (.823)
- Female	89.25 (10.26)	96.40 (2.68)	-1.603 (.170)
All			
- Male	75.21 (15.81)	77.13 (15.73)	-1.598 (.118)
- Female	73.35 (12.98)	77.46 (15.24)	-3.189 (.003) *
LRLL: ASIS-MM			
1-5 years	53.65 (5.06)	54.62 (7.20)	-.591 (.564)
- Male	52.40 (5.44)	52.72 (7.26)	-.127 (.902)
- Female	55.52 (4.17)	57.47 (6.67)	-1.084 (.328)
6-9 years	69.28 (4.89)	71.93 (5.71)	-2.172 (.045) *
- Male	69.60 (3.51)	74.19 (4.08)	-3.520 (.007) *
- Female	68.81 (6.71)	68.70 (6.44)	.058 (.955)
10-13 years	79.14 (4.54)	84.09 (7.07)	-3.756 (.001) *
- Male	80.74 (4.21)	84.04 (6.65)	-1.591 (.146)
- Female	77.54 (4.48)	84.13 (7.83)	-4.240 (.002) *
14-18 years	91.26 (8.95)	93.04 (5.06)	-.678 (.507)
- Male	92.48 (8.63)	91.51 (5.21)	.331 (.747)
- Female	88.82 (9.89)	96.10 (3.24)	-1.529 (.187)
All			
- Male	75.24 (15.98)	76.95 (15.55)	-1.425 (.162)
- Female	73.21 (12.94)	77.37 (15.28)	-3.130 (.004) *
Real LLD: ASIS-MM			
1-5 years	1.03 (0.86)	0.53 (0.45)	2.063 (.058)
- Male	1.08 (0.94)	0.37 (0.36)	2.272 (.053)
- Female	0.95 (0.79)	0.77 (0.49)	.482 (.650)
6-9 years	0.71 (0.49)	0.84 (0.87)	-.524 (.607)
- Male	0.72 (0.35)	0.74 (0.82)	-.073 (.943)
- Female	0.69 (0.67)	0.97 (0.98)	-.600 (.570)
10-13 years	0.86 (0.60)	0.58 (0.59)	1.620 (.122)
- Male	0.89 (0.76)	0.76 (0.71)	.452 (.662)
- Female	0.82 (0.43)	0.40 (0.38)	2.418 (.039) *
14-18 years	0.85 (0.88)	0.88 (0.89)	-.121 (.905)
- Male	0.94 (0.95)	0.88 (0.74)	.193 (.851)
- Female	0.66 (0.75)	0.88 (1.23)	-.321 (.761)
All			
- Male	0.91 (0.78)	0.70 (0.69)	1.349 (.185)
- Female	0.78 (0.62)	0.71 (0.79)	.329 (.745)

**** indicates comparisons with significant difference (p < .05)***

From Table 2, Both RRLL:ASIS-MM and LRLL:ASIS-MM were significantly shorter in 6-9 year old male subjects than male controls (p = .008; p = .007) and all 6-9 year old subjects than all 6-9 year old controls (p =.046; p = .045) respectively. The result was similar for 10-13 year old female subjects and controls (p = .002; p = 0.002), all 10-13 year olds (p = .001; p = .001) and all female subjects and controls (p = .003; p = .004) for both parameters. For Real LLD: ASIS-MM, significant difference only existed for females aged 10-13 years (p = .039), for which the subjects were higher.

Table 3: RRLL: ASIS-HEEL, LRLL: ASIS-HEEL and Real LLD:ASIS-HEEL of Subjects and Control

RRLL:ASIS-HEEL Age group – sex	SS Mean (SD)	AA Mean(SD)	t (p-value)
1-5 years	58.81 (5.24)	58.93 (7.05)	-.066 (.948)
- Male	58.19(5.95)	57.27(7.08)	.337 (.745)
- Female	59.73 (4.30)	61.42 (6.81)	-.834 (.442)
6-9 years	74.28 (5.45)	77.78 (5.77)	-2.428 (.027)*
- Male	74.79 (3.51)	80.46 (3.94)	-4.381 (.002)*
- Female	73.56 (7.72)	73.96 (6.04)	-.150 (.886)
10-13 years	84.50 (5.01)	90.72 (7.23)	-4.543 (< .001)*
- Male	85.95 (5.09)	90.65 (6.80)	-1.949 (.083)
- Female	83.04 (4.72)	90.78 (8.01)	-6.149 (< .001)*
14-18 years	97.26 (9.36)	100.43 (5.44)	-1.160 (.262)
- Male	98.16 (8.71)	99.26 (5.66)	-.349 (.734)
- Female	95.47 (11.18)	102.77 (4.49)	-1.403 (.219)
All			
- Male	80.71 (16.05)	83.36 (16.65)	-2.026 (.049)*
- Female	78.50 (14.01)	83.12 (16.31)	-3.202 (.003)*
LRLL: ASIS-HEEL			
1-5 years	58.65 (5.37)	59.23 (7.67)	-.308 (.762)
- Male	57.86 (6.03)	57.03 (7.45)	.291 (.778)
- Female	59.85 (4.44)	62.52 (7.35)	-1.411 (.217)
6-9 years	74.40 (5.17)	77.86 (5.82)	-2.518 (.023)*
- Male	74.73 (3.48)	80.42 (3.94)	-4.470 (.002)*
- Female	73.93 (7.26)	74.20 (6.36)	-.112 (.914)
10-13 years	84.59 (5.16)	90.55 (7.30)	-4.153 (.001)*
- Male	86.20 (5.21)	90.51 (7.01)	-1.688 (.126)
- Female	82.97 (4.82)	90.60 (7.95)	-6.048 (< .001)*
14-18 years	96.97 (8.94)	100.02 (5.31)	-1.151 (.266)
- Male	98.21 (8.38)	98.81 (5.60)	-.200 (.845)
- Female	94.50 (10.31)	102.43 (4.07)	-1.599 (.171)
All			
- Male	80.70 (16.16)	83.13 (16.63)	-1.873 (.068)
- Female	78.39 (13.53)	83.28 (15.88)	-3.544 (.001)*
Real LLD:ASIS-HEEL			
1-5 years	0.91 (0.73)	0.89 (0.92)	.103 (.919)
- Male	1.00 (0.91)	0.70 (0.59)	.998 (.347)
- Female	0.78 (0.35)	1.17 (1.30)	-.864 (.427)
6-9 years	0.66 (0.69)	0.86 (0.53)	-1.024 (.321)
- Male	0.50 (0.36)	0.90 (0.55)	-2.115 (.064)
- Female	0.89 (1.00)	0.81 (0.55)	.177 (.865)
10-13 years	0.67 (0.40)	0.74 (0.78)	-.369 (.716)
- Male	0.75 (0.45)	0.86 (0.94)	-.404 (.696)
- Female	0.60 (0.35)	0.62 (0.61)	-.082 (.936)
14-18 years	1.49 (1.05)	0.88 (0.83)	1.818 (.087)
- Male	1.63 (1.04)	0.82 (0.81)	2.235 (.047)*
- Female	1.20 (1.10)	1.00 (0.93)	.279 (.792)
All			
- Male	1.00 (0.86)	0.82 (0.72)	1.096 (.280)
- Female	0.83 (0.73)	0.86 (0.83)	-.133 (.895)

**** indicates comparisons with significant difference (p < .05)***

From Table 3, Similar to results in table 2, Both RRLL: ASIS-HEEL and LRLL: ASIS-HEEL were significantly shorter in 6-9 year old male subjects ($p = .002$; $p = .002$) and all 6-9 year old subjects ($p = .027$; $p = .023$) than their respective controls. The result was similar to 10-13 year old female subjects and controls ($p = .001$; $p = < 0.001$), all 10-13 year olds ($p = <.001$; $p = .001$) and all female subjects and controls ($p = .003$; $p = .001$) for both parameters. However male subjects had only the RRLL: ASIS-HEEL significantly shorter than those of the controls. For real LLD:ASIS-H, significant difference only existed for males aged 14-18 years ($p = .047$), for which the subjects' were higher than the control.

Table 4: Comparison of RALL:UMB-MM, LALL:UMB-LL and ALLD:UMB-MM between Subjects and Controls

RALL:UMB-MM Age group – Sex	SS Mean(SD)	AA Mean(SD)	t (p-value)
1-5 years	58.30(5.83)	57.99(7.16)	.187(.854)
– Male	57.49(6.73)	56.54(6.94)	.370(.721)
– Female	59.53(4.44)	60.15(7.55)	-.312(.767)
6-9 years	74.68 (5.63)	75.55 (6.06)	-.621 (.543)
– Male	75.24(4.36)	77.79(4.27)	-1.747(.115)
– Female	73.87(7.40)	72.36(7.08)	.585(.580)
10-13 years	84.28 (4.81)	87.71 (6.81)	-2.335 (.031)*
– Male	86.30(4.19)	87.66(6.52)	-.551(.595)
– Female	82.25(4.71)	87.77(7.43)	-3.802(.004)*
14-18 years	97.01 (9.02)	97.40 (4.58)	-.163 (.873)
– Male	97.88(8.17)	96.45(4.76)	.523(.612)
– Female	95.25(11.15)	99.30(3.88)	-.847(.436)
All			
– Male	80.67(16.15)	81.00(15.79)	-.275(.785)
– Female	78.22(13.86)	80.72(15.53)	-1.833(.077)
LALL:UMB-MM			
1-5 years	58.57(6.06)	58.04 (7.17)	.296 (.772)
– Male	57.68(6.90)	56.32(7.15)	.477(.646)
– Female	59.92(4.80)	60.62(7.00)	-.409(.699)
6-9 years	75.14 (5.85)	75.77 (6.16)	-.408 (.689)
– Male	75.57(3.94)	78.04(4.10)	-1.897(.090)
– Female	74.53(8.19)	72.53(7.41)	.635(.549)
10-13 years	84.52 (4.88)	87.70 (6.97)	-2.118 (.048)*
– Male	86.29(4.71)	87.64(6.52)	-.533(.607)
– Female	82.75(4.59)	87.75(7.76)	-3.271(.010)*
14-18 years	96.32 (8.99)	97.56 (4.68)	-.479 (.638)
– Male	97.08(8.32)	96.70(4.94)	.124(.904)
– Female	94.78(10.89)	99.27(3.94)	-.934(.393)
All			
– Male	80.55(15.85)	81.08(15.95)	-.411(.683)
– Female	78.53(13.70)	80.84(15.41)	-1.622(.116)
ALLD:UMB-MM			
1-5 years	0.49 (0.42)	0.59(0.52)	-.530 (.604)
– Male	0.57(0.40)	0.49(0.60)	-.319(.758)
– Female	0.38(0.46)	0.73(0.37)	-1.530(.187)
6-9 years	0.89 (1.11)	0.51 (0.49)	1.184 (.254)
– Male	0.67(0.33)	0.65(0.54)	.080(.938)
– Female	1.20(1.72)	0.31(0.35)	1.324(.234)
10-13 years	0.80 (0.82)	0.56 (0.48)	1.195 (.247)
– Male	0.99(1.02)	0.58(0.36)	1.181(.268)
– Female	0.60(0.55)	0.54(0.59)	.317(.758)
14-18 years	1.38 (2.98)	0.62 (0.36)	1.101 (.286)
– Male	1.53(3.65)	0.67(0.40)	.845(.416)
– Female	1.07(0.87)	0.53(0.29)	1.315(.246)
All			
– Male	0.98(2.03)	0.60(0.46)	1.186(.243)
– Female	0.80(1.00)	0.52(0.45)	1.325(.196)

**** indicates comparisons with significant difference (p < .05)***

From Table 4, there was a significant difference in RALL:UMB-MM and also in LALL:UMB-MM between the subjects and the control but only for females, 10-13 years ($p = .004$)($p = .010$)] and all 10-13 year olds ($p = .031$)($p = .048$) for which the subjects had lower values than the controls. No significance existed in ALLD:UMB-MM.

DISCUSSION:

Mild leg length discrepancy of up to 2 cm is quite common. Approximately 3 to 15% of population has a limb length discrepancy (LLD) of around 1 cm[32,33]; in 95% of cases, the causes are unknown[33-36] Our sample contrasts with the published results, with 68.6% for mild discrepancies in controls. This may be due to differences in methodology like the use of the less accurate tape measure and difficulty with identifying bony prominences while the higher prevalence (81.4%) of mild LLD in subjects suggests a disease influence.

Most LLDs < 2 cm are idiopathic, due to normal anatomic variation (asymmetry) of the human body resulting in non-significant disorders in gait parameters[36] or occasionally cause pelvic obliquity in the frontal plane with scoliosis in the lumbar region[32]. However the compensatory mechanism of LLD is beyond the scope of this study.

Although small leg length discrepancies have been associated with increased muscle activity, low back pain and lumbar pain, a 71% in healthy soldiers and 59.9% in those without lumbar pain have also been reported[37].Thus LLD of as little as 1 cm may or may not cause functional changes in hips, pelvis or spine. This study did not examine the symptoms of LLD.

In screening examinations performed in the years 1992-2002[23] by the staff of the Centre of Rehabilitation for Children and Adolescents, significant LLD was found in about 10% of a population of primary school children. Our observed 8.6% prevalence of moderate LLD in the control group compare favorably with this earlier finding since the primary school-aged controls (6-9 years male and 10-13 years females) contributed significantly to LLD.

Eduardo *et al*[32] observed an LLD prevalence of 63.7% in adolescents with idiopathic scoliosis, this may be likened to our 92.8% prevalence of Real LLD MM for subjects, our higher value being a result of wider ranges of age and LLD severity studied. A more comparable observation is that by Kowalik-Nitera[38] of 71% LLD in patients treated surgically due to lumbar disc herniation. Noteworthy is the significantly higher Real LLD at the heel found in 14-18 year old males of this study. A plausible explanation for this may be the reported[39] higher incidence of chronic ankle leg ulcers in this age group and sex with resultant ankle contractures contributing to anomalies in leg length beyond the medial malleolus. Thus occurrences of LLD greater than 3

cm have been reported as equal to the frequency of their causes with bigger differences found in greater and more distinct disorders[33,40].

Jan W et al[40]. reported a shortening of the left lower limb in 86% of cases of children and adolescents treated for LLD. Eduardo[32] also reported a female adolescent preponderance of LLD with 63.7% of the sample having a shorter left lower limb relative to the contra-lateral limb. Similarly, the early adolescent female subjects (10-13 years) in this study showed significantly shorter real left leg lengths and higher Real LLD at the medial malleolus than the female controls of the same age.

Conclusion: True LLD due to leg shortening is common in SCA especially in the early adolescent females and the late adolescent males and involves mainly the left leg. The LLD are of mild and moderate severity. A proportion of the population also has mild LLD. Routine screen for LLD in SCA is recommended.

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