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Original Research Article

An Anthropometric Comparison between Sickling and Non-Sickling Individuals of Tribal Population of Bastar Division, Chhattisgarh, India

Dr. Bithika Nel Kumar*[1], Dr. Manik Chatterjee[2]
[1]Assistant Professor, Department of Anatomy, Lt. Baliram Kashyap Memorial Government Medical College, Jagdalpur, Bastar (C.G), 494001, India
[2]Professor and HOD, Department of Anatomy, Pt. Jawaharlal Nehru Memorial Government Medical College, Raipur (C.G), 492001, India

***Corresponding author:** Dr. Bithika Nel Kumar
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Abstract

Background: Hemoglobinopathies including Thalassemia with an estimated 10,000 live births each year and Sickle cell disease (SCD) with an estimated 5,200 live births each year, are a major public health problem in India specially in scheduled tribes, who have a high prevalence of socio-economic disadvantage and are frequently medically underserved [1]. In Bastar, the land of tribes as about 70% of population comprises of tribals, which is 26.76% of the total tribal population of Chhattisgarh [2]. Hence this work was an attempt to compare anthropometrically between Sickling and Non-Sickling individuals of tribal population of Bastar Division, Chhattisgarh. ***Aims & Objectives:*** To compare anthropometrically between sickling and non-sickling individuals of tribal population of Bastar division, Chhattisgarh. ***Material and methods:*** An observational case-control study of 138 sickle cell disease patients with electrophoresis/sickle solubility test positive, aged 5yrs to 30yrs and 138 sickle solubility negative age and sex matched controls was done. Anthropometrical parameters like height, weight, upper and lower limb lengths were statistically compared. ***Results:*** In males, in the age group of 5-14yrs, the parameters that were statistically significant were of axial skeleton and limb lengths. This suggests that it is the most vulnerable group. In the age group of 20-30yrs the parameters that were statistically significant were hemoglobin concentration ($p<0.0001$), weight ($p=0.004$), maximum calf circumference ($p=0.02$) and BMI ($p=0.02$). In females, statistically significant difference for hemoglobin concentration between the cases and controls in all three age groups was seen i.e.,5-14yrs($p=0.05$), 15-19yrs(0.001), 20-30yrs ($p<0.0001$) and in the age group of 15-20yrs, t-test for weight between cases and controls in female group showed significant difference ($p= 0.01$). ***Conclusions:*** From the above results and low SES, it may be stated that the poor growth status of the cases may be due to the SCD and poor socio-economic conditions.

Keywords: Sickle cell Disease, Anthropometery, Tribal population.

INTRODUCTION

Sickle cell disease results from a point mutation caused by substitution of valine for glutamic acid at 6th position of beta globin chain. It is inherited as an autosomal recessive trait. It is of two types:

- Sickle cell disease (homozygous)
- Sickle cell trait (heterozygous)

Homozygous only produce abnormal beta chains that make hemoglobin S (HbS, termed SS), and this results in clinical syndrome of Sickle cell disease. Heterozygous produce a mixture of both normal and abnormal beta chains that make normal HbA and abnormal HbS (termed AS) that results in clinically asymptomatic sickle cell trait.

Acute problems include painful vaso-occlusive crisis of bones and joints, especially long bones, metacarpals and metatarsals with overlying soft tissue involvement (the hand –foot syndrome), sequestration crisis, aplastic crisis and hyperhaemolytic crisis. The bone marrow responds to the aplastic crisis by a compensatory hyperplasia. Gnathopathy, skull bossing, finger clubbing and lymphadenopathy were common presentations in studies done in Africa with Sickle cell disease. (SCD) [3, 4].

Although it is generally believed that SCD had an adverse effect upon the physical growth and development, published data on this aspect from India are very limited [5-8]. Population screening (Anthropological Survey of India) [9] established sickle cell trait frequencies up to 35% throughout much of central India, the highest frequencies occurring in

Orissa, Madhya Pradesh, Maharashtra and Gujarat [10, 11]. According to an on-going project at Pt. Jawaharlal Nehru Medical College (JNMC), around 10% of the state's population has prevalence of sickle cell anaemia [12].

Bastar, Sarguja, Narayanpur district of Chhattisgarh have a high proportion of tribes (65%) [13]. In Bastar, the land of tribes about 70% of the total population comprises of tribals, which is 26.76% of the total tribal population of Chhattisgarh [14].

This work was an attempt to compare anthropometrically between Sickling and Non-Sickling individuals of tribal population of Bastar Division, Chhattisgarh.

MATERIAL AND METHODS

Study Design

This is an observational case-control study (Comparative study).

Study Setting

- Study centre-This study was done at Department of Anatomy, Pt. Jawaharlal Nehru Medical College, Raipur (Chhattisgarh).
- Study area-This study was conducted in Bastar division, Chhattisgarh.
- Study duration-From year 2014 to 2015, subjects were recruited till sample size was obtained.

Study Subjects

Registered cases with positive sickle solubility test or electrophoresis test for sickling were recruited for study from L.B.R.K.M Govt. Medical College, Jagdalpur and M.P.M Hospital, Jagdalpur. Matched samples for age and sex were recruited following negative sickle solubility test as non–sickling individuals from villages near Jagdalpur.

Sample Size

Around 276 (138 Sickling & 138 Non-Sickling) individuals, according to sample size calculation using 95% confidence interval anticipated and absolute precision of 0.10 were recruited.

Inclusion Criteria

- Registered OPD or IP patient's with positive sickle solubility test or electrophoresis test for sickle cell disease were recruited for study from L.B.R.K.M Government Medical College, Jagdalpur and M.P.M Hospital, Jagdalpur.
- Individuals who have negative sickle solubility test were recruited as non-sickling subject.
- Age group 05 to 30 yrs.
- Tribal's belonging to Bastar division, Chhattisgarh.
- Signed, informed consent of patient or parents/guardian.

Exclusion Criteria

- Non-tribal population of Bastar district, Chhattisgarh.
- Tribal's who are non domicile of Chhattisgarh.
- Age less than 05yrs & more than 30yrs.
- Refusal of consent.

MATERIALS

Fig-1: Anthropometer

Fig-2: Sliding Calliper

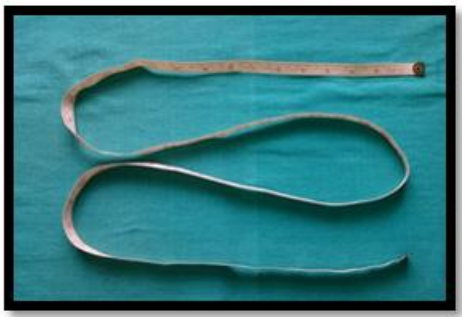

Fig-3: Measuring Tape

Fig-4: Electronic Weighing Machine

METHODOLOGY

On recruitment of subjects for cases and controls fulfilling the inclusion and exclusion criteria , the proforma was filled in which their name, father's name , husband's name, date of birth (as per school /birth certificate), age(years), sex , caste, religion, education status, phone number, address, dietary habits, physique, educational qualification and occupation of parents ,income of family ,investigations like haemoglobin, electrophoresis report, sickle solubility test report with dates, date of initial diagnosis.

Examination of the subject with special mention of date, time and place was done. Using standard instruments the following parameters were measured [15-19]:

Body Weight (Fig-4):

The weight of the subject was taken with minimum light clothes on. Then the subject was asked to stand in the centre of the weighing machine, facing the recorder, looking straight ahead and hands were placed by the sides. Once the subject was correctly positioned and the readout in the machine become stable, the reading was recorded in the proforma. The weight was recorded to the nearest of 0.1kg.

Instrument used: **Portable Digital Weighing Machine**

Stature (Fig-5):

The subject was asked to stand on a plane surface, against the wall with his/her heels together and toes slightly apart, looking straight forward, shoulder relaxed and arms by the side of body with palms facing medially. The heels, buttocks and shoulder blades making contact with the wall. The head was aligned in the Frankfort horizontal plane. The subject was asked to stretch upwards, added by a gentle tilt of head up or down to get proper alignment, slight upward pressure was applied below the mastoid process in order to help in stretching to the fullest and was asked to take a deep breath and hold that position. The horizontal arm of the anthropometer was brought down to the subject's head with enough pressure to compress the hair while keeping the instrument vertical. The reading was taken to the nearest of 0.1 cm.

Instrument used: **Anthropometer**

Fig-5: Stature

Upper Limb Length (Fig-6):

It is the straight distance between acromion (a) and middle finger or dactylion (da), while the arm is hanging downwards parallel to the body. The acromion (a) point was located by the fingers of left hand to place the upper fixed bar on it. The movable cross-bar was then raised against the tip of the middle finger or dactylion (da) (longest finger) for taking the measurement.

Instrument used: **First two segments of anthropometer rod**.

Fig-6: Upper Arm Length

Arm Length (Fig-7):

The subject stands erect with feet together and right arm flexed 90^0 at the elbow with the palm facing up. This measurement is the straight distance between acromion (a) and radiale (r). The acromion (a) point was located by the fingers of left hand, to place the upper fixed bar on it. The movable cross-bar was then raised against the tip of the olecranon process (the bony part of the mid-elbow) for taking the measurement.

Instrument used: **First segment of anthropometer rod.**

Fig-7: Arm Length

Lower Limb Length:

This parameter was obtained indirectly for each subject by subtracting the sitting height from his/her stature.

Thigh Length (Fig-8):

The subject sat straight on the flat surface with the right knee bent at 90^0 angle. The small sliding calliper was positioned as if one were to measure the breadth of the patella. The blades of the calliper were positioned against the distal end of the femur on either side of the patella. The horizontal bar of the calliper was touching the anterior surface of the thigh, proximal to the patella. Using the superior edge of the horizontal bar of the calliper as a guide, a line was marked on the anterior surface of the thigh. The measurement was taken from midpoint of inguinal crease to upper border of patella along the midline of the thigh using a measuring tape.

Instrument used: **Measuring tape and sliding caliper**

Fig-8: Thigh Length

Maximum Calf Circumference (Fig-9):

The subject was asked to sit on a stool with the feet resting firmly on the ground. Maximum circumference was obtained of the calf by moving the tape vertically up and down on the right calf region.

Instrument used: **Measuring tape.**

Fig-9: Maximum Calf Circumference

Statistical Analysis

Descriptive analysis was carried out to calculate mean, standard deviation, student t-test, p-value (<0.05 as significant) to see the relationship between anthropometric variables between cases and controls. Analysis was done using Windows Microsoft Office Excel 2007.

RESULTS

The result of analysis of 07 body measures of case (sickling) and control (non-sickling) individuals of Bastar division of Chhattisgarh, ranging from age 05 to 30 years are presented. The subjects are stratified in three groups according to age: 05 to 14yrs, 15 to 19yrs and 20 to 30yrs. Each body measure is described with regard to mean, standard deviation, standard error and range with the help of necessary tables. 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: The anthropometric parameters of males of the age group of 5-14yrs

Age group in yrs 5-14	Male cases (n=12)					Male controls (n=12)						
	Mean	S.D	S.E of mean	Min	Max	Mean	S.D	S.E of mean	Min	Max	t-stat	P value
Hb gm/dl	7.23	3.18	0.92	2.2	10.6	10.06	2.62	0.76	7.6	14.9	-2.38	0.03
Body Weight (in Kg)	20.92	7.95	2.29	10.5	36.4	31.97	9.81	2.83	14	45.1	-3.03	0.006
Stature(cm)	122.78	18.66	5.39	90.2	155.8	141.37	17.62	5.09	103.3	159.7	-2.51	0.02
ULL(cm)	54.32	9.62	2.78	40	73.3	64.82	8.41	2.43	46.9	73.8	-2.85	0.01
Arm Length(cm)	25.46	4.35	1.26	18.1	34.3	29.63	4.07	1.18	22.5	34.5	-2.42	0.02
LLL(cm)	61.23	11.27	3.25	43.7	81.3	72.25	9.65	2.78	51.3	85.6	-2.57	0.02
Thigh Length(cm)	29.00	5.87	1.69	20.5	40.8	34.37	5.44	1.57	23.7	40.5	-2.32	0.03
MCC (cm)	21.85	3.86	1.12	15.5	27.8	26.17	3.29	0.95	20.1	30.6	-2.95	0.01
BMI	0.49	1.71	13.59	8.79	15.65	15.50	1.56	0.45	13.12	18.04	-3.21	0.004

Table-1 shows that in the age group of 5-14yrs in male, the parameters that were statistically significant are hemoglobin concentration (p=0.03), weight(p=0.006), height(p=0.02), upper limb length(p=0.01), arm length(p=0.02), lower limb length(p=0.02), thigh length(p=0.03), maximum calf circumference(p=0.01) and BMI (p=0.004). ULL: Upper limb length (cm), LLL: Lower Limb Length (cm), MCC: Maximum Calf Circumference (cm).

Table-2: Shows the anthropometric parameters of males of the age group of 15-19yrs

Age group in yrs 15-19	Male cases (n=17)					Male controls (n=17)						
	Mean	S.D	S.E of mean	Min	Max	Mean	S.D	S.E of mean	Min	Max	t-stat	P value
Hb gm/dl	8.29	2.37	0.58	3.8	13	10.76	1.87	0.45	8.3	14.2	-3.36	0.002
Body Weight (in Kg)	47.93	10.29	2.50	34.5	69	47.10	9.58	2.32	33.9	66.3	0.24	0.80
Stature(cm)	162.38	7.80	1.89	149.6	175.9	161.59	7.16	1.74	148.5	174	0.31	0.76
ULL (cm)	73.81	3.90	0.95	66.2	79.9	73.69	3.92	0.95	67.4	82.3	0.09	0.93
Arm Length (cm)	33.75	2.53	0.61	27.9	37.4	34.05	1.96	0.47	30.7	37.6	-0.39	0.70
LLL(cm)	82.34	5.16	1.25	72.4	90.1	81.70	3.78	0.92	72.8	87.4	0.41	0.68
Thigh Length (cm)	40.85	2.91	0.71	36.7	45	39.42	2.51	0.61	35.3	44	1.53	0.14
MCC (cm)	29.32	3.29	0.80	23.1	36	30.39	2.90	0.70	26.5	36.4	-1.01	0.32
BMI	18.13	3.56	0.86	12.89	27.36	17.94	2.77	0.67	14.37	24.41	0.18	0.86

Table-2 shows that in the age group of 15-19yrs old males the parameters which showed statistical difference in case and control was hemoglobin concentration (p=0.002), none of the other parameters showed any statistical significance.

Table-3: The anthropometric parameters of males of the age group of 20-30yrs

Age group in yrs 20 - 30	Male cases (n=40)					Male controls(n=40)						
	Mean	S.D	S.E of mean	Min	Max	Mean	S.D	S.E of mean	Min	Max	t-stat	P value
Hb gm/dl	8.55	0.43	2.71	4	13.9	11.61	1.84	0.29	8.5	16.1	-5.91	1.16E-07
Body Weight (in Kg)	48.83	6.64	1.05	38.8	69.1	53.71	7.79	1.23	38.4	71.6	-3.01	0.004
Stature (cm)	162.89	5.82	0.92	150.6	173.3	165.53	6.66	1.05	149.1	179.2	-1.89	0.06
ULL(cm)	74.70	3.45	0.55	67	81	75.87	3.36	0.53	67.2	84.1	-1.54	0.13
Arm Length (cm)	34.85	1.66	0.26	31.2	38	35.43	1.87	0.30	31.9	39.3	-1.45	0.15
LLL(cm)	82.30	4.16	0.66	73.9	90.1	82.92	4.50	0.71	72.6	94.2	-0.64	0.53
Thigh Length (cm)	40.30	2.76	0.44	35.9	47	40.45	2.84	0.45	33.8	49	-0.24	0.81
MCC (cm)	29.63	2.28	0.36	25.5	35.1	31.37	3.09	0.49	21.9	37.8	-2.87	0.01
BMI	18.38	2.14	0.34	14.99	25.35	19.58	2.38	0.38	14.60	24.16	-2.36	0.02

Table-3 shows that in the age group of 20-30yrs old males the parameters which showed statistical difference in case and control were hemoglobin concentration($p<0.0001$), weight($p=0.004$), sitting height($p=0.03$), maximum calf circumference($p=0.02$) and BMI ($p=0.02$).

Table-4: The anthropometric parameters of females of the age group of 5-14yrs

Age group in yrs 5 - 14	Female cases(n=10)					Female controls(n=10)						
	Mean	S.D	S.E of mean	Min	Max	Mean	S.D	S.E of mean	Min	Max	t-stat	P value
Hb gm/dl	7.28	3.01	0.95	2.2	12.2	9.48	0.96	0.29	7.6	10.7	-2.21	0.05
Body Weight (in Kg)	27.27	9.34	2.95	16.1	45.9	30.54	10.54	3.18	14.5	43.3	-0.75	0.46
Stature (cm)	133.59	15.70	4.96	110.5	154.6	136.32	23.16	6.98	81.6	156	-0.32	0.75
ULL (cm)	59.08	8.25	2.61	44.2	71.1	62.65	8.39	2.53	48.8	71.5	-0.98	0.3
Arm Length (cm)	27.66	3.9	2.73	21	33.2	28.60	4.32	1.30	22.1	33	0.63	0.54
LLL (cm)	66.35	8.49	2.68	52.8	75.5	68.25	9.00	2.71	53.4	77.5	-0.50	0.6
Thigh Length (cm)	32.89	4.72	1.49	25	38.6	33.85	4.49	1.35	26	39	-0.48	0.6
MCC(cm)	24.44	3.40	1.07	20	30.9	25.39	4.40	1.33	19.3	30.8	-0.56	0.6
BMI	14.79	1.84	0.58	13.00	19.20	16.42	4.55	1.37	11.36	27.78	-1.09	0.29

Table-5: Shows the anthropometric parameters of females of the age group of 15-19yrs

Age group in yrs 15 - 19	Female cases (n=21)					Female controls (n=20)						
	Mean	S.D	S.E of mean	Min	Max	Mean	S.D	S.E of mean	Min	Max	t-stat	P value
Hb gm/dl	6.89	2.72	0.59	2	10.8	9.22	1.28	0.29	7.2	12.1	-3.54	0.001
Body Weight (in Kg)	43.20	6.29	1.37	30.6	55	38.33	5.16	1.15	30.8	52	2.72	0.01
Stature (cm)	151.74	6.55	1.43	141.5	166.6	150.71	5.09	1.14	142.9	159.8	0.57	0.57
ULL (cm)	69.13	3.59	0.78	61.8	76.2	68.33	2.16	0.48	65	72.1	0.88	0.4
Arm Length (cm)	32.56	1.93	1.84	28.3	36.2	31.99	1.02	0.23	29.9	33.4	1.28	0.21
LLL (cm)	76.31	4.43	0.97	69.5	88.1	74.98	3.36	0.75	68.4	80.2	1.09	0.3
Thigh Length (cm)	37.84	2.53	0.55	33.4	42.6	36.86	2.19	0.49	32.9	41.2	1.34	0.2
MCC (cm)	28.77	2.57	0.56	24	33.8	27.88	2.30	0.51	25.5	35.2	1.17	0.2
BMI	18.73	0.50	2.31	15.19	23.86	16.84	1.77	0.40	14.66	20.36	2.95	0.005

Table-6: The anthropometric parameters of females of the age group of 20-30yrs

Age group in yrs 20 - 30	Female cases (n=38)					Female controls(n=38)						
	Mean	S.D	S.E of mean	Min	Max	Mean	S.D	S.E of mean	Min	Max	t-stat	P value
Hb gm/dl	7.91	2.23	0.36	2.1	11.4	9.81	1.38	0.22	7	13	-4.45	3.59E-05
Body Weight (in Kg)	44.03	6.91	1.12	33.4	69.2	45.34	8.38	1.36	30.7	72.8	-0.74	0.46
Stature (cm)	151.27	7.04	1.14	135.6	166	151.91	5.20	0.84	141.4	161.2	-0.45	0.65
ULL (cm)	68.64	4.24	0.69	57.9	79	68.43	3.61	0.59	57.9	74	0.24	0.8
Arm Length (cm)	32.11	2.21	0.36	25.6	37.9	32.07	1.90	0.31	25.6	34.8	0.08	0.94
LLL (cm)	76.28	5.19	0.84	68.5	88.6	75.75	4.57	0.74	65.3	85	0.47	0.6
Thigh Length (cm)	36.25	2.90	0.47	30.2	43.5	36.33	2.27	0.37	32.8	41.5	-0.13	0.90
MCC (cm)	28.98	2.69	0.44	23.8	37.8	29.51	2.76	0.45	24.3	37.5	-0.85	0.4
BMI	19.24	2.66	0.43	14.92	26.63	19.63	3.42	0.56	14.50	31.63	-0.55	0.59

Tables 4, 5 & 6 shows that in females, statistically significant difference for hemoglobin concentration between the cases and controls in all three age groups were seen i.e.,5-14yrs($p=0.05$), 15-19yrs(0.001), 20-30yrs($p<0.0001$)and in the age group of 15-19yrs, t-test for weight between cases and controls in female group showed significant difference ($p= 0.01$).

Table-7: Socioeconomic status of subjects

	Male				Females			
Socioeconomic status	**Cases**	**%**	**Controls**	**%**	**Cases**	**%**	**Controls**	**%**
Upper (I)	6	8.70	5	7.25	9	13.0	3	4.3
Upper Middle (II)	22	31.88	24	34.78	21	30.4	23	33.3
Middle/Lower middle (III)	10	14.49	20	28.99	19	27.5	19	27.5
Lower/Upper lower (IV)	31	44.93	20	28.99	20	29.0	24	34.8
Lower (V)	0	0	0	0	0	0.0	0	0.0
Total	69	100	69	100	69	100.0	69	100.0

Table-7 shows socioeconomic status (According to Kuppuswamy's socio-economic status scale) In male cases group, maximum number of the subjects belonged to lower/Upper lower (IV) status (44.93%).and in control group the maximum subjects belonged to Upper middle (II) status (34.78%). In female cases group, maximum number of the subjects belonged to Upper middle (II) status (30.4%) and in control group the maximum subjects belonged to lower/Upper lower (IV) status (34.8%).

DISCUSSION

This study was conducted on 276 tribal individuals [138 cases (sickling) + 138 controls (non-sickling)] belonging to Bastar division of Chhattisgarh state. This region was chosen because of good density of sickling in this tribal belt.

The present study examined the anthropometric parameters of growth of subjects from 05–30 years. The subjects were stratified in three groups according to age: 05 to 14yrs, 15 to 19yrs and 20 to 30yrs.

Anemia was found to be very common in the sickle cell disease subjects of all the three groups. Their hemoglobin levels varied from 2.2g/dl-10.6g/dl in 5-14yrs age group, 3.8g/dl-13g/dl in 15-19yrs age group, and 4g/dl-13.9g/dl in 20-30yrs age group. At all age groups, cases had hemoglobin concentration less than controls which improved slightly with growing age. According to the t-test results; the difference was statistically significant ($p<0.05$) between cases and controls in males and females of all age groups especially in the adults ($p<0.001$). The association of low Hb and SCD is well known, some studies done recently in India showing similar results are by Gunjal S. S *et al*., [20], Chawla *et al.*, [21] and Nandanwar R. A *et al*., [22].

At all age groups, cases had mean weight less than control except in the age group of 15-19yrs for male where it was almost equal and in the same age group in females the control had mean weight less than cases. The difference was statistically highly significant at the age groups of 5- 14 (p value 0.006) and 20- 30 (p value 0.004) in males and in the age groups of 15-19 (p value 0.01) in females. Similar results were seen in studies done by, Nandanwar R. A [22], Ashcroft M. T *et al*., [23], Stevens M. C *et al*., [24], Barden E. M *et al*., [25], Mukherjee M. B [26], Moheeb H *et al*., [27] and Radke A. V *et al*., [28]. Another study by Chawla A *et al.*, [21] showed 22.4% obese and only 6.7% underweight subjects who further concluded that an increased health awareness and availability of improved medical facilities led to these results.

The t-test for stature was statistically significant only in the age group of 5-14yrs (p value 0.02) and near significance in age group of 20-30yrs (p value 0.06) in males. Difference was not statistically significant in any of the age groups in female. On classifying the stature in the age group of 20-30yrs (adults), maximum case subjects were short (32.5%) while in controls maximum subjects were below medium height in males while in females maximum case and control subjects were short (39.5% and 31.6% resp.). The studies like, Nandanwar R. A. [22], Moheeb H *et al.*, [27], Stevens M. C *et al.*, [29] and Deshpande R [30] have shown stunting in SCD patients while Ashcroft M. T *et al.*, [23] had shown that SCD cases caught up with their peers for height with time.

Body Mass Index (BMI) is a body mass per unit area and a measure of adiposity of an individual and is a good indicator to assess the nutritional status. However, it is difficult to find out if the inadequacy of nutrients is due to inadequate diet or poor absorption or defective metabolic utilization by an individual. In this study the differences in BMI values were highly significant in age groups of 5-14yrs (p value 0.004), 20-30yrs (p value 0.02) in males and in 15-19yrs (p value 0.005) in females. Similar findings (lower values) have been observed by Mukherjee M. B *et al*., [26] and Olatunji-Bello, I. I. *et al*., [31].

According to Kuppuswamy's socio-economic status scale. In male cases group, maximum number of the subjects belonged to lower/upper lower (IV) status (44.93%) while in control group the maximum subjects belonged to upper middle (II) status (34.78%). In female cases group, maximum number of the subjects belonged to upper middle (II) status (30.4%) while in control group the maximum subjects belonged to lower/upper lower (IV) status (34.8%). In males case group had lower SES compared to controls and they showed statistically significant differences in various parameters in this group while in female group the controls had lower SES than cases and we didn't get significant findings in this group on comparison. In a study done by Animasahun *et al*., [32], they concluded

that poor socioeconomic status has an adverse effect on the nutritional status and hemoglobin of SCD patients.

CONCLUSION

In the age group of 5-14yrs in males the cases and controls showed maximum parameters were statistically significant .i.e., hemoglobin concentration (p=0.03), weight (p=0.006), height(p=0.02), upper limb length (p=0.01), arm length (p=0.02), lower limb length(p=0.02), thigh length (p=0.03), maximum calf circumference(p=0.01) and BMI (p=0.004). This suggests that this is the most vulnerable group.

In females, statistically significant difference for hemoglobin concentration between the cases and controls in all three age groups was seen i.e., 5-14yrs (p=0.05), 15-19yrs (0.001), 20-30yrs (p<0.0001). In the age group of 15-20yrs, t-test for weight between cases and controls in female group showed significant difference (p= 0.01).

In the age group of 20-30yrs in males the parameters which showed statistical difference in case and control were hemoglobin concentration(p<0.0001), weight(p=0.004), maximum calf circumference(p=0.02) and BMI (p=0.02). From the above results, it may be persuasive to state that the poor growth status of the cases & controls, as judged by body weight and BMI, may be due to SCD and poor socio-economic condition.

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