

A STUDY OF RELATIONSHIP BETWEEN WEIGHT, HEIGHT, HEAD & CHEST CIRCUMFERENCE IN CHILDREN BETWEEN 3 TO 5 YEARS IN THE MALWA REGION OF MADHYA PRADESHS. K. Wankhede¹, M. Bhandari², Ravi Jain³**HOW TO CITE THIS ARTICLE:**

S. K. Wankhede, M. Bhandari, Ravi Jain. "A Study of Relationship Between Weight, Height, Head & Chest Circumference In Children Between 3 To 5 Years in the Malwa Region of Madhya Pradesh". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 33, April 23; Page: 5658-5668, DOI: 10.14260/jemds/2015/828

ABSTRACT: INTRODUCTION: The growth & development are the important attributes of childhood. The studies on physical development & growth of infants & children are important as they are determinants of a nation's health. The appreciation of progress of any country in the field of health can be made from time to time with the help of such studies. The principal aim of the nutritional assessment of a community is to map out the magnitude & geographic distribution of malnutrition & a public health problem to find out the ecological factor & where possible to suggest appropriate corrective measures. **AIMS & OBJECTIVES:** To determine the anthropometric measurements of the pre- school age children in both sexes, to study the growth spurt & velocity of growth in the children between 3 & 5 years, to construct selected percentiles of the various measurements for boys & girls in Malwa region & to compare the figures obtained by anthropometric studies with those determined by other workers in the different regions. **MATERIALS & METHOD:** A cross sectional study of weight, height, circumference of head, chest & arm of school going children ranging from 3 to 5 years in age was carried out in the city of Indore. Total 1,000 children, belonging to both low & high socio-economic status, were examined. **OBSERVATIONS:** The mean values of head & chest circumferences shows a gradual increase with in both sexes. The mean value of the mid-arm circumference also shows an increase with increasing age on both sexes. As regards the height, the mean value is a bit higher in females at 3.5 years & 4.5 years as compared to Males at 3, 3.5, 4 & 5 years of age. The mean values of weight are more in females than males at the age of 4, 4.5 & 5 years. **SUMMARY & CONCLUSION:** Anthropometric studies were carried out in all children uniformly by determining weight, height and circumferences of head, chest & mid-arm. The head & chest circumferences equalizes at the age of 3 years. After the age of 3 years, the chest circumference exceeds the head circumference. The physical development of the child can be assessed by the comparative study of growth of head & chest circumferences.

KEYWORDS: Head circumference, Chest circumference, Growth.

INTRODUCTION: The growth & development are the important attributes of childhood. If the genetic potential for growth is normal & environment is suitable, the human fetus grows & differentiates in an orderly & predictable manner during the pregnancy. After birth, the baby grows continuously to mature into normal adulthood. The studies on physical development & growth of infants & children are important as they are determinants of a nation's health. The appreciation of progress of any country in the field of health can be made from time to time with the help of such studies. The simplest & most reliable means by which progress of a normal child is evaluated are the measurements of height & weight.

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Also gross abnormalities can be detected even when no other clinical signs of illness are manifested. By comparing the physical measurements of child over a particular period of time with those of other healthy children, it is possible to determine to some extent the rate of the child's growth & development. As there may be variations in the growth pattern of children due to ethnic, racial, cultural or geographic factors, every community should develop its own norms for the growth of the children. The anthropometric studies should be repeated periodically to compare the effects of environmental variables over a period of time on the physical growth & health of the children. Not many studies on growth & development of Indian children are available in the country.

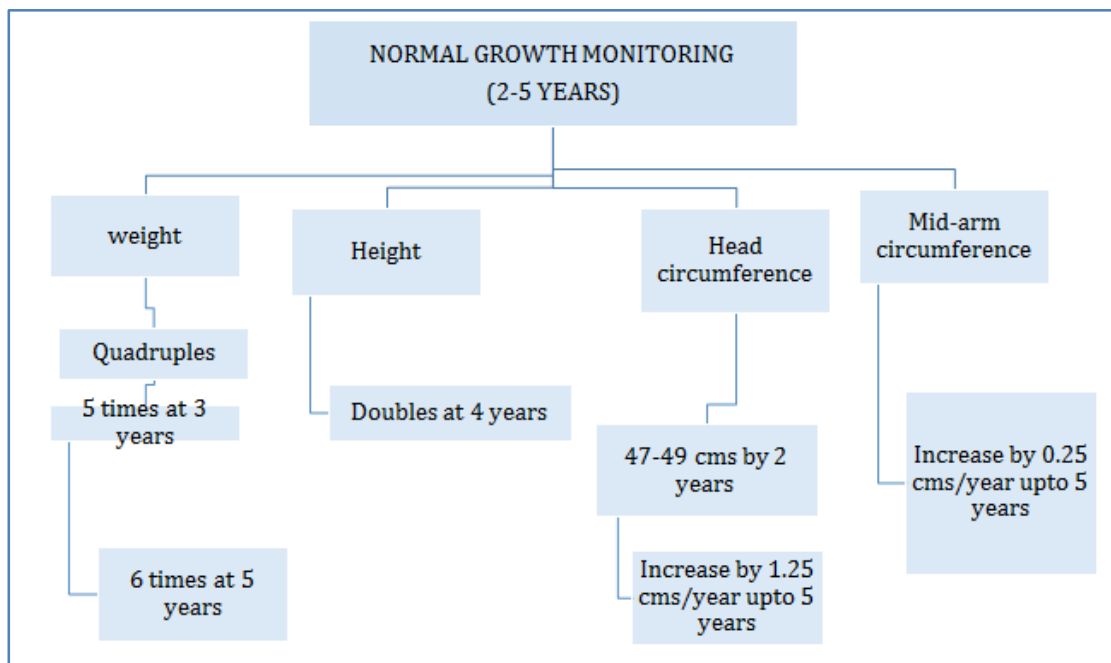
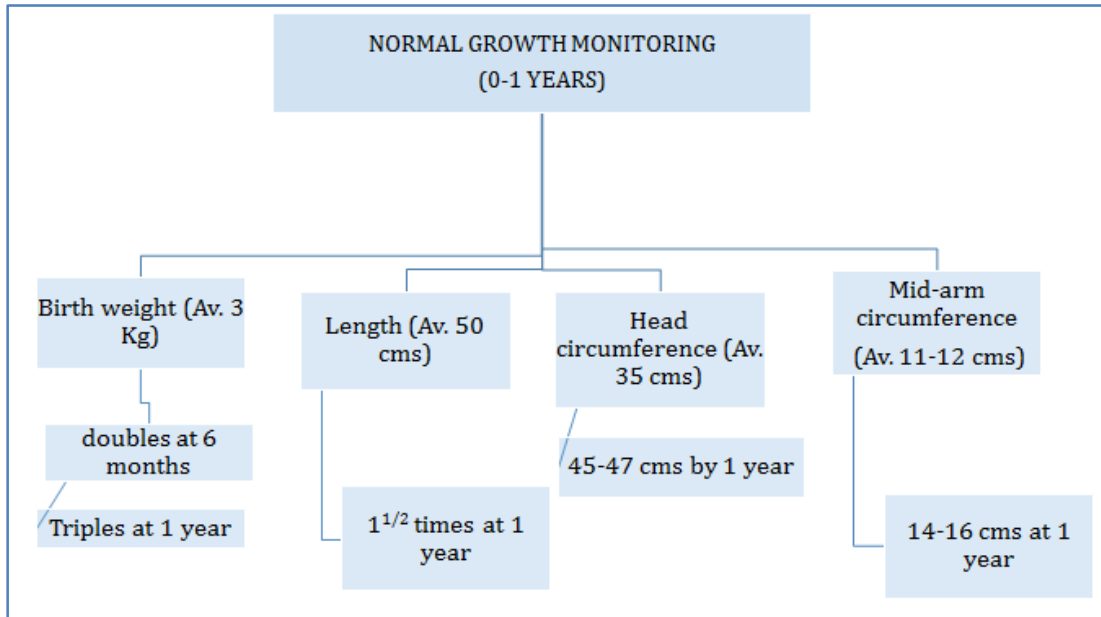
In many of these reports, the data base includes both healthy children & those with marginal or overt nutritional deficiencies & illnesses, anthropometric observations were not made at fixed point of ages. The recorded data often referred to sets of children of ages spread over a period of time & the ages of the children included in these studies were not always known precisely. The principal aim of the nutritional assessment of a community is to map out the magnitude & geographic distribution of malnutrition & a public health problem to find out the ecological factor & where possible to suggest appropriate corrective measures. It is essential & important to provide health services to school children because of their large number of population in the community.

Assessment of Growth & Development:

1. **Height:** It is related to bone growth & hence not much altered with acute malnutrition. Measuring recumbent length is more convenient in a child who is less than 3 years old age & standing height after that. Standing height is measured by making the child stand against a vertical scale. The child should stand erect with heels, buttocks, upper part of back & occiput against vertical scale with arms hanging by the side of the body. A head piece having two faces at right angles may be firmly placed on the head & then the height is measured
 - a. At birth–50 cms.
 - b. At 1 year of age–75 cms.
2. **Weight:** This is the single most important parameter for assessing the growth of the child. The weight can be recorded with a spring or lever type of balance. Frequent measurement over a period of time is more important than a single measurement at particular age. Only when the measurements are taken regularly, one can assess the status of the child.
3. **Head Circumference:** It need not be measured routinely after 3 years of age. The tape is firmly placed over the glabella & supra-orbital ridges anteriorly & that part of the occiput posteriorly that gives maximal circumferences. If the head has an abnormal shape, then the points that give maximum circumference anteriorly & posteriorly should be taken:
 - a. At Birth – 33-35 cms.
 - b. 1 year - +12 cms (45-47 cms).
 - c. 2 years - + 2cms (47-49 cms).
 - d. 3-5 years - +1.25 cms/year (50-52 cms).
 - e. 5-15 years - +1.5 cms/every 5 years (53-55 cms).
 - f. 12-15 years – Adult size.
4. **Chest Circumference:** Chest circumference is taken at mid inspiration at the level of xiphoid cartilage or sub sternal notch, in the plane at right angles to the vertebral column. At birth, head circumference is 3 cms more than that of chest. At 1 year, they become equal & after that chest circumference is more than that of head.

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5. **Mid-arm Circumference:** The mid-point of upper arm between olecranon & acromion is taken & the circumference of arm is measured at this point. The mid-arm circumference at different ages is:
- a. At birth – 11.5 cms
 - b. 1 year – 14-16 cms
 - c. 1 – 5 years - +0.25 cm/year.
 - d. Between 1 & 5 years, the increase in mid-arm circumference is only by 1 cm, & hence it is used as an age independent criteria for assessing malnutrition.



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Background of Anthropometric Surveys: The need for anthropometry in physical examination was recognized by Stuart in 1934. In U. S. A, the school health service programmes is determined on the principle that the family has primary responsibility for the health of school child. Some states have public health laws or school regulations requiring immunizations & the local boards of education are responsible for implementation. Chaudhary et al¹ during his sociological, hematological & anthropometric studies of two communities children at Calcutta revealed both body weight & sitting heights to be higher in Sikh children in both sexes from 12 -13 years to 15-16 years, but thereafter at the age of 16-17 years, Bengali children showed catch-up growth as regards height. Melhans² published practical composite national & international graphs for head circumference from birth to 8 years of age. Lal et al³ carried out a general health survey in Singur health center, west Bengal. Rao⁴ in a nutrition survey in children in Nilgiri district concluded that boys weighed more & were taller than girls. Currimbhoy⁵ reported in a study of growth & development of Bombay children that the children belonging to upper socio-economic groups were taller than an average American child up to 5 years in age, while there is little difference in weight.

Head circumference is less than those of American children & there is little difference with respect to chest circumference. Lower values with respect to weight/height/circumference of head & chest were recorded in children from lower socio-economic groups. Udani⁶ studied physical growths of 5, 540 children of various age groups belonging to different socio-economic groups of Bombay city & observed that growth depends upon socio-economic factors & illness that further dietary depletion had adverse effects on the growth of the children. Mohanta et al⁷ in their study on the anthropometric measurements of children of western Orissa examined 300 children ranging from 0-10 years of age.

The increase in head circumference was maximum up to the age of 3 years. According to Agrawal et al,⁸ the nutritional sub-committee of Indian academy of Pediatrics has recommended the use of Harvard scale as the basis for classifying malnutrition throughout the country. They found that Indian children have low mean values for height, weight & circumference of skull for age than those reported for American white children by Harvard school of public health. The failure of our children to approach Harvard standards indicated that for assessment of growth, we must use the Indian standards.

AIMS & OBJECTIVES:

1. To determine the anthropometric measurements of the pre-school age children in both sexes.
2. To study the growth spurt & velocity of growth in the children between 3 & 5 years in Malwa region of Madhya Pradesh.
3. To construct selected percentiles of the various measurements for boys & girls in Malwa region.
4. To establish a base line for the organization of health programmes in school age children of the country.
5. To compare the figures obtained by anthropometric studies with those determined by other workers in the different regions.

MATERIALS & METHODS: A cross sectional study of weight, height, circumference of head, chest & arm of pre-school going children ranging from 3 to 5 years in age was carried out in the city of Indore. Total 1, 000 children, belonging to both low & high socio-economic status, were examined. The schools were selected on the basis of socio-economic status. The survey was done in 3 schools namely:

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1. Sarafa Vidya Niketan, Indore.
 2. Shrimati Tirathbai Montessari & Primary school, Indore.
 3. St. Raphael's Primary school, Indore.
- Information of every child was collected as per the Proforma.

**DEPARTMENT OF ANATOMY:
M. G. M MEDICAL COLLEGE, INDORE.**

CASE RECORD:

Sl. No..... Date of examination.....Name of school.....
 Name of child..... Class..... Age..... Sex.....Religion.....
 Name of Father/guardian..... Occupation.....
 Address.....
 Income per capita..... Monthly income..... Inmates.....

ANTHROPOMETRY

Weight.....Kgs, Expected Wt. Kgs, %age..... Wt. age.....
 Height.....Cms, Expected Ht..... Cms, %age..... Ht. age.....
 Circumference of head.....Cms, Expected Circumference of head..... Cms.
 Chest Circumference Cms, Mid-arm Circumference Cms.
 CR: RH Ratio.....
 Skin fold thickness: Triceps..... Subscapular.....

Nutritional Status:

- Food habits: Vegetarian/Non-Vegetarian/Mixed.
- General nutritional status – Good/Fair/Poor/Very poor.

The class teacher of each class was consulted for the information required & also the school record register was seen for noting the biographic data.

OBSERVATIONS:

Age	Male	Female	Total
3 years	100	100	200
3 ^{1/2} years	100	100	200
4 years	100	100	200
4 ^{1/2} years	100	100	200
5 years	100	100	200
Total	500	500	1000

Table 1: Shows age & sex wise distribution of children

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Age	Male		Female	
	Mean	S. D	Mean	S. D
3 years	49.02	1.30	48.06	2.68
3 ^{1/2} years	49.04	3.11	48.20	1.37
4 years	49.58	1.36	48.59	1.40
4 ^{1/2} years	48.96	0.89	48.90	1.41
5 years	49.72	1.39	49.32	1.32

Table 2: Mean & S. D of occipito-frontal circumference in cms. At different age groups

Age	Male		Female	
	Mean	S. D	Mean	S. D
3 years	52.32	2.32	51.98	2.50
3 ^{1/2} years	53.10	2.05	52.76	2.17
4 years	54.99	2.26	52.52	2.02
4 ^{1/2} years	53.51	1.87	53.24	2.63
5 years	55.54	2.49	54.10	2.18

Table 3: Mean & S. D of Chest circumference in cms. At different age groups

Age	Male		Female	
	Mean	S.D	Mean	S.D
3 years	15.92	0.87	16.14	0.93
3 ^{1/2} years	16.58	0.97	16.53	1.12
4 years	16.09	0.89	16.18	0.97
4 ^{1/2} years	16.57	0.88	16.63	1.09
5 years	16.78	1.16	16.67	0.80

Table 4: Mean & S.D of Mid-arm circumference in cms. At different age groups

Age	Male		Female	
	Mean	S.D	Mean	S.D
3 years	100.63	4.65	100.23	4.71
3 ^{1/2} years	100.63	4.77	100.73	4.38
4 years	104.17	4.07	103.65	4.14
4 ^{1/2} years	105.40	5.27	106.50	5.72
5 years	109.34	4.98	107.91	4.96

Table 5: Mean & S. D of Height in cms. At different age groups

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Age	Male		Female	
	Mean	S.D	Mean	S.D
3 years	14.56	1.56	14.18	1.78
3 ^{1/2} years	15.78	1.72	13.54	1.92
4 years	16.53	1.52	16.62	1.36
4 ^{1/2} years	16.35	1.65	17.42	2.48
5 years	17.36	2.18	17.44	2.18

**Table 6: Mean & S.D of Weight in Kgs.
At different age groups**

Percentile for Males				Weight in Kgs & Height in Cms	Percentile for Females			
10 th	50 th	75 th	90 th		10 th	50 th	75 th	90 th
3 years								
12.39	14.52	15.36	16.72	Weight	11.91	14.19	15.22	16.57
91.17	97.78	100.69	103.68	Height	90.75	98.05	100.03	102.95
46.65	48.24	49.15	50.10	Head Circum.	45.88	47.83	48.75	49.50
49.57	52.21	53.82	53.39	Chest Circum.	48.57	51.70	53.15	55.40
14.03	15.30	16.11	16.90	Mid-arm Circum.	14.55	15.61	16.28	16.44
3^{1/2} years								
13.39	15.68	16.86	18.23	Weight	13.08	15.92	16.42	18.13
94.00	100.90	104.24	106.54	Height	94.50	100.92	103.50	106.63
46.28	48.53	49.31	50.19	Head Circum.	45.77	47.79	48.50	49.68
50.21	53.13	54.56	55.44	Chest Circum.	49.79	52.83	54.83	55.32
14.79	16.03	16.65	17.40	Mid-arm Circum.	14.51	16.05	16.78	17.38
4 years								
14.69	16.63	18.09	18.84	Weight	14.53	16.09	17.17	18.10
98.93	103.91	107.44	109.17	Height	98.25	103.50	106.00	109.31
47.60	49.80	50.95	50.35	Head Circum.	46.54	48.03	49.02	49.88
52.20	55.68	56.45	57.27	Chest Circum.	49.83	51.50	53.85	55.16
15.52	16.34	16.98	17.39	Mid-arm Circum.	14.41	15.74	16.24	16.72
4^{1/2} years								
14.56	16.50	17.58	18.43	Weight	14.73	17.12	18.93	20.22
98.97	105.75	109.25	111.80	Height	99.60	105.63	110.17	114.68
48.84	49.08	49.89	52.33	Head Circum.	46.88	48.38	49.29	50.32
50.30	53.93	55.14	56.02	Chest Circum.	49.77	53.19	54.94	56.72
14.95	16.12	16.72	17.31	Mid-arm Circum.	14.63	16.10	16.80	17.46
5 years								
14.82	17.06	18.72	20.38	Weight	14.50	17.22	18.98	20.64
102.90	109.45	112.75	116.00	Height	101.59	107.46	111.38	115.26
47.91	49.70	50.72	51.34	Head Circum.	47.20	48.65	49.68	50.63
52.00	55.75	57.28	58.94	Chest Circum.	51.28	53.80	55.60	57.36
14.78	16.25	16.98	17.43	Mid-arm Circum.	15.00	16.17	16.79	17.27

Table 7: Percentiles of selected measurements from 3 to 5 years

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Age	Weight	Height	Head Circum.	Chest Circum.	Mid-arm Circum.
3 years	N. S	N. S	S	N. S	N. S
3 ^{1/2} years	S	N. S	S	N. S	N. S
4 years	N. S	N. S	S	S	N. S
4 ^{1/2} years	N. S	N. S	N. S	N. S	N. S
5 years	N. S	S*	S*	S	N. S

Table 8: Significance of differences of means between Males & Females at 0.01 level of significance

S = Significant, N. S = Not significant.

*Significant at 0.05 level, but insignificant at 0.01 level.

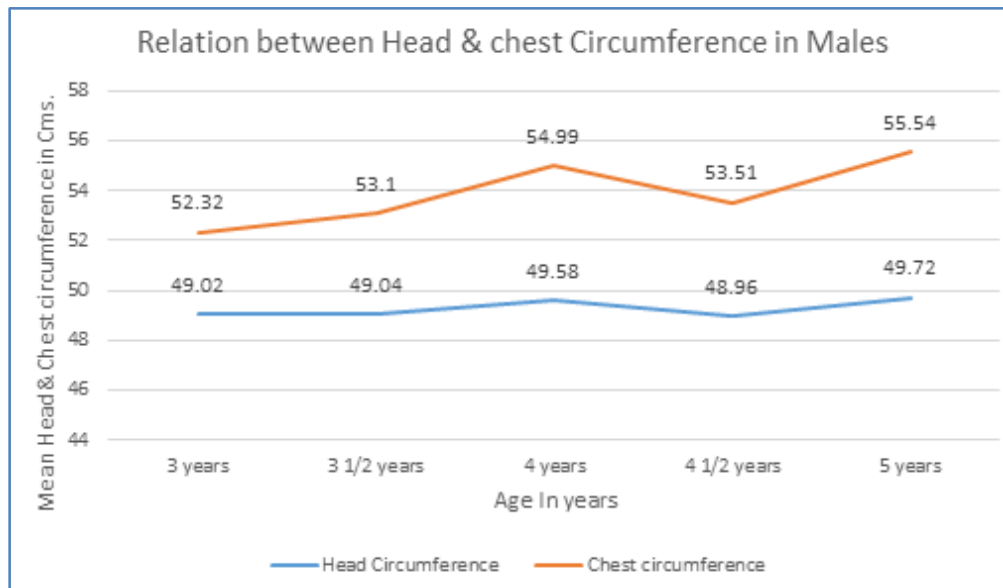
Workers	Age groups									
	3 years		3 ^{1/2} years		4 years		4 ^{1/2} years		5 years	
	M	F	M	F	M	F	M	F	M	F
Currimbhoy ⁵	47.77	46.80	--	--	48.50	47.40	--	--	49.50	48.00
Ghai& Sandhu ⁹	48.79	46.15	--	--	49.79	49.44	--	--	50.00	50.10
Banik et al ¹⁰	48.03	46.93	--	--	48.86	47.89	--	--	49.46	48.47
ICMR ¹¹	47.40	46.20	--	--	48.30	47.10	--	--	48.70	47.90
Present study	49.02	48.06	49.04	48.20	49.58	48.59	48.96	48.90	49.72	49.32

Table 9: Comparison of head circumference (in cms) of present study with other workers in Male (M) & Female (F) children

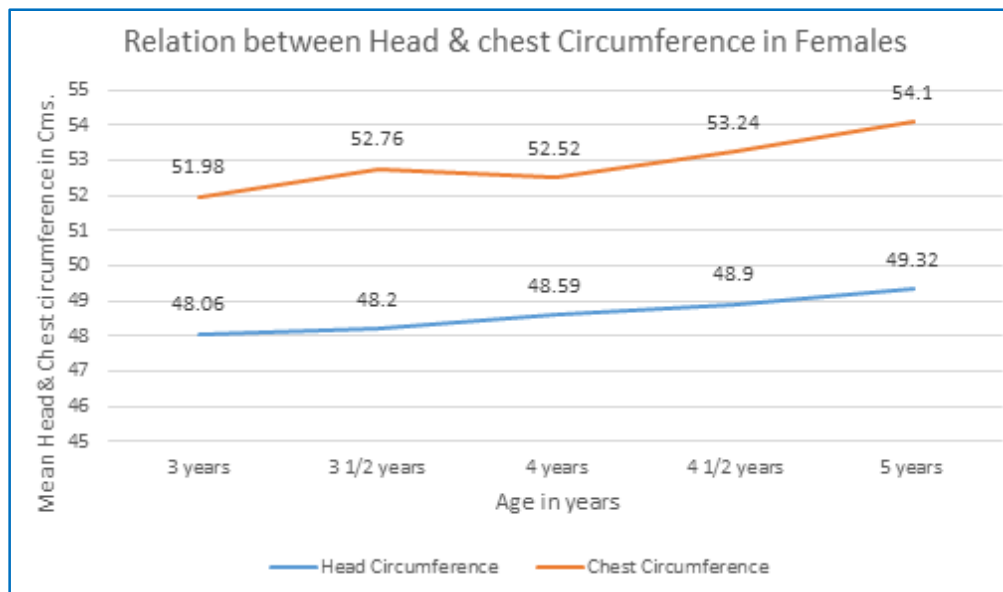
Workers	Age groups									
	3 years		3 ^{1/2} years		4 years		4 ^{1/2} years		5 years	
	M	F	M	F	M	F	M	F	M	F
Currimbhoy ⁵	49.00	47.32	--	--	50.12	49.82	--	--	52.08	52.43
Ghai& Sandhu ⁹	49.39	49.39	--	--	51.56	52.50	--	--	53.57	54.28
Banik et al ¹⁰	48.30	47.16	--	--	49.78	48.66	--	--	51.11	49.83
ICMR ¹¹	48.30	47.00	--	--	49.30	48.60	--	--	51.20	50.10
Present study	52.32	51.98	53.10	52.76	54.99	52.52	53.51	53.24	55.54	54.10

Table 10: Comparison of chest circumference (in cms) of present study with other workers in Male (M) & Female (F) children

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Graph 1: Relation between Head & chest Circumference in Males



Graph 2: Relation between Head & chest Circumference in Females

DISCUSSION: Assessment of velocity of growth of a given group of population is not an easy task. Anthropometry provides the optional measure of long term nutritional status. This is assumed that in growing individuals, the larger ones have been better nourished. Since body increases generation after generation, size has become a leap frogging phenomenon with time. We do not have any

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absolute standards of size comparison for a human population up till now including our own. Sporadic cross-sectional studies on anthropometry have been appearing in literature from time to time. The nutritional advisory committee of Indian council of medical research has been actively engaged in recommending & organizing surveys in different parts of the country. Local anthropometric standards should be prepared & used wherever possible, because they may often be considered a more realistic goal. The present study was carried out in Indore district of Malwa region of Madhya Pradesh. Three schools were involved in the study irrespective of socio-economic status. On the basis of observations obtained after careful measurements of weight, height, circumferences of head, chest & mid-arm, we see that the mean values of head & chest circumferences (Table 2 & 3) shows a gradual increase with in both sexes.

The mean value of the mid-arm circumference (Table 4) also shows an increase with increasing age on both sexes. But the values in Males are a bit higher than the Females at all age groups in consideration. As regards the height (Table 5) , the mean value is a bit higher in females at 3^{1/2} years & 4^{1/2} years, but it is less than Males at 3, 3^{1/2}, 4 & 5 years of age. When we look at the values of weight (Table 6), the mean values of weight are more in females than males at the age of 4, 4^{1/2} & 5 years. Table 7 shows percentiles for weight, height, head, chest & mid-arm circumferences for the age groups 3, 3^{1/2}, 4, 4^{1/2}, & 5 years. The selected percentiles are 10th, 50th, 75th & 90th. Here the values are higher in male children than female children of all age groups. When we consider the significance of differences of means between the males & females (Table 8) at 0.01 level, we find that at 3 years of age, there is no significant difference. At 3^{1/2} years, the weight & head circumference shows statistically significance.

At the age of 4 years, the head & chest circumferences shows significant differences, while the mid-arm circumference, height & weight are not significant. At the age of 4^{1/2} years, there is no significant difference between weight, height, head, chest & mid-arm circumferences. At the age of 5 years, the weight & mid-arm circumference does not show any significant difference, while the weight & head circumference shows significance at 0.05 level, but are insignificant 0.01 level. But the chest circumference shows significant difference at 0.01 level. The present study is carried out in the Indore district of Malwa region of Madhya Pradesh & the mean values of head & chest circumferences in the males & females are towards slightly higher side when it is compared with mean values given by other workers in various parts of the country (Table 9 & 10). This shows that the children of Malwa region have better growth norms which can be easily compared to the children of other parts of India.

SUMMARY: The present study was undertaken on 1000 children of school age. 500 children were boys & 500 were girls. Selection of cases was done from schools of Indore city. Anthropometric studies were carried out in all children uniformly by determining weight, height and circumferences of head, chest & mid-arm. Figures obtained from the present study are compared with those given by ICMR & by other workers in various regions of our country. The difference in findings is explained on the basis of difference in environmental, nutritional, genetic & social factors. The selected percentiles have been constructed for weight, height & circumferences of head, chest & mid-arm, have been compared with corresponding ICMR percentiles. The values obtained have been critically studied & statistically analyzed.

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CONCLUSION: At birth, the circumference of head is larger than the circumference of chest in both the sexes. The head & chest circumferences equalizes at the age of 3 years. After the age of 3 years, the chest circumference exceeds the head circumference. The physical development of the child can be assessed by the comparative study of growth of head & chest circumferences.

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