EFFECT OF GENERAL OBESITY INDEX (BMI) AND BODY FAT PERCENTAGE ON RESTING HEART RATE IN SCHOOL GOING FEMALE CHILDREN (AGED BETWEEN 14-17 YEARS)

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Abstracts: Background & objectives: This study was conducted to determine the association between general obesity index (BMI) & body fat percentage with Resting Heart Rate (RHR) in obese and non-obese school going female children (aged between 14-17 Years). **Methods**: The study was carried out among 70 female subjects aged between 14 to 17 years. All the subjects were divided into two groups according to BMI and Body Fat %. The observed values were analyzed by students- t test and then compared by pearson's coefficient correlation. Any difference was significant when p- value <0.005. **Results**: The general obesity index (BMI) showed 48% subjects were generally obese (BMI ≥ 25 kg/m^2). Body fat % was found in 17% (BF% Mean = 32.57±2.80). Obese group presented with continuous faster RHR in standing & supine conditions (Mean RHRst. = 81.25±3.64bpm & RHRsup= 76.66±3.86bpm) and was significantly positively correlated with obesity indices BMI, BF% (RHRst. r = 0.72, RHRsup. r = 0.58, RHRst. r = o.73, RHRsup. r = 0.56 respectively). Interpretation & conclusion: Resting Heart Rate in standing condition had higher values and significantly positive correlation with obesity indices among obese group compared to non-obese group (p<0.05).

Key Words: General body index (BMI), Body Fat% (BF %), Resting Heart Rate (RHR).

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Introduction:

Obesity is a nutritional health problem[1], which is caused by imbalance between calorie intake and calories utilized. Other factors which causes of obesity are genetic, behavioural, and environmental. Childhood obesity causes physical, psychological, and social health problems[2]. General obesity, described in terms of body mass index (BMI), is calculated by dividing the patient's weight in kilograms by height in meters squared (kg/m^2). Obesity and overweight can be defined[3] when BMI ≥25kg/m^2 and ≥ 30kg/m^2.

Heart rate (HR) is an important indicator of cardiovascular health. The Resting Heart Rate (RHR) is influenced by several constitutional and environmental factors and most important determinants are parasympathetic and sympathetic influences. Thus, quantifying RHR can give state of imbalance between sympathetic and parasympathetic activity[4]. Obesity causes of autonomic dysfunction and RHR is dependent on autonomic dysfunction. RHR is predict the life threatening cardiovascular consequences in advancing age[5]. Obese has increased RHR as autonomic responsiveness has been shown to diminish due to obesity[6].

Material and Methods:

In the present study, we selected 70 school going female children (Aged between 14-17 years) of Jodhpur, Rajasthan during the year of 2018-2019. Institutional ethical clearance was obtained before commencement of the study. Written informed consent was taken from each subject. The participants were first given an explanation about the purpose and procedure of the experiment.

Inclusion Criteria:

1. Age between 14-17 years and willing to participate in the study.
2. Physically and mentally fit.
3. Not suffering from any known medical problems.

Exclusion Criteria:

1. Age below 14 years and above 17 years.
2. Smokers.
3. Physically not fit.

4. Hypertensive, diabetic or suffering from any long term systemic illness.

5. Uncooperative subject.

The anthropometric data i.e. Height (Ht), Weight (Wt) to calculate Body Mass Index (BMI) and Body Fat % (BF%) of subjects were taken followed by measurements of RHR. All the subjects were divided into two groups according to BMI and Body Fat % (BF %).

Procedure for Measurement:

Body Mass Index (BMI) – was calculated by dividing the weight taken in kg by the square of height taken in meters. It was calculated by Quetlet's index [Wt (kg) / Ht (m2)]

Body Fat (%) – It was calculated from the formula (1.2×BMI) + (0.23×Age) -10.8×sex) -5.4

[Where male =1 & female = 0]

(Deurrenberg P, Westsrate JA, Seidell JC, 1991:)

RHR was measured after a complete rest of 5 minute by taking the radial pulse. Three successive readings were taken in the resting condition for 60 seconds each with an interval of one minute while the person was standing. Similarly three readings for supine resting heart rate were obtained after a further rest period of 3 minute.

Statistical analysis:

Mean and standard deviation of all measured parameters with resting heart rate of all subjects were calculated by Microsoft Excel. The data were computed by student t-test in 'Open Epi software and Pearson's correlation analysis. The p-value <0.05 was considered as statistically significant.

Result:

Table – 1 Descriptive analysis *based on BMI* of school going normal and obese group of female subjects (14-17 years)

Parameters	BMI < 25kg/m²	BMI > 25kg/m²	Students t- test	
	Normal Weight (N=36)	Obese (N=34)		
	Mean ± SD	Mean ± SD	T value	P value
Age	15.66 ±1.11	15.76 ±1.07	-0.38	>0.5 N.S.
Height (cm)	155.55 ±5.98	154.05 ±6.12	1.03	>0.5 N.S.
Weight (kg)	48.38 ±7.89	63.41 ±8.4	-7.71	**<0.1 H.S.**
BMI (kg/m)	19.91 ±2.41	26.67 ±2.05	-12.6	**<0.1 H.S.**

In our study, Resting Heart Rate (RHR) is increased in obese group both in standing and supine postures (Table 2 & Fig-1).

Table - 2 Resting heart rate *based on BMI* School going of normal & obese group of female subjects (14-17 years)

Parameters	BMI < 25 kg/m²	BMI >25 kg/m²	Students t test	
	Normal Weight (N=36)	Obese (N=34)		
	Mean ± SD	Mean ± SD	T value	p-value
RHR (standing)	74.52 ±2	81.08 ±3.4	-9.9	**<0.1 H.S.**
RHR (supine)	69.58 ±2	75.38 ±3.53	-8.51	**<0.1 H.S.**
Δ change	4.94	5.7 ±0.13	-35.09	**<0.1 H.S.**

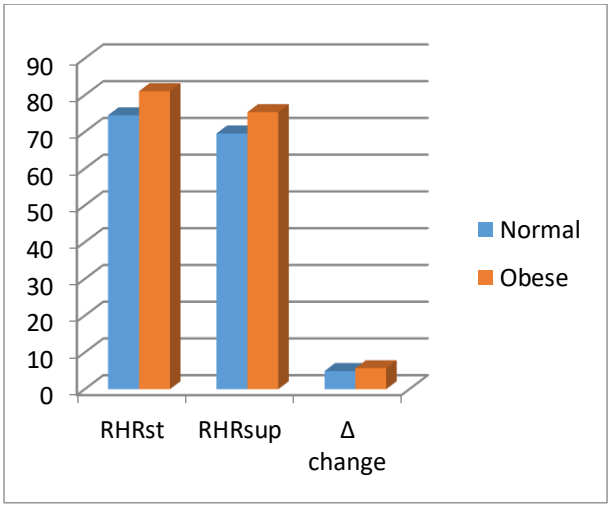

Fig-1: Resting heart rate in standing & supine postures of normal & obese female subjects.

TABLE – 3 Descriptive analysis *based on BF%* of school going normal and obese group of female subjects (14-17 years)

Parameters	BF% <30% Normal Weight (N=58)	BF% >30% Obese (N=12)	Students t- test	
	Mean ± SD	Mean ± SD	T value	P value
Age	15.63 ±1.1	16.08 ±0.99	-1.31	>0.05 N.S.
Height (cm)	154.37 ±5.76	157 ±7.09	-1.38	>0.05 N.S.
Weight (kg)	52.56 ±8.46	70.75 ±9.66	-6.61	**<0.01 H.S.**
BMI (kg/m^2)	22.08 ±3.36	28.56 ±2.43	-6.33	**<0.01 H.S.**

We observed that obese group have increased Resting Heart Rate both in supine and standing postures but the more rise RHR during standing posture (Table 4 & Fig-2).

TABLE – 4: Resting heart rate *based on BF%* school going of normal & obese group of female subjects (14-17 years)

Parameters	BF% <30% Normal Weight (N =58)	BF% >30% Obese (N=12)	Students t- test	
	Mean ±SD	Mean ±SD	T value	P value
RHR (Stand-ing)	76.98 ±4.03	81.25 ±3.64	-3.39	**<0.01 H.S.**
RHR (Supine)	71.98 ±4.08	74.91 ±3.58	-2.30	**<0.05 HS.**
Δ change	5.1 ±0.05	6.34 ±0.06	-75.55	**<0.01 H.S.**

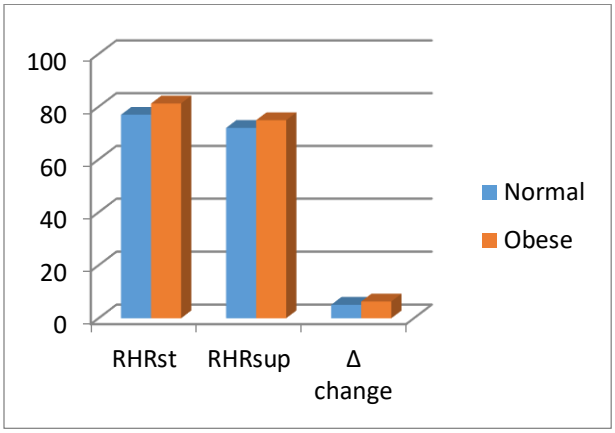

Fig-2: Resting heart rate in standing & supine posture of normal & obese female subjects.

In our study, we found that the RHR in standing condition was strongly correlated with BMI, BF% (Table 5).

Table – 5 Correlation of obesity indices with Resting heart rate in female subjects.

Name of parameters	BMI	BF%
RHR (supine)	0.58	0.56
RHR (standing)	0.72	0.73

We found, the correlation of BMI with RHR in supine posture in female subjects and BMI explained 58% of cases of RHR in supine posture respectively (Fig 3). Similarly, the correlation of BF% with RHR in supine posture in female subjects and BF% explained 56% of cases of RHR in supine posture respectively (Fig 4).

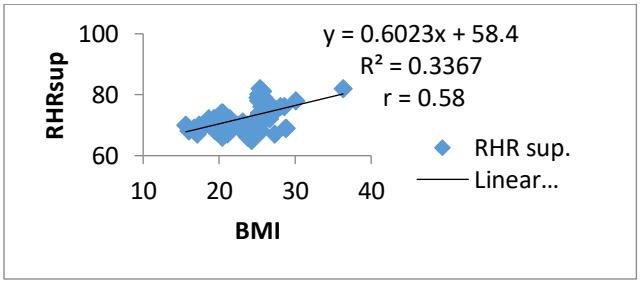

Fig -3: Correlation of BMI with RHR (supine) in female subjects.

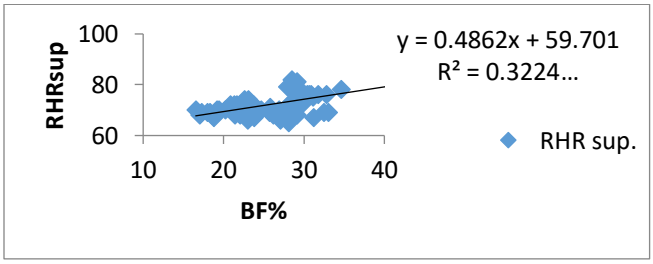

Fig -4: Correlation of BF% with RHR (supine) in female subjects.

Fig: 5 is showing the correlation of BF% with RHR in standing posture in female subjects. BMI explained 72% of cases of RHR in standing posture respectively and Fig: 6 is showing the correlation of BMI with RHR in supine posture in female subjects. BMI explained 73% of cases of RHR in standing posture respectively.

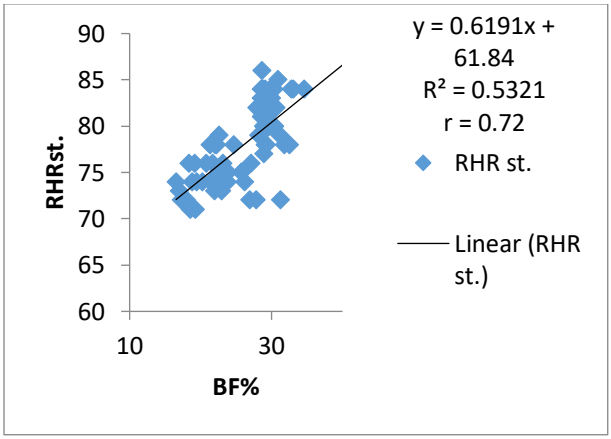

Fig -5: Correlation of BF% with RHR (standing) in female subjects.

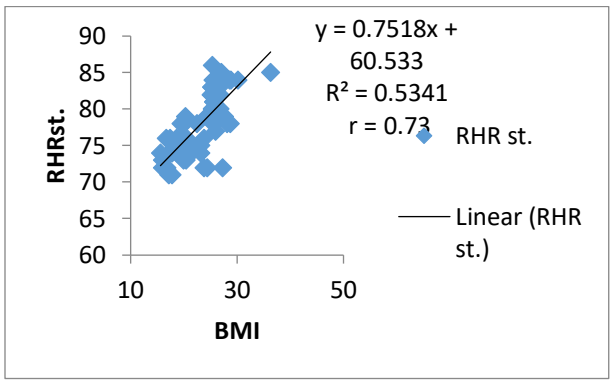

Fig -6: Correlation of BMI with RHR (standing) in female subjects.

Discussion:

The present study was designed to assess the relationship between indices of general obesity and body fat% and blood pressure in Indian school going female subjects (14-17 years), which in turn gives the information about the relationship of Resting Heart Rate with body fat% and general obesity among school going female subjects (14-17 years).

The present study carried out in 70 healthy school going female children in the age range of 14-17 years, to assess the effect of general obesity and body fat (%) on Resting Heart Rate. The subjects were distributed into 2 groups. Out of total 70 subjects, using the BMI criteria 36 (51%) subjects were of normal category and 34 (48%) were found under obese category and BF% showed 58 (82%) subjects in normal group and 12 (17%) comes under obese group. In our present study, the RHR was significantly greater in 48% subjects having general obesity i.e. BMI > 25kg/m^2 and 17% on based on body fat% as compared to non-obese subjects.

On applying Pearson's coefficient correlation analysis we observed a significant correlation of RHR with BMI in the supine & standing posture, explained as 58% & 72% variation and with BF% in the supine & standing posture explained as 56% & 72% variation. This increase may be due to higher sympathetic tone in the obese and parasympathetic tone less compared to normal. The RHR relatively higher in both standing & supine position in obese.

Postural changes and RHR:

RHR changes are known to occur when one moves from a recumbent to an upright position or vice versa. The sympathetic tone higher in the obese than non-obese or the parasympathetic tone was comparatively less in obese compared to non-obese. However, the effects of autonomic dysfunction would be reduced in supine position especially if they are related to the sympathetic activation[7]. Benefit of the study that the young students may be advised to alter their eating habits and lifestyle by demonstrating to them an immediate observable effect of obesity on RHR. This is useful at the stage of life when the subjects are in the adolescent years because the weight gain after 18 years of age increases cardio-vascular risk even

in patients with normal body mass index[8]. These findings of our study are comparable in the literature with the study outcome of Indira Anil Kurane et al[9]. They observed that obese children have increased heart rate when compared to non-obese children.

Conclusion:

In this study, we found significant positive correlation between general obesity index i.e. BMI and Body Fat % with Resting Heart Rate in obese group female subjects compared to normal weight group subjects. Thus, to make aware the healthy lifestyle including dietary and physical activity modification specially in early age in female subjects so, that they can be prevented from various life threatening consequences with advancing age. Because the continuous high Resting Heart Rate in these female school going children (Aged between 14-17 years) exhibiting general obesity and BF% could contribute to various cardiovascular problems later in life. Further research with large number of subjects is required for confirming our present study results and applying these results to be effectively for these subjects.

References:

1. Chhatwal J, Varma M, Riar SK. Obesity among preadolescents and adolescents of a developing country (India). Asia Pac j Clin Nutr 2004; 13 (3):231-5.
2. Karnik S, Kanekar A. Childhood Obesity: A Global Public Health Crisis. Int J Prevent Med.2012; 3(1):1–7.
3. Obesity: preventing and managing the global epidemic. Report of a WHO consultation. World Health Organ Tech Rep Ser 2000; 894:1-253.
4. Fox K, Borer JS, Camm AJ, Danchin N, Ferrari R, Lopez Sendon JL et al. Resting heart rate in cardiovascular disease. J Am Coll Cardiol 2007; 50(9); 823-30.
5. Helmreich RJ, Hundley V, Varvel P, The effect of obesity on obesity on heart rate (heart period) and physiological parameters during pregnancy. Biol Res Nurs 2008; 10(1):63-78.
6. Haslam DW, James WP. Obesity. Lancet 2005; 366(9492):1197-209.
7. Grassi G. Adrenergic overdrive as the link among hypertension, obesity, and impaired thermogenesis: lights and shadows. Hypertension 2007; 49(1):5–6.
8. Celik T, Iyisoy A, Yuksel UC, Isik E. The role of abdominal obesity and weight gain since adolescence in early atherosclerosis. Int J Cardiol 2009; 132:263–4.
9. Indira Anil Kurane, A B Kurane, R S Bhatker. Association of Heart Rate and Blood Pressure with BMI in Children. International Journal of Basic and Applied Physiology. IJBAP Vol. 2 Issue 1: 145-149.

Conflict of Interest: None