

Full Length Research Article

Comparative anthropometry between Sickling and Non-Sickling individuals of local population of Raipur city of Chhattisgarh by measuring upper extremity length, mid arm circumference, maximum calf circumference and total lower extremity length

Praveen Kumar Banjare, Manik Chatterjee, Dharam Singh Rathia, *Bichitrananda Roul and Praveen Kurrey

Department of Anatomy Pt. JNM Medical College Raipur (C.G), India

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ABSTRACT

Studies on child growth and development have always occupied an important position in the scientific research curriculum and are of interest to the researchers of both Medical Science and Physical Anthropology all over the world. Sickle Cell Anemia (SCA) is a hereditary anemia, predominantly seen amongst various tribal populations of India. This problem decreases the amount of oxygen flowing to body tissues which affects growth and nutritional status of individuals. In present study, 316 subjects of Raipur city [157 cases (sickling) + 159 controls (non-sickling)] were taken and various anthropometric measurements sitting height, upper extremity length, maximum calf circumference, arm length, mid arm circumference and total lower extremity length were obtained. After analysis of data of above parameters, we found that Upper extremity length, Mid arm circumference, Maximum calf circumference and Total lower extremity length of cases were less than that of controls for both male and female. Significant differences were observed in Upper extremity length and Maximum calf circumference.

Key words: Anthropometry, Sickle cell Anemia, Anthropometer, Spreading Calliper.

INTRODUCTION

Sickle Cell Anemia (SCA) is a hereditary anemia, predominantly seen amongst various tribal populations of India. Sickle gene is found all over the world, particularly amongst people originated/migrated from Malaria endemic areas of Africa and Asia. According to one of the hypothesis, it is a natural mutation in Hemoglobin molecule to protect RBCs from malarial parasites by making them a little rigid, so that malarial parasites can't enter into RBCs. REF, (Vinay Kumar, ?; Childs, 1995). SCA occurs due to inherited abnormal hemoglobin (Hb) gene, which produces Hb-S (Hb-Sickle). Due to the presence of Hb-S and because of its abnormal characteristic, converts RBCs into rigid-brittle half moon (Sickle) shaped instead of soft round biconcave shape, which is the main cause of complication of Sickle Cell disease. REF (Vinay Kumar, ?; Childs, 1995). The fragile, sickle-shaped cells deliver less oxygen to the body's tissues. They can also get stuck more easily in small blood vessels, as well as break into pieces that can interrupt healthy blood flow. These problems decrease the amount of oxygen flowing to body tissues even more. REF. (Patra PradeepKumar *et al.*, 2010) According to a study, prevalence of SCD in India is highest in the state of Chhattisgarh (23%) and highest for

Kurmi (55%) and Teli (53%) caste which belong to backward castes. This work is an attempt to study the growth status and anthropometric variation of Sickling individuals of Raipur city of Chhattisgarh state and compare them with non - sickling individuals of the same region.

MATERIALS AND METHODS

In the present study, data were collected from local population of Raipur Dist. during the months from October 2012 to July 2013. In order to study the physical growth and nutritional status of Sickling and Non-Sickling individuals, a simple schedule was prepared to record the different Anthropometric variables.

1. Sickling cases taken in this study, were registered cases in Sickle Cell Unit of Pt.J.N.M. Medical College Raipur (C.G.).
2. Sample size 316 [157 cases (sickling) + 159 controls (non-sickling)] according to inclusion and exclusion criteria.
3. Individuals were examined for the following Anthropometric measurement:-

- Upper extremity length
- Mid arm circumference
- Maximum calf circumference
- Total lower extremity length

*Corresponding author: Bichitrananda Roul,
Department of Anatomy Pt. JNM Medical College Raipur (C.G),
India.

4. The data were analysed, compared and interpreted by using the proper statistical methods.

Inclusion Criteria

- Individuals of local population of Raipur district of Chhattisgarh.
- Age group 10 to 26 years.
- Apparently healthy individuals for control and
- Individuals suffering from Sickling who were registered in sickle cell unit of Pt. J. N. M. Medical College Raipur.

Exclusion Criteria

- Individuals other than local population of Raipur district Chhattisgarh state.
- Age less than 10 and more than 26 yrs.

Total Upper Extremity Length: REF, (Chatterjee, 1982; Gupta, 2012; Agrawal, 2008). With the subject's arm and hand fully extended by his/her side, the tip of one arm of the Anthropometer was placed at the inferior border of acromian process. The distance to the tip of the longest finger was measured.

Instrument used: **Anthropometer**

Mid Arm Circumference: REF, (Chatterjee, 1982; Gupta, 2012; Agrawal, 2008). The measurement was taken with the left arm hanging relaxed just away from his/her side, and the circumference was taken horizontally at the marked level, that is the midway between the tip of the acromian and the olecranon process.

Instrument used: **Measuring Tape.**

Maximum Calf Circumference: REF, (Banjare and Chaterjee, 2014). The subject was asked to sit on a table with the legs hanging freely. Maximum circumference was obtained by moving the tape vertically up and down. The measurement was taken at right angles to the axis of the lower leg.

Instrument used: **Measuring Tape.**

Total Lower Extremity Length: REF, (Chatterjee, 1982; Gupta, 2012; Agrawal, 2008). This parameter was obtained indirectly from each subject by subtracting the sitting height from his/her stature.

RESULT AND DISCUSSION

REF, (Banjare and Chaterjee, 2014). The result of analysis of 4 body measures of case (sickling) and control (non-sickling) individuals of Raipur city of Chhattisgarh, ranging from age 10+ to 25+ years are presented and each body measure is described with regard to mean, standard deviation and distance curve with the help of necessary tables and figures. They are shown separately for males and females. Case and control differences are assessed for all body measures by using "t-test" and "p value"

Table 1. Total upper extremity length (in cm)

Age	Diseased Male			Control Male			t-test	P value
	No.	Mean	S.D.	No.	Mean	S.D.		
10+	6	52.32	1.17	5	54.04	0.98	-2.65	0.03
11+	3	53.2	1.54	5	55.14	0.81	-2.02	0.15
12+	6	55.88	0.96	5	57.3	0.45	-3.21	0.01
13+	8	58.43	0.74	5	60.2	0.62	-4.68	<0.001
14+	7	61.89	0.54	5	63.62	0.35	-6.75	<0.001
15+	4	65.13	0.56	5	68.02	1.32	-4.44	0.01
16+	7	69.84	1.73	7	71.7	1.83	-1.95	0.08
17+	3	71.8	0.53	5	72.76	1.36	-1.41	0.21
18+	3	70.13	2.73	7	73.23	2.19	-1.74	0.18
19+	2	71.5	0.71	7	74.73	2.11	-3.43	0.01
20+	3	73	1.32	5	73.76	0.49	-0.96	0.43
21+	3	72.5	1.8	10	75.31	3.22	-1.93	0.1
22+	3	70.5	3.04	5	73.22	2.56	-1.3	0.27
23+	4	74.28	1.72	6	75.23	1.68	-0.87	0.42
24+	4	73.55	1.91	4	74.8	1.64	-0.99	0.36
25+	5	73.44	1.9	3	74.53	1.96	-0.77	0.48
Total	71	65.59	8.23	89	69.16	7.6		

Table 2. Total upper extremity length (in cm)

Age	Diseased female			Control female			t-test	P value
	No.	Mean	S.D.	No.	Mean	S.D.		
10+	7	47.69	2.16	4	49.3	2.33	-1.13	0.3
11+	4	49.2	0.58	4	51.08	0.6	-4.75	0.01
12+	8	51.51	0.75	5	52.72	0.48	-3.07	0.01
13+	7	55.19	0.81	5	56.16	0.41	-2.45	0.04
14+	10	58.24	0.61	4	59.85	0.48	-5.23	<0.001
15+	7	60.46	0.41	4	62.25	0.29	-8.49	<0.001
16+	8	64	1.3	5	66.2	1.38	-2.86	0.02
17+	4	66.15	1.27	3	68.13	1.29	-2.03	0.11
18+	7	71	1.51	3	72.47	2.29	-1.02	0.39
19+	3	67.43	2.27	9	69.14	2.17	-1.14	0.33
20+	5	67.14	1.41	6	68.98	1.3	-2.24	0.05
21+	3	69.17	1.04	6	69.5	1.67	-0.37	0.73
22+	4	68.43	0.61	3	70.07	0.47	-4.02	0.01
23+	3	67.03	1.33	3	68.87	1.06	-1.87	0.14
24+	2	67	0.85	3	68.5	0.56	-2.2	0.19
25+	4	69.63	0.57	3	71.57	0.51	-4.73	0.01
Total	86	60.94	7.69	70	63.96	7.55		

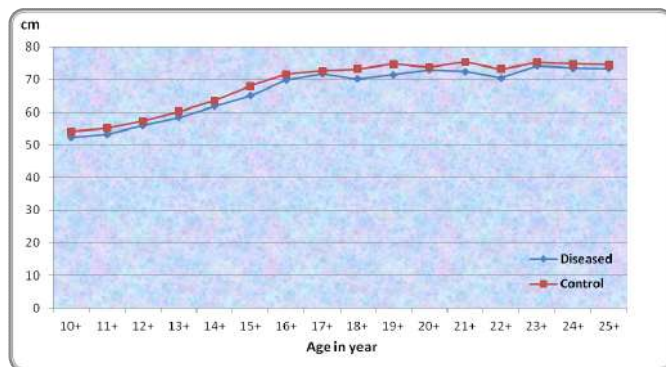


Fig. 1 Total Upper Extremity Length (Male)

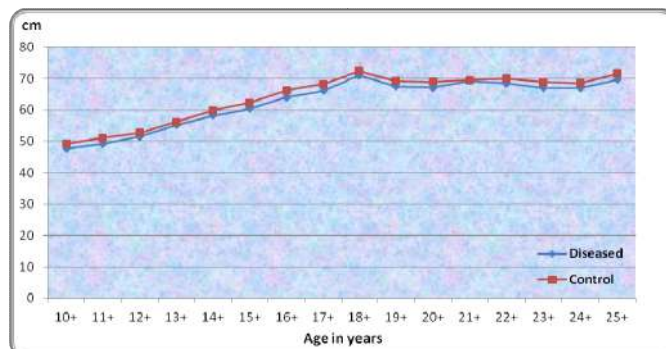


Fig. 2 Total Upper Extremity Length (Female)

REF, (Park, ?). A comparison of distance curve of total upper extremity length reveals that curve for case ran below the distance curve for control at every age periods in male and female. In male difference is significant at the age periods of 10+, 12+, 13+, 14+, 15+ and 19+ (p value < 0.05) and highly significant at the age periods of 13+ and 14+ (p value <0.001).In female difference is significant at the age periods of 11+, 12+, 13+, 14+, 15+, 16+, 22+ and 25+ (p value < 0.05) and highly significant at the age periods of 14+ and 15+ (p value <0.001).

Arm Circumference (Table No.3 & 4)

REF.[5]A comparison of distance curve of arm circumference reveals that curve for case ran below the distance curve for control at every age periods in male and female. In male difference is significant at the age periods of 13+ and 19+ (p value < 0.05). In female difference is significant at the age periods of 12+, 13+ and 14+ (p value < 0.05) and highly significant at the age periods of 13+ (p value <0.001).

Table 3. Upper ARM Circumference (in cm)

Age	Diseased Male			Control Male			t-test	P value
	No.	Mean	S.D.	No.	Mean	S.D.		
10+	6	15.53	1.34	5	16.6	1.23	-1.37	0.2
11+	3	17.13	0.72	5	18	0.96	-1.45	0.2
12+	6	17.42	0.78	5	18.3	0.51	-2.26	0.05
13+	8	17.95	0.65	5	18.76	0.56	-2.38	0.04
14+	7	17.94	1.08	5	19.06	0.93	-1.91	0.09
15+	4	19.98	1.2	5	20.34	1.31	-0.44	0.68
16+	7	21.94	1.49	7	22.74	1.37	-1.04	0.32
17+	3	22.37	1.64	5	22.86	1.26	-0.45	0.68
18+	3	28.07	4.07	7	28.74	2.77	-0.26	0.81
19+	2	28.35	0.21	7	30.13	1.74	-2.63	0.04
20+	3	30.2	2.46	5	31.94	1.78	-1.07	0.36
21+	3	25.23	2.05	10	25.58	2.44	-0.25	0.82
22+	3	23.8	4.35	5	25.4	3.58	-0.54	0.62
23+	4	30.3	6.13	6	31.67	5.54	-0.36	0.73
24+	4	30.8	1.95	4	31.63	1.8	-0.62	0.56
25+	5	30	1.99	3	31.43	2.66	-0.81	0.47
Total	71	22.42	5.75	89	24.65	5.68		

Table 4. Upper ARM circumference (in cm)

Age	Diseased Female			Control Female			t-test	P value
	No.	Mean	S.D.	No.	Mean	S.D.		
10+	7	13.93	0.76	4	14.7	0.72	-1.68	0.14
11+	4	15.15	0.77	4	15.98	0.43	-1.54	0.2
12+	8	15.78	0.45	5	16.54	0.38	-2.69	0.03
13+	7	15.87	0.58	5	16.78	0.5	-4.27	<0.001
14+	10	17.48	0.64	4	18.25	0.42	-2.64	0.03
15+	7	18.06	0.71	4	18.9	0.48	-2.34	0.05
16+	8	18.41	1.09	5	19.44	0.99	-1.75	0.11
17+	4	18.65	0.91	3	19.6	0.61	-1.65	0.16
18+	7	19.54	1.49	3	20.63	1.8	-0.92	0.42
19+	3	22.5	1.5	9	25.78	4.42	-1.92	0.08
20+	5	22.76	2.82	6	23.65	2.53	-0.55	0.6
21+	3	24.57	1.6	6	25.67	2.16	-0.86	0.43
22+	4	22.1	0.67	3	22.9	0.85	-1.34	0.26
23+	3	26.07	2.61	3	27.17	2.93	-0.49	0.65
24+	2	24.1	2.26	3	24.33	1.53	-0.13	0.91
25+	4	23.98	1.42	3	24.33	1.53	-0.32	0.77
Total	86	19.06	3.91	70	21.14	4.4		

Total Lower Extremity Length (Table No. 5 & 6)

REF.[5]A comparison of distance curve of total lower extremity length reveals that curve for case ran below the distance curve for control at every age periods in male and female. In male difference is significant at the age periods of

13+ and 19+ (p value < 0.05) and highly significant at the age period of 13+ (p value 0.01). In female difference is significant at the age period of 25+ (p value < 0.05).

Table 5. Total lower extremity length (in cm)

Age	Diseased Male			Control Male			t-test	P value
	No.	Mean	S.D.	No.	Mean	S.D.		
10+	6	57.07	6.76	5	59.42	6.78	-0.57	0.58
11+	3	59.43	4.25	5	65.14	5.5	-1.64	0.16
12+	6	60	1.99	5	63.18	2.68	-2.19	0.06
13+	8	64.1	1.4	5	66.74	1.28	-3.49	0.01
14+	7	68.86	1.88	5	71.28	2.73	-1.71	0.13
15+	4	70.38	3.85	5	73.1	4.25	-1.01	0.35
16+	7	73.09	3.02	7	75.94	2.97	-1.79	0.1
17+	3	74.37	2.78	5	77	3.24	-1.22	0.28
18+	3	76.6	6.18	7	83.71	5.09	-1.75	0.17
19+	2	84.75	0.35	7	88.6	3.05	-3.26	0.02
20+	3	84.43	1.97	5	88.22	2.38	-2.43	0.06
21+	3	84.77	1.59	10	88.01	5.24	-1.71	0.12
22+	3	83.13	3.96	5	86.36	2.2	-1.3	0.29
23+	4	83.88	3.02	6	87.65	2.26	-2.13	0.08
24+	4	84.95	1.64	4	87.95	2.14	-2.22	0.07
25+	5	81.98	2.41	3	85.63	2.53	-2.01	0.11
Total	71	72.64	10.79	89	78.7	10.51		

Table 6. Total lower extremity length (in cm)

Age	Diseased Female			Control Female			t-test	P value
	No.	Mean	S.D.	No.	Mean	S.D.		
10+	7	58.87	4.92	4	61.53	4.93	-0.86	0.42
11+	4	59.68	2.17	4	62.93	2.07	-1.77	0.15
12+	8	59.6	3.03	5	62.18	3.51	-0.92	0.4
13+	7	63.06	3.32	5	66.26	3.31	-1.17	0.28
14+	10	66.18	2.86	4	69	3.68	-1.38	0.23
15+	7	63.47	2.57	4	66.93	2.8	-2.03	0.09
16+	8	67.38	2.83	5	70.54	2.53	-2.09	0.06
17+	4	80	4.71	3	82.17	4.4	-0.63	0.56
18+	7	73.19	3.67	3	75.67	4.05	-0.91	0.42
19+	3	71.53	5.6	9	76.74	5.1	-1.43	0.24
20+	5	71.16	4.05	6	74.38	3.03	-1.47	0.18
21+	3	78.2	0.2	6	75.9	6.8	0.83	0.45
22+	4	72.95	1.89	3	76.7	1.83	-2.65	0.05
23+	3	75.27	2.32	3	78.27	1.6	-1.84	0.15
24+	2	76.35	3.04	3	80.3	2.01	-1.62	0.28
25+	4	79.78	1.55	3	82.9	1.35	-2.85	0.04
Total	86	67.92	7.41	70	72.24	7.46		

Maximum Calf Circumference (Table No. 7 & 8; Figure No. 3& 4)

Table 7. MID thigh circumference (in cm)

Age	Diseased Male			Control Male			t-test	P value
	No.	Mean	S.D.	No.	Mean	S.D.		
10+	6	30.42	2.07	5	31.78	1.67	-1.21	0.26
11+	3	33.23	2.11	5	34.54	1.3	-0.97	0.41
12+	6	33.37	1.39	5	34.8	1.52	-1.62	0.14
13+	8	34.39	1.68	5	35.98	1.43	-1.82	0.1
14+	7	34.3	1.84	5	36.62	2.2	-1.92	0.09
15+	4	37.18	2.31	5	39	2.42	-1.15	0.29
16+	7	42.29	1.93	7	44.11	2.48	-1.54	0.15
17+	3	45.8	2.75	5	49.52	2.97	-1.8	0.14
18+	3	51.06	8.37	7	51.67	5.48	-0.12	0.92
19+	2	53.5	2.83	7	54.56	2.19	-0.49	0.69
20+	3	49.13	2.03	5	51.66	2.97	-1.43	0.21
21+	3	44.23	1.97	10	49.02	5.1	-2.43	0.04
22+	3	45.6	7.91	5	50.94	7.27	-0.95	0.39
23+	4	48.68	3.98	6	51.28	3.85	-1.03	0.34
24+	4	55.4	4.41	4	56.48	4.48	-0.34	0.74
25+	5	53.48	0.4	3	55.23	1.37	-2.17	0.15
Total	71	41.42	8.68	89	45.69	8.6		

MID thigh circumference (in cm)

Age	Diseased Female			Control Female			t-test	P value
	No.	Mean	S.D.	No.	Mean	S.D.		
10+	7	30.46	2.18	4	31.75	2.4	-0.89	0.41
11+	4	32.78	2.23	4	34.78	1.86	-0.92	0.4
12+	8	33.64	2.06	5	35.36	1.77	-1.15	0.29
13+	7	35.24	0.9	5	36.8	0.95	-2.45	0.04
14+	10	35.83	1.81	4	37.7	2.24	-1.49	0.2
15+	7	35.74	1.64	4	37.28	1.92	-1.34	0.23
16+	8	36.83	1.14	5	38.58	1.36	-2.41	0.04
17+	4	39.35	3.04	3	41.8	2.55	-1.16	0.3
18+	7	42.97	2.02	3	44.73	2	-1.27	0.27
19+	3	42	1.5	9	46	8.09	-1.41	0.19
20+	5	43.92	4.42	6	45.48	4	-0.61	0.56
21+	3	43.33	0.76	6	46.67	3.72	-2.11	0.08
22+	4	44.65	2.1	3	46.2	2.88	-0.79	0.48
23+	3	39.4	1.28	3	40.5	1.5	-0.97	0.39
24+	2	41.85	2.33	3	44.7	1.37	-1.56	0.3
25+	4	45.43	1.3	3	47.27	1.1	-2.03	0.1
Total	86	38.22	5.42	70	41.17	6.01		

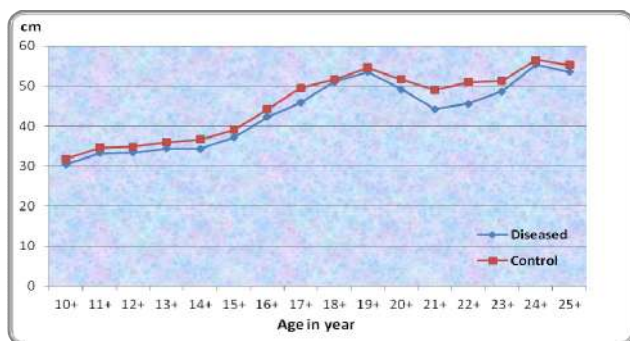


Fig. 3. Mid thigh Circumference (Male)

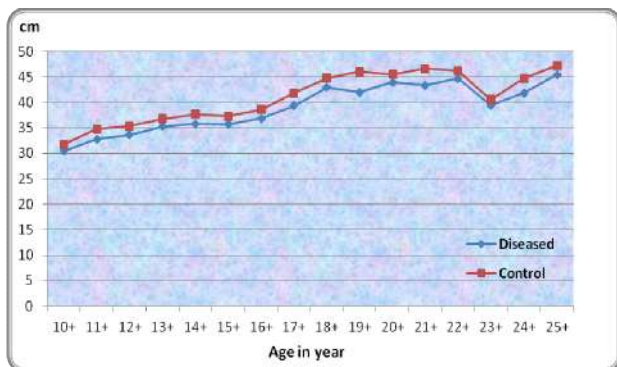


Fig. 4. Mid thigh Circumference (Female)

REF.[5]A comparison of distance curve maximum calf circumference reveals that curve for case ran below the distance curve for control at every age periods in male and female. In male difference is significant at the age period of 12+, 13+, 14+,and 20+ (p value < 0.05) and highly significant at the age periods of 12+ and 14+ (p value 0.01). In female difference is significant at the age periods of 12+, 14+,15+,16+, 18+, 19+ and 20+ (p value < 0.05) and highly significant at the age periods of 12+ and 14+ (p value <0.001). At all ages, upper extremity length of case were less than control and statistically significant at most of age group. There was an earlier increase in both groups then became near stable.

Barden *et al*, (2002) found significantly lower z scores for weight, height, arm circumference, and upper arm fat and muscle areas, delayed skeletal maturation delayed puberty,

and poor nutritional status in children with SCD. Upper arm circumference and total lower extremity length, were less than control but differences were statistically insignificant at most of age group. At all ages, maximum calf circumference of case were less than control and statistically significant at most of age group. From the above discussion, it may be tempting to state that the poor growth status of the cases & controls, as judged by body weight and height, in comparison to Indian standard may be due to the poor socio-economic condition. Apart from under-nutrition, sickling may be responsible for less growth.

Conclusion

On comparison mean value of various body measures Upper extremity length, Mid arm circumference, Maximum calf circumference and Total lower extremity length of cases were less than that of controls for both male and female. Significant differences were observed in Upper extremity length and Maximum calf circumference.

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