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ANTHROPOMETRIC MEASUREMENTS, SKINFOLD THICKNESSES & BLOOD PRESSURE: DIFFERENCES AMONG NORMAL WEIGHT, OVERWEIGHT AND OBESE SCHOOL GOING GIRLS

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ABSTRACT :
The purpose of this study was to see the differences in anthropometric measurements, skinfold thickness & blood pressure among normal weight (NW), overweight (OW) and obese (O) school going girls (10-12 yrs; N=450: 50 each from 10+, 11+ & 12+ yrs). Subjects were purposively chosen. Anthropometric measurements including standing height, weight, mid upper arm (MUAC), waist & hip circumference as well as skinfolds at triceps & subscapular were measured. Blood pressure of subjects was also measured. The results suggest that the mean values of standing height of NW girls of all age groups (10+, 11+ &12+ yrs) were higher as compared with the mean values of OW & O girls. Mean values of weight, MUAC, waist & hip circumference, waist to hip ratio (WHR), measures of triceps & subscapular & blood pressure parameters of OW & O girls were found to be greater than NW girls indicating adverse effects of obesity which if not controlled can lead to many obesity related health issues in future. The study concluded that there is a vast difference between the school going girls aged 10+, 11+ & 12+ yrs for anthropometric measurements, skinfold thicknesses & blood pressure. From public health perspective, this study emphasizes the importance of primary prevention of overweight from early childhood with continuation of health promotion activities throughout the course of life.
Keywords: Anthropometric measurements, skinfolds, obese & overweight

INTRODUCTION:

Childhood obesity is rapidly emerging as a global epidemic that can have profound public health consequences as overweight children become overweight adults. The growing prevalence of overweight and obesity in children is a serious public health concern. Worldwide, proportion of overweight and obese children rose by 47.1% between 1980 and 2013. Recent studies have documented that the high prevalence of obesity among adults extends to the adolescent population as well, and childhood obesity has become a new type of challenge for pediatric care (Batsis, J. A. et. al., 2005). Declining levels of physical activity and escalating caloric intake have been proposed as an explanation for the increasing rate of obesity in children and adolescents (Luepker, R. V., 1999 and Harper, M. G., 2006). Childhood obesity is associated not only with important implications for the risk of childhood diseases but also with increased risk of chronic diseases and decreased life expectancy in adult life (Williams, C. L. and Strobino, B. A., 2008). Obese children and teenagers are likely to remain obese in their adult life (Weiss, R. and Kaufman, F. R., 2008) and the consequences of obesity, such as high blood pressure may occur even in childhood (Botton, J. et al., 2007 and Nathan, B. M. et. al., 2008).

The early detection and intervention may reduce obesity in childhood and in later stages of life, consequently reducing associated diseases (Li, M. et. al., 2008). Accurate assessment of body measurements & composition is important in many areas of obesity and nutrition-related research. Accurate appropriate assessment of overweight and obesity in children and adolescents is a critical aspect of contemporary medical care. To obtain a reasonable estimation of body-fat distribution in children, several anthropometric parameters have been proposed, such as subcutaneous skinfolds and body circumferences, which are easy to perform and have a sufficient degree of accuracy. Some anthropometric measures or indexes, such as body mass index (BMI) and waist circumference, have been used in a large number of studies to analyse the association between adiposity and obesity related risk factors. Few studies have shown that waist circumference may be a better predictor of cardiovascular disease than BMI and WHR. In fact, waist circumference is better correlated with visceral adipose tissue than BMI and WHR. However, these studies are done vigorously among adult population. In contrast, the degree of association between obesity related risk factors and anthropometric parameters has not been studied extensively in school going children. Therefore, the

purpose of this present study was to see the relationship and differences between anthropometric variables, skinfold measurements and blood pressure (BP) in a group of normal weight, overweight & obese girls of 10 to 12 years of age.

METHODOLOGY:

Subjects under this research were obese and non-obese female children (10-12 years of age). Subjects were purposively chosen from different schools of Maharashtra. From these schools, normal weight (NW i. e. healthy weight), overweight (OW) & obese (O) girls were purposively selected. For the present study, screening of normal, overweight and obese female children was done based on their BMI [Weight (kg) ÷ Height (m^2)] categories (WHO, 2012 and http://www.cdc.gov/healthy weight/assessing /bmi/). Table 1 shows selection of subjects.

Anthropometric measurements of subjects including standing height, body weight, mid-upper arm circumference (MUAC), waist circumference (WC), hip circumference (HC) & skin fold measurement at triceps & subscapular were measured. BP measurements on the left arm with the subject supine, using a digital BP apparatus were measured. Systolic BP (SBP) & diastolic BP (DBP) were used for analysis.

Data was tabulated & mean, standard deviation, range & percentage were derived. Comparisons between normal weight, overweight & obese subjects from each age group were done with the available reference standards for age & gender.

RESULTS AND DISCUSSION:

Anthropometric characteristics of subjects included in the study are described in Table 2. The mean values of standing height of NW girls from all age groups (10+, 11+ & 12+ yrs) were higher compared with the mean values of OW & O girls. With the exception of NW girls aged 10+, rests of the groups of girls were unable to meet the standards for height for age (Table 2). In contrast to height, the mean values of all other anthropometric measurements including body weight, BMI, MUAC, WC, HC & WHR of O girls were found to be greater than that of OW & NW girls.

Weight adjusted for height is a far more useful index to assess overweight and is a reasonable indicator of fatness (Mary, B. and William, D., 1999). 12+ O girls were heavier than 10+ & 11+ O girls. With the increase in the category of BMI, weight of subjects was also found to be increased with % excess ranged from 2.87 to 45.38.

A difference of 4.37, 5.52 & 7.04 cm was noted between O & NW girls from age groups 10+, 11+ & 12+ yrs, respectively whereas a difference of 1.27, 2.08 & 3.22 cm was noted between O & OW girls from age groups 10+, 11+ & 12+ yrs, respectively. Differences in the measurements of MUAC indicate the differences in fat depositon.

WC is an important abdominal obesity indicator among children and teenagers, being able to predict the future risk of metabolic complications (Plachta-Danielzik, S. et. al., 2008). WC has attracted much recent attention as an indicator of fatness and health risks in children. The interest in WC stems from research linking accumulated visceral adipose tissue to increased health risks and metabolic disorders in children (Gower, B. A., et. al., 1999). No greater differences were noted between NW girls aged 10+, 11+ & 12+ yrs for WC; in contrast to this, differences were obvious for girls aged 10+, 11+ & 12+ yrs for WC as far as within group comparisons are concerned (O & OW, Table 2). WHR is a good predictor of central obesity (Fernandez, J. R. et. al., 2004 & Hatipoglu, N., et. al., 2007). Both WC & HC increased with age. Mean WHR among NW & OW girls aged 10+, 11+ & 12+ yrs showed an increasing trend with increase in weight.

Skinfold thicknesses have been used in myriad studies of nutritional status, body composition, and relative subcutaneous fat distribution. Because the thicknesses of subcutaneous fat are very specific to adipose tissue and can be measured noninvasively, skinfold thickness remains an important and valid anthropometric indicator of regional and total body fatness. Skinfold thicknesses-triceps and subscapular measurements of subjects are described in Table 3. The mean values of triceps and sub scapular measurements of NW girls from all age groups (10+, 11+ & 12+ yrs) were higher as compared to the mean values of OW & O girls.

With the exception of NW girls from all three age groups, OW & O girls showed excess mean values of triceps skinfold as compared to reference standards for age, indicating the effect of additional fat deposition in the area owing to weight gain. Similar results were noticed for subscapular skinfold measurement. Percentage excess ranged from 7.67 to 69.67 (Table 3).

Outcomes related to childhood obesity include hypertension. The association between obesity and hypertension in children has been reported in numerous studies among a variety of ethnic and racial groups, with virtually all studies finding higher blood pressures and/or higher prevalences of hypertension in obese compared with lean children (Verma, M. et al., 1994). Blood pressure parameters i.e. SBP (Systolic Blood Pressure) and DBP (Diastolic Blood Pressure) of subjects included in this study are described in Table 4. The mean values of SBP & DBP of NW girls from all age groups (10+, 11+ & 12+ yrs) were higher than mean values of O girls. Mean SBP & DBP values of O girls were recorded as 117.97±15.42, 108.82±10.08 & 111.44±6.73 mm/Hg, respectively & 78.60±11.49, 76.44±12.96 & 80.66±11.00 mm/Hg, respectively (Table 4). Raj, M. et al. (2010) reported SBP values among girls aged 10 to12 yrs as104.4±9.87 to 109.8±10.35 mm/Hg, respectively & DBP values as 68.5±8.17 to 71.7±7.62 mm/Hg, respectively.

CONCLUSION:

Present study has shown that there is a high prevalence of obesity in school going girls aged of 10+, 11+ & 12+ yrs. Results showed that there is a vast difference between NW, OW & O girls for anthropometric measurements, skinfold thicknesses & blood pressure values. The results indicate positive effects of obesity on health status of these school going girls. Efforts to prevent obesity-related disease should start in childhood and should probably target not only children who are frankly overweight or obese but also those who are silently moving up the BMI percentiles. From a public health perspective, present study emphasizes the importance of primary prevention of overweight from early childhood with continuation of health promotion activities throughout the course of life.

Table 1: Age Wise Classification of Subjects

Sr. No.	Age (Years)	Girls (n=450)		
		NW (BMI Percentile Criteria of 5th to <85th percentile)	**OW** (BMI Percentile Criteria of 85th to <95th percentile)	**O** (BMI Percentile Criteria of ≥95th percentile)
1	10 +	50	50	50
2	11 +	50	50	50
3	12 +	50	50	50
Total		**150**	**150**	**150**

Table 2: Data on Anthropometric Measurements of Subjects

Parameters	10+ Yrs			11+ Yrs			12+ Yrs		
	NW	**OW**	**O**	**NW**	**OW**	**O**	**NW**	**OW**	**O**
Height (cm)									
M±SD	140.54 ± 6.52	137.40 ± 6.35	135.56 ± 8.14	144.66 ± 9.01	143.75 ± 6.82	142.25 ± 7.21	149.5 ± 7.16	144.84 ± 5.61	143.69 ± 8.06
Range	124.0 - 153.0	124.5 – 152.0	119.4 – 157.0	125.5 – 164.0	127.8 – 157.0	124.5 – 154.5	134.7 – 166.1	132.2 – 155.0	124.2 – 157.0
Std		140.0			145.3			150.2	
% E/D	0.39	-1.86	-3.17	-0.44	-1.07	-2.10	-0.47	-3.57	-4.33
Body Weight (kg)									
M±SD	34.26 ± 4.99	39.44 ± 3.47	45.36 ± 5.21	36.11 ± 6.09	43.73 ± 4.87	47.81 ± 5.18	37.88 ± 5.77	47.04 ± 4.09	55.38 ± 6.31
Range	25.5 – 44.2	32.5 – 50.1	33.2 – 57.3	26.9 – 52.3	34.0 – 53.5	37.7 – 59.5	29.0 – 52.7	40.0 – 57.2	44.5 – 73.4
Std		31.2			34.8			39.0	
% E	9.81	26.41	45.38	3.76	25.66	37.39	2.87	20.62	42.00
BMI (kg/m²)									
M±SD	17.29 ± 1.83	20.90 ± 0.77	24.70 ± 2.18	17.05 ± 1.73	21.10 ± 1.01	23.62 ± 1.88	16.97 ± 1.85	22.40 ± 0.97	26.81 ± 1.95
Range	14.59– 23.13	19.41 – 22.39	21.8 – 32.77	14.39 – 20.67	20.15 – 24.69	21.13 – 29.42	14.56 – 21.22	19.56 – 24.76	22.9 – 31.89
MUAC (cm)									
M±SD	19.78 ± 1.70	22.88 ± 0.85	24.15 ± 0.96	19.70 ± 1.66	23.14 ± 1.59	25.22 ± 1.22	19.22 ± 1.36	23.04 ± 0.81	26.26 ± 1.88

Range	17.0-23.0	20.0 – 24.0	22.0 – 26.0	17.0 – 24.0	19.0 – 25.0	24.0 – 28.0	17.0 – 23.0	22.0 – 24.0	29.0 – 30.0
Waist Circumference (cm)									
M±SD	59.28 ± 4.73	71.58 ± 2.46	77.72 ± 4.75	59.80 ± 6.49	75.72 ± 6.19	83.10 ± 6.13	59.10 ± 3.39	80.28 ± 6.40	85.52 ± 6.61
Range	52.0 – 69.0	76.0 – 65.0	69.0 – 86.0	50.0 – 75.0	62.0 – 85.0	68.0 – 94.0	53.0 – 66.0	68.0 – 91.0	69.0 – 95.0
Hip Circumference (cm)									
M±SD	72.56 ± 4.69	78.44 ± 2.86	83.60 ± 11.64	71.87 ± 7.51	79.80 ± 4.81	89.42 ± 4.48	72.64 ± 4.63	84.98 ± 4.06	94.40 ± 5.98
Range	83.0 – 62.0	72.0 – 84.0	80.0 – 94.0	58.0 – 90.0	70.0 – 93.0	80.0 - 99.0	57.0 – 79.0	72.0 – 95.5	80.0 – 105.0
WHR									
M±SD	0.82 ± 0.05	0.91 ± 0.04	1.10 ± 1.32	0.83 ± 0.05	0.95 ± 0.07	0.93 ± 0.06	0.82 ± 0.06	0.94 ± 0.06	0.91 ± 0.08
Range	0.73 - 0.94	0.82 – 0.99	0.77 – 1.03	0.75 – 0.95	0.81 – 1.07	0.78 – 1.02	0.71 – 1.04	0.77 – 1.05	0.70 – 1.02

Std-Standard; E-Excess; D-Deficit

Table 3: Data on Skinfold Measurements of Subjects

Parameters	10+ Yrs			11+ Yrs			12+ Yrs		
	NW	OW	O	NW	OW	O	NW	OW	O
Triceps Skinfold (mm)									
M±SD	11.80 ± 3.09	20.28 ± 3.77	22.40 ± 4.21	10.40 ± 3.09	17.12 ± 2.41	22.54 ± 8.01	9.62 ± 2.67	18.24 ± 3.29	23.30 ± 7.01
Range	7.0 – 19.0	15.0 – 25.0	15.0 – 32.0	5.0 – 17.0	10.0 – 20.0	12.0 – 44.0	5.0 – 16.0	10.0 – 25.0	13.0 – 44.0
Std	15.4			15.9			16.2		
% E/D	-23.38	31.69	45.45	-34.59	7.67	41.76	-40.62	12.69	43.83
Subscapular Skinfold (mm)									
M±SD	8.32 ± 2.41	17.06 ± 4.94	20.36 ± 3.54	8.14 ± 2.64	16.38 ± 3.31	19.10 ± 3.48	7.48 ± 2.36	16.66 ± 4.38	20.40 ± 3.58
Range	5.0 – 14.0	9.0 – 25.0	10.0 – 25.0	5.0 – 16.0	9.0 – 22.0	11.0 – 27.0	5.0 - 16.0	10.0 – 25.0	12.0 - 26.0
Std	12.0			12.9			13.1		
% E/D	-30.67	42.17	69.67	-36.90	26.98	48.06	-42.90	27.18	55.73

Std-Standard; E-Excess; D-Deficit

Table 4: Data on Blood Pressure of Subjects

Parameters	10+ Yrs			11+ Yrs			12+ Yrs		
	NW	OW	O	NW	OW	O	NW	OW	O
SBP (mm/Hg)									
M±SD	100.10 ±12.44	106.51 ± 9.12	117.97 ± 15.42	98.12 ± 11.13	114.51 ± 14.61	108.82 ± 10.08	97.48 ± 11.51	109.70 ± 8.76	111.44 ± 6.73
Range	62.0 – 120.0	92.0 – 135.0	88.0 – 159.0	76.0 – 120.0	80.0 – 150.0	91.0 - 136.0	75.0 – 120.0	96.0 – 125.0	96.0 – 120.0
DBP (mm/Hg)									
M±SD	65.88 ± 11.05	75.82 ± 11.28	78.60 ± 11.49	63.78 ± 7.10	75.80 ± 11.42	76.44 ± 12.96	64.02 ± 10.90	78.22 ± 9.83	80.66 ± 11.00
Range	43.0 – 111.0	45.0 – 99.0	53.0 – 100.0	45.0 – 80.0	50.0 – 99.0	53.0 – 100.0	40.0 – 90.0	59.0 – 99.0	65.0 – 101.0

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