Growth Status among Females of Solan District of Himachal Pradesh

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Abstract: *The study aims to see the age related changes in anthropometric and physiological characteristics and association between adiposity measures and cardiovascular functions among preadolescent and adolescent females. Growth pattern diverge at time of preadolescence and adolescence. The present study was conducted by cross-sectional method among 125 growing Rajput females ranging from 9 years to 16 years of Solan district, Himachal Pradesh. The adiposity assessed by BMI, WHR, GMT. There is an increase in BMI with age in the present study and the highest mean value is found at the age of 16. As far as correlation between cardiovascular functions and adiposity measure are concerned there is a significant correlation between blood pressure with BMI, GMT and WHR till 12 years, but in the later years no such pattern was observe.*

Key words: Anthropometry, Rajput females, Body Mass Index.

INTRODUCTION

Many changes both structural and functional in the human body are witnessed with the increasing age. These changes could be attributed to growth and development which starts right from conception and also due to environmental conditions such as nutritional pattern, physical activity level, health status etc experienced by the human body.

Increasing body fatness is accompanied by profound changes in physiological functions. These changes are to a certain extent, associated with the regional distribution of adipose tissue. Body fatness and its distribution is a useful epidemiological and clinical marker of health risk among humans. Adiposity is the result of an excessive number and/or size of white adipose

cells. At an individual level, a combination of excessive caloric intake and a lack of physical activity are thought to explain most cases of adiposity (Lau et al 2007). A limited number of cases are due primarily to genetics, medical reasons, or psychiatric illness (Bleich et al 2008). Anthropometry is the widely accepted tool for measures the adiposity of the human. Studies in this regard reveal that BMI, WC, WHR, GMT are the good indicators of the adiposity measures of the preadolescent and adolescent females. According to Barness et al (2007) adiposity is a leading preventable cause of death worldwide, with increasing prevalence in adults and children, and is viewed as one of the most serious public health problems of the 21st century. Excessive body weight is associated with various diseases, particularly cardiovascular diseases, diabetes mellitus type 2, obstructive sleep apnea, certain types of cancer, and osteoarthritis (Haslam et al 2005). It has been very recently observed by Kotchen et al. (2008) that blood pressure levels and the prevalence of hypertension are related to adiposity, the main components of adiposity being BMI, waist/hip ratio, waist/height ratio (WHtR) and percent body fat.

Taking the above issues into consideration, the present study on the association of different anthropometric parameters of adiposity and blood pressure was designed in the Solan district of Himachal Pradesh.

Materials and methods

Keeping in mind the objective of the study, data on anthropometric and physiological measurements were collected by using cross-sectional method on 125 preadolescent and adolescent females in the age groups 9 to 16 years of Solan district, Himachal Pradesh. The data was collected from the schools in that area; besides some data was also collected from home visits. Age was recorded by the verbal response of the subjects. An exhaustive proforma was catered to obtain general data of the population under study. The general information collected from the mating pattern (constructed using maternal and paternal subcastes) established the fact that the Rajputs follow the rule of caste endogamy and sub-caste exogamy. Different body measurements were taken on each individual such as height vertex, body weight, mid upper arm circumference, waist circumference, maximum hip circumference, skinfold thickness at biceps, triceps, subscapular, suprailiac, calf posterior, blood pressure both systolic and diastolic, heart rate, pulse rate and breadth holding time. These measurements were taken according to the standard recommendations of Weiner and

Lowrie (1981). For assessing the adiposity measures of preadolescent and adolescent females we have adopted various anthropometric indices, body mass index, waist-hip ratio and grand mean thickness and statistical methods were used to calculate mean, standard deviation, t-test value and correlation to draw meaningful conclusions. Mean standard deviation and t-value were used to assess the changes in successive ages, while an attempt has been made to correlate adiposity measures with blood pressure. The analysis of the data was done by using the Windows Vista basic version of Windows. The calculation of data was done in the Microsoft Excel program. The data was analyzed by SPSS version 15 evaluation product package and excel program itself.

Results

The basic information of the Rajput females of the Solan district, Himachal Pradesh (Table 1) indicates a gradual increase in mean stature, body weight with age. The increase in height vertex from 9 to 12 years was found to be statistically significant and increase in body weight from 13 to 14 years and 14 to 15 years also found to statistically significant. An increasing trend was observed in mid upper arm circumference but at the age of 12 years a slight decreasing pattern was observed.

Table1: Basic information of Rajput females in different age groups.

Variables / Age(yrs)	N	Height (cm) Mean±SD	t- value	Weight(kg) Mean±SD	t-value	MUAC(cm) Mean±SD	t- value
9	8	123.0±4.06		18.9±2.90		16.1±1.0	
10	8	128.2±4.24	2.488*	22.6±4.75	1.875	19.1±9.1	.937
11	12	135.8±6.78	2.799*	26.7±5.4	1.742	17.4±1.7	.633
12	13	141.0±5.95	2.070*	27.6±6.0	.468	17.0±1.4	.605
13	9	143.9±5.70	1.114	31.0±5.5	1.601	17.3±1.5	.367
14	25	150.0±5.98	2.671*	36.5±5.3	2.679*	19.6±1.6	3.778***
15	16	152.2±10.90	.858	41.5±4.3	3.198**	20.0±3.2	.533
16	34	154.8±5.55	1.108	44.0±5.4	1.624	21.9±1.7	2.728**

*p<0.05 **p<0.01 ***p<0.001

MUAC- Mid Upper Arm Circumference

Table 2 displays a various adiposity measures among Rajput females in different age group. In this table BMI and WC showed an increasing trend with age but WHR and GMT does not show consistent pattern in subsequent age groups. The maximum mean value of waist-hip-ratio was found at 10 years (.879cm). The increase in body mass index and waist circumference and grand mean thickness from 14 to 15, 15 to 16 were found to be statistically significant.

Table2: Adiposity assessed by BMI, WHR, WC, GMT

Variables / Age(yrs)	N	BMI (kg/m^2) Mean±SD	t-value	WHR Mean±SD	t-value	WC (cm) Mean±SD	t-value	GMT (mm) Mean±SD	t-value
9	8	12.6±1.7		.83±.08		50.1±2.6		7.1±1.5	
10	8	13.6±2.3	1.188	.88±.21	.614	55.2±11.2	1.246	6.0±1.8	1.312
11	12	14.3±1.4	.842	.85±.13	.325	54.7±4.9	.133	6.9±2.0	1.051
12	13	13.8±1.5	.894	.80±.11	1.183	54.2±7.9	.183	6.9±1.4	.096
13	9	14.9±1.8	1.497	.78±.04	.576	55.4±4.9	.410	6.3±2.2	.738
14	25	16.1±1.5	2.070	.78±.07	.339	59.6±3.8	2.622*	7.2±2.1	1.109
15	16	18.0±2.2	3.198**	.77±.06	.566	62.4±3.4	2.351*	7.3±2.2	.077
16	34	18.3±1.5	.529	.74±.10	1.108	84.4±4.9	.069	9.0±2.1	2.556*

*p<0.05 **p<0.01 ***p<0.001
BMI- Body Mass Index
WHR- Waist- Hip Ratio
WC- Waist Circumference
GMT- Grand Mean Thickness

Table 3 displays mean values of various physiological variables along with their standard deviation among Rajput females of different age group. An increasing trend was observed in systolic blood pressure and breathes holding time. The diastolic blood pressure, heart rate and pulse rate declined and inclined pattern was found with advancing age. The increase in

systolic blood pressure from 12 to 13 years was statistically significant and the maximum mean value mean value was found at 13 years of age.

Table3: The various physiological variables of the subjects.

Variables / Age (yrs)	N	SBP (mm/hg) Mean±SD	t-value	DBP (mm/hg) Mean±SD	t-value	HR (b/min) Mean±SD	t-value	PR (p/min) Mean±SD	t-value	Breath holding time(sec) Mean±SD	t-value
	8	100.5±6.7		72.0±6.2		80.6±6.3		77.5±4.8		14.6±3.7	
10	8	108.0±11.5	1.60	72.1±7.2	.037	81.5±5.3	.301	76.6±4.4	.378	21.2±7.9	2.114
11	12	109.7±8.3	.384	68.6±6.1	1.187	76.5±7.2	1.674	73.4±7.3	1.105	16.1±5.4	1.764
12	13	105.8±9.6	1.095	66.3±4.6	1.058	81.2±8.1	1.507	78.2±7.2	1.652	21.8±13.1	1.430
13	9	115.7±8.0	2.536*	66.2±9.7	.028	77.6±7.0	1.079	75.7±7.2	.816	22.2±10.8	.016
14	25	104.4±21.3	1.533	70.4±7.9	1.266	79.7±4.9	.996	75.8±6.1	.054	25.9±11.2	.858
15	16	112.6±9.6	1.446	72.4±9.3	.742	76.2±3.6	2.452*	72.9±3.8	1.691	25.8±10.9	.032
16	34	114.7±14.4	.527	71.7±7.3	.307	72.9±7.1	1.735	69.2±6.2	2.207*	27.8±11.4	.612

*p<0.05 **p<0.01 ***p<0.001

SBP- Systolic Blood Pressure

DBP- Diastolic Blood Pressure

HR- Heart Rate

PR- pulse Rate

In table 4 shows the correlation coefficient of blood pressure with body mass index, waist hip ratio and grand mean thickness of Rajput females in advancing age. In this table attempted was made to correlate the various and blood pressure in different age groups and it is concluded that correlation vary from variable to variable in all the groups. There is a significant correction between blood pressure with body mass index, grand mean thickness and waist hip ratio till 12 years but in later years no such pattern was observed.

Table4: Correlation coefficient of blood pressure with BMI, WHR, GMT of the participants.

Variable Age(yrs)	N	BMI(kg/m^2)		WHR		GMT(mm)	
		SBP	DBP	SBP	DBP	SBP	DBP
9	8	.541	.273	.758*	.452	.964**	.736*
10	8	.154	.348	.059	.365	.267	.534
11	12	.852**	.420	.492	.124	.233	.291
12	13	.617*	.535	.039	.042	.571*	.576*
13	9	.645	.353	.181	.155	.350	.365
14	25	.131	.040	.173	.061	.048	.051
15	16	.378	.095	.083	.003	.341	.107
16	34	.038	.066	.133	.101	.093	.121

*p<0.05 **p<0.01 ***p<0.001

BMI- Body Mass Index

WHR- Waist- Hip Ratio

GMT- Grand Mean Thickness

Discussion

The variables considered in this present study show an increasing trend from 9 to 16 years but all parts of the body do not grow at the same rate. Some body parts or dimensions increase more than others during the adolescent period (Tanner 1962).

Mean value of height vertex (stature) increased among the growing Rajput females of the Solan district of the Himachal Pradesh. Similar findings were observed by Sinha and Kapoor (2009) where there was an increase in stature of adolescent girls aged 11-17 years. The height increases in girls from the age of 9 years in study conducted by the Abbassi (2000). It is observed that there is an increase in body weight from 9 years to 16 years in the present study. The weight of the girls increases with age in study the conducted by the Abbassi (2000).

According to the study conducted by Tyagi et al (2005) the increase in weight with age could be due to imbalance of energy in favour of energy intake. The circumference measurement that is mid upper arm circumference show gradual increase with age which indicates musculature development and the similar results is found by Nadia et al (2009) the mean mid upper arm circumference

(MUAC) and arm muscle area (AMA) for girls gradually increased with age up to 17 years.

BMI and GMT of skinfold do not show steady increase with age. There is fluctuation, but a definite trend of increase witnessed would entail this due to increase in fat mass. This increase in fatness established the fact that there continues to be increase in fat content in females throughout life. The fluctuation could be a reflection of fluctuation for fat stores as fat is depleted incase of faster growth phase (Kapoor et al 1998, Parizkova 1977, Sinha and Kapoor 2006). There is an increase in BMI from 9 years to 16 years in the present study on preadolescent and adolescent girls of Solan, Himachal Pradesh with a slight dip from 11 years to 12 years.

Waist/hip ratio (WHR) is used as index of obesity and regional fat distribution in epidemiological studies. The decreases of mean of waist-hip ratio in the age group 9 years-16 years among the growing Rajput females implies gynoid fat distribution during the growing period. During adolescence, there is widening of the pelvis resulting into broader hips relative to their waist, hence the ratio decreases as the denominator increases at a faster rate than the numerator of the ratio (Malina, 1974).

With age physiological fitness also starts stabilizing. But at the present study there is relative decline in heart rate and pulse rate. Comparatively higher heart rate and pulse rate at an earlier age could be imputed to higher metabolic rate as well as relatively low blood pressure. Breath holding time displays a steady increase with age.

An attempt was made to correlate the various adiposity measures and cardiovascular functions in different age groups and it was concluded that the correlations vary from variable to variable in all the groups. The correlation coefficients reflect an inconsistent pattern. As far as correlations between cardiovascular functions and adiposity measure are concerned there is significant correlation between blood pressure and BMI, GMT and WHR till 12 years, but in later years no such pattern is observed. Deshmukh et al (2006) found strong correlation between systolic blood pressure and diastolic blood pressure with body mass index and waist circumference in Wardha district of Central India.

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