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ORIGINAL ARTICLE

CORRELATION BETWEEN BODY MASS INDEX AND SEXUAL MATURITY RATE AMONG ADOLESCENT BOYS

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ABSTRACT: OBJECTIVE: To know the correlation between the BMI and SMR among adolescent boys and to determine the average age of different SMR staging among study groups.**DESIGN:** Prospective study.**SETTING:** Tertiary centre, Pediatrics department, KRH, GRMC, Gwalior.**METHODOLOGY:** The study subjects included indoor and outdoor patients as well as students from govt. and private school with age groups from 10 to 16 years group. The anthropometric measurement was done with appropriate privacy and public hair, and testicular staging done with orchidometer as per Tanner's staging. Appropriate statistical test applied to observe the values for the test of significance.**RESULTS:**15.9%subjects were overweight, 5% subjects were obese and 16.36% were underweight. The mean age in years for genital staging were 12.66 year, 13.79 year, 14.63 year, 16 year for G2, G3, G4 and G5 showing increasing in age with genital maturity. The mean age for public hair staging was 13.08 year. 13.87 year, 14.48 year, 14.75 year for P2, P3, P4 and P5 showing increasing staging with age of adolescent. The study has shown that 34% of adolescent boys with BMI of 85th to 95th percentile (overweight) were found to be having late maturity whereas 27% of adolescent boys with BMI more 95th percent (obese) were found to have late genital maturity. In study the genital stage was showing linear correlation with the mean waist circumference.**CONCLUSION:** It's concluded that as the age increases the genital and pubic hair of SMR increases. The mean height showed linear correlation with genital staging. Also genital staging was showing linear correlation with waist circumference. 34% of adolescents boys with BMI of 85th to 95th percentile (overweight) were found to be having late maturity whereas 27% of adolescent boys with BMI more 95th percentile (obese) were 85th to 95th percentile and 6.5% of boys with 5th to 95th percentile had early genital maturity.

KEYWORDS :BMI, orchidometer, SMR, tanner's staging.

INTRODUCTION: Puberty is a very important in child development. This is a time when many physical and psychological changes take place. The growth during puberty accounts for 15 to 20% of the height reached at adulthood. Various genetic and environmental factors have been explored for their correlation with the age pubertal development such as social class, dietary habits, and nutrition. Obesity and overweight are the growing problem in children of affluent classes.

Obesity is the condition of excess body fat which can lead to such health risk as an elevated cholesterol, triglycerides, or insulin levels, high blood pressure, sleep apnea. Orthopedic complications and mental health problems. And the body mass index measures excess body weight for a particular height and shown to correlate with body fat. It is a screening tool to asses' obesity.

Sexual maturity Rate refers to a quantitative scale of anatomical changes in adolescent undergoes visible sexual characteristics e.g. genitals and pubic hairs among boys and pubic hair and breast development in girls. It was originally described by J M Tanner in 1960s.

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WHO defines adolescent between 10 to 19 years of group as most of the change of puberty are complete by this age.

METHODOLOGY: TITLE; Correlation of body mass index (BMI) and sexual maturity rate (SMR) among adolescent boys.

SETTING: This study was carried out in department of pediatrics, Kamla Raja Hospital, G. R. Medical College, Gwalior. This is a medical college, hospital and caters the population of whole north M.P. and adjoining Rajasthan and U.P. This study includes subject from indoor and outdoor patients as well as students from government and private schools of Gwalior.

STUDY DESIGN: Prospective study.

MATERIALS USED:

- Electronic Weighing Machine.
- Measuring tape (non-stretchable).
- Stadiometer.
- Orchidometer.

INCLUSION CRITERIA:

- Adolescent boys of 10-16 years of age group.
- School going adolescents.
- Indoor and outdoor adolescent patients.

EXCLUSION CRITERIA:

- Physically handicap.
- Taking drugs like steroids.
- Children not willing to participate after group counseling.
- Children having endocrinal diseases.
- Children with chronic illness.

METHODS: Measurement of waits circumference was done with non-stretchable tape at the mid-point the 10^{th} rib and the highest point of the iliac crest. The hip girth was measured at the level of anterior superior iliac spine. The height and the weight measurement were taken twice and the mean of two measurements was used to calculate BMI WEIGHT/ (HEIGHT).^{2}Which is defined as expressed as Kg/m^2.

The cut off value of BMI obtained by Cole et al[3] was used to classify children as normal, overweight and obese.

1. 85^{th} percentile-overweight.
2. 95^{th} percentile-corresponds to a BMI of 30.
3. $>95^{th}$ percentile –obese.

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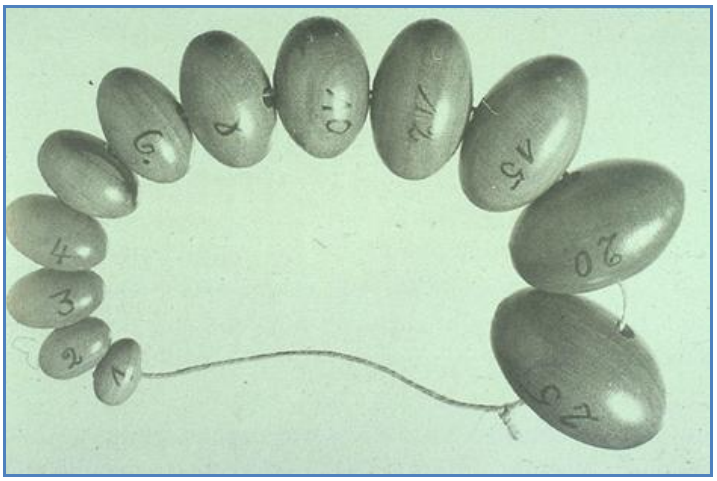

The testicular size was measured by orchidometer and was noted as per the Tanner's staging

OBSERVATION TABLES: The present study was done to assess the correlation of BMI & SMR among adolescent boys in Kamla Raja Hospital, Gwalior.

Age (years)	No. of Subjects	%age
10	12	5.45
11	21	9.54
12	32	14.54
13	41	18.63
14	62	28.18
15	38	17.27
16	14	6.36
Total	**220**	**100**

Table 1: Age wise distribution of subjects

Mean age of the subjects was 13.31 Years and majority belongs to 14 Years of age group i.e. 28.18% of total subjects.

Social class	No. of Subjects	%age
I	90	40.90
II	78	35.45
III	34	15.45
IV	16	7.27
V	2	0.90
Total	**220**	**100**

Table 2: Distribution according to socioeconomic status (modified B.J. Prasad)

Majority of the subjects belongs to Social Class I and II i.e. 76.35%.

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Age in years	No. of adolescents					Total
	Stage1	Stage 2	Stage3	Stage4	Stage5	
10	9 (75%)	3 (25%)				12
11	14 (66.6%)	6 (28.6%)	1 (4.75%)			21
12	9 (28.13%)	15 (48.6%)	8 (25%)			32
13		21 (51.2%)	15 (36.58%)	5 (12.19%)		41
14		13 (20.96%)	28 (45.16%)	21 (33.87%)		62
15			17 (44.73%)	21 (55.27%)		38
16		1 (7.14%)	1 (7.14%)	10 (71.43%)	2 (14.28%)	14
Total						**200**

Table 3: Age wise distribution of adolescents in relation to genital stage

Genital Stage Shows that only 25% children were in stage 2 at 10 years of age. No subject was seen in stage 1 after 12 year. After 15 year none was found in genital stage 2. None of the subjects entered in stage 5 before age of 16 year.

Age	Total No.	Total Mean Weight	Mean weight of Various Stages					P-Value
			Stage 1	Stage 2	Stage 3	Stage 4	Stage5	
10	12	29.33 +5.84	27.14 + 3.7	32.4 + 3.7				0.050
11	21	30.52 +5.8	30.56 + 5.84	30.73 + 6.34	28			0.910
12	32	30.97 +5.6	30.56 + 8.8	29.2 + 8.23	34.75 + 7.5			0.310
13	41	37.85 +6.95		33.1 + 7.98	41.93 + 7.23	45.6 + 8.68		0.001
14	62	44.52 +8.63		40.76 + 9.22	42.60 + 9.4	49.38+ 9.67		0.017
15	38	51.87 +11.23			48.47 + 11.57	54.61 + 12.1		0.122
16	14	59.07 +12.72		60	80	58.5 + 13.31	51+13.75	0.405

Table 4: Mean Wt in relation to Genital stages in different age groups

Mean weight is showing linear correlation with the genital staging in all the age groups except at 11 and 16 years.

Age	Total No.	Total Mean Height	Mean Height of Various Stages					P-Value
			Stage 1	Stage 2	Stage 3	Stage 4	Stage5	
10	12	136.5 + 6.69	131.55 +3.16	136.67 + 3.17				0.03
11	21	138.7+ 6.69	132.57+4. 4	138.67 + 4	144			0.007
12	32	139.93 + 6.73	134.67 +5.29	140.4 + 5.67	145+6.08			0.003
13	41	150.68+ 6.69		147.9 + 6.61	153.2 + 7.72	154.8 + 5.08		0.037
14	62	157.05+		151.46 +	157.21 +	160.29+		0.000

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		8.65		9.27	9.59	10.58		
15	38	163.63+ 10.34			159.47 + 11.31	167 + 11.5		0.05
16	14	167.57+ 11.26		158	170	167 + 12.35	174.5 + 12.54	0.7

Table 5: Mean Ht in relation to Genital stages in different age groups

Mean height is showing correlation with the genital staging in all age groups and this correlation is highly significant (P=<0.001) at 12 and 14 years of age groups.

Age in years	Mean BMI					P-Value
	Stage1	Stage 2	Stage3	Stage4	Stage5	
10	16.29 + 2.54	15.11 + 2.54				0.5
11	16.60 + 2.73	17.74 + 2.62	13.5			0.33
12	16.45 + 1.9	14.7 + 2.09	16.35 + 2.24			0.08
13		15.3 + 2.48	17.72 + 2.74	19.04 + 2.9		0.005
14		17.71 + 3	17.20 + 3.07	19.03 + 3.2		0.128
15			19.27 + 3.65	19.41 + 3.83		0.94
16		24.00	27.68	19.2 + 3.99	24.77 + 3.95	0.12

Table 6: Body Mass Index (BMI) in Adolescents in Relation to Genital Development and Age

Between 10 to 15 years of subjects genital staging between 2 to 4 showing linear correlation with the BMI and 13 years of age genital staging 2 to 4 having statistically significant (P=<0.05) linear correlation with the BMI. At age of 16 year subjects with BMI > 95th percentile were lagging behind in genital maturity.

No.	Genitalstage	Total No.	Waist circumference
1	G1	32	54.36 +6.46
2	G2	59	56.42 +6.46
3	G3	70	61.96 +6.59
4	G4	57	65.79 +8.48
5	G5	2	88 +9.26

Table 7: Correlation of waist circumference to Genital Stage

Genital stage showing linear correlation with the mean waist circumference, in genital stage 1- mean waist circumference was 54.36 in genital stage 5- mean waist circumference was 88 and the correlation between genital stage and mean waist circumference statistically highly significant (P=<0.001).

Age	Waist circumference (mean)	Hip Circumference (mean)	W/H ratio (mean)
10	50.75 +2.9	61.17 +2.86	0.83 +0.03
11	52.71 +2.93	62.67 +2.86	0.84 +0.026
12	58.28 +3.86	69.90 +3.84	0.86 +0.04
13	58.58 +6.61	69.90 +6.13	0.83 +0.056
14	62.15 +7.25	78.40 +6.97	0.83 +0.06
15	66.24 +8.28	78.71 +8.57	0.83 +0.057
16	69.5 +9.17	80.64 +9.15	0.85 +0.058

Table 8: Age wise waist, hip & Waist/ hip ratio measurement

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Mean waist circumference was rising with the age at 10 year, mean waist circumference was 50.75 and at 16 year of age mean waist circumference was 69.5 cm. Similarly mean hip circumference was also increasing with the age, at 10 years mean hip circumference was 61.17 cm and at 16 year mean hip circumference was 80.64 cm. though the W/H ratio (Mean) remaining within a narrow range of 0.832-0.86 to all age groups.

DISCUSSION: Most of the boys had a BMI between 5-85 percentile[1]. 16 % of the study subjects were overweight. 5 % were obese. The prevalence was higher than that observed by ICMR, India, Laxmaiah et al (6.1% & 1.6 %). the findings were similar to T.S. Cole et al[2] that observed by D.K. Agrawal et al[3].

Age wise distribution of boys in relation to genital maturity reveals that only 25% of children were in genital stage II at 10 years. All children were in stage IIor higher after the age of 12 years. None of the subjects entered stage 5 before 16 year. The mean age for genital stage 2, stage 3, stage 4, stage 5 were 12.66, 13.79, 14.63, and 16 respectively. Age for stage 2 was higher than that observed by Marshall tanner et al. (11.67 year) [4] and NHANES III study (9.7 year).this was similar to Indian studies by Kaul et al. (11.1 year) [5], Agrawal KN (11.3 year) but lower than that reported by Bhargava et al (12.5 year) [6].

The mean weight is showing linear correlation with the genital stage in all the age groups. This was a similar to those found by Eveleth et al[7].

Age wise mean height in different age group also has a linear correlation which is highly significant at 12 and 14 years of age. There is progressive increase in mean height from 10 years. The height velocity was maximum at 12 to 13 years and 13 to 14 years age group. These findings are similar to that observed by KN Agrawal et al[8]. Final height at 16 years was equal to those of Indian affluent adolescents. In relation to genital stage peak height velocity was attained at Stage 4 & this was similar to the finding of Amit Ghuley et al[9].

BMI of study subjects is rising with the age. This was almost stable from 10 to 12 year. Thereafter steady increase was seen from 15.5 at 12 year to 20.9 at 16 year. The mean BMI was laser than affluent Indians up to the age of 13 years and thereafter it was equal up to 15 year and higher at 16 year[10].

The mean waist circumference shows a linear increase from 50.7 cms at 10 year to 69.5cms at 16 year. Similarly hip circumference also rises from 61.17 cms at 10 year to 80.86 cms at 16 year. Waist hip ratio doesn't change significantly with age & varies from 0.83 to 0.85. as similar to Chao Yang Li. [11]

Pubic hair maturity at 10 year is only 8.3% of subjects in contrast to 25% for stage II of genital development. The mean age for pubic hair stage II was 13.08year. this was higher than that for G2 stage (12.66). as similar to Laron Z. [12]

SUMMARY AND CONCLUSION:

Background: This study was done for 'correlation of BMI and SMR in adolescent boys' in Kamla Raja Hospital, Department of Pediatrics. Study design: prospective study.

Sample and subjects: A total of 220 adolescents boysbetween the age groups 0f 10 t0 19 years were enrolled fromvarious schools, indoor and outdoor adolescents patients in our study.

Intervention: Prior consents were taken from principals of respective schools, guardians as well of subjects. Under strict privacy the weight, height, waist circumference, hip circumference was taken and BMI and weight hip ratio was calculated. Also both genital and pubic hair staging of respective subjects as per Marshall and Tanner classification was done.

RESULTS:

1. The mean age of our study was 13.31 years with majority in 14 years of age (28.18 %)
2. 40.9% AND 35.45% subjects were in social class I & class II.
3. 15.9 % subjects were overweight, 5% subjects were obese and 16.36% were underweight.

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