Synergistic effect of Family History of Chronic Diseases and Longer Duration of Leisure Time Activity on Adiposity and Body Composition among the Bengali Hindu Children and Adolescents of Kolkata, India

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ABSTRACT

Objectives: Children with family history of chronic diseases like diabetes, cardiovascular disease, hypertension, dyslipidaemia along with adoption of less physical activity increases the susceptibility of the diseases in adult life among them later. The present study examined the synergistic effect of family history of chronic disease (FHD) and longer duration of leisure-time activity (LTA) on somatotype and cardiovascular health among the Bengali Hindu children and adolescents. **Material and Methods**: A total of 2267 Bengali Hindu children (including 471 boys and 417 girls of age 5-9 years) and adolescents (including 688 boys and 691 girls of age 10-17 years) living in the northern part of Kolkata, India from low-to-middle socio-economic strata were studied. Anthropometric measures and body composition were calculated using standard techniques. Somatotype was calculated following Heath-Carter method. All participants were classified in to three groups viz., 1) Both FHD & LTA > 1h; 2) Either FHD or LTA > 1h; and 3) Neither FHD nor LTA >1h. LTA was accessed on time spent tentatively on such daily activities that require very less or no physical activity. **Results:** The analysis of covariance (ANCOVA) test with age as covariate showed that children and adolescents who had both FHD and LTA spend > 1 hour of had significantly higher (p<0.001) endomorphy (indicator of relative fatness), and significantly lower (p<0.001) ectomorphy (indicator of relative linearity), than their counterparts, irrespective of age and sex. **Discussion:** Family history of chronic disease along with more leisure time spend on activities of either very low or no physical activity had adversely affecting the cardiovascular health as reflected through poor somatotype scale More sedentary activity mediated through habitual practice of during childhood and adolescent when coupled with FHD seems to put a synergistic effect leading to an early predisposition to CVD risk in adulthood. **Conclusion:** Habitual practice of active lifestyle needs to be initiated right from early childhood otherwise children and adolescents adopting sedentary lifestyle are at more risk of developing chronic disease by the time they renter into early adulthood.

KEYWORDS: Family History, leisure time activity, Somatotype, children, adolescent, Bengali, Asian Indian

INTRODUCTION

Family history of chronic diseases (FHD) reflects the consequences of genetic susceptibility, shared environment and common behaviour (Yoon et al., 2002). Positive FHD by itself is the most useful for predicting disease when there are multiple family members affected, the relationship among relatives is close, and disease is premature, that is, it occurs at younger ages than would be expected (Yoon et al., 2002). Therefore on one hand, children with positive FHD are more susceptible to chronic diseases by the time they enter in to adulthood. On the other hand, less physical activity or spending more time on such leisure activities which require very less or no physical activity at all has increased globally, particularly among the millennial. Poor leisure time activity (LTA) has been found to be associated strongly with cardiovascular disease (CVD) and diabetes (Moe et al. 2013). Like any other aspect of human behaviour LTA as spent during childhood and adolescent, not only shape the adulthood behaviour it also exhibit change across the life span.

The present study was therefore aimed to evaluate the synergistic effect positive FHD and longer duration of LTA on somatotype and cardiovascular health among the Bengali Hindu boys and girls living in Kolkata, India.

MATERIALS AND METHODS

Study population

A total of 2267 Bengali Hindu school-going children (including 471 boys and 417 girls of age 5-9 years) and adolescent (including 688 boys and 691 girls of age 10-17 years) were studied belonging to low-to-middle socio-economic status. The children were from primary school (class I-IV) and adolescent from high school (class V-XII) living in the northern part of Kolkata, India. The protocol of the present study was approved by the Institutional Ethics Committee of the West Bengal State University, Kolkata. Written consent was obtained from all participants with due permission form their parents or class teachers, prior to the commencement of the study.

Anthropometric measures, body composition, and somatotype

Height (in cm), weight (in kg), and waist circumference (in cm) were measure following standard techniques (Lohman et al., 1988) as well as skinfolds including triceps, sub-scapular, supraspinale and calf were measured using Slim guide skinfold caliper (CESCORF, Brazil). Somatotype was calculated as per Health-Carter somatotype method (Carter & Heath, 1991). Accordingly the three somatotypes representing the physique were calculated viz., 1) ectomorphy – relative linearity of a physique, 2) mesomorphy – denotes musculoskeletal robustness, and 3) endomorphy - the level of fatness.

Leisure-Time Activity (LTA)

LTA levels were ascertained by means of a questionnaire which includes the frequency and intensity of leisure-time activity i.e., time spent on those activities that require very less physical activity or no physical activity at all. All participants were then divided into two groups: i) LTA > 1h - spending more than one hour daily on activities that hardly requires any physical activity, and ii) LTA $\leq$ 1h – children spending no more than an hour on leisure activities.

The activities include time spent over playing video games, use of cell/smart phones, watching television, movies, and sheer gossiping etc.

Family history of Chronic Disease (FHD)

FHD was obtained from each participant through questionnaire filled by their respective parents which include CVD, diabetes, hypertension, dyslipidaemia, and or currently under medication. According to the information the FHD was classified in to three groups: i) both parents, ii) either parents, and iii) none of the parents.

Statistical analyses

Mean differences in adiposity, body composition and somatotype between three groups between viz., Group I - both FHD & LTA >1h, Group II - either FHD or LTA >1h, and Group III neither FHD nor LTA>1h were determined by analyses of covariance (ANCOVA) with age as covariate, separately for boys and girls. The multivariate analysis of covariance (MANCOVA) test was undertaken to establish whether the three groups (as independent variables) are statistically significantly differ on the somatotypes (as dependent variables) components (i.e., endomorphy, mesomorphy, and ectomorphy) with age as covariate. The Wilks' Lambda value was considered for MANCOVA statistics and partial eta-square was calculated in order to find out the effect size-variance explained by the given variable. The means of the somatotypes of both the groups were plotted in the somatochart using X and Y co-ordinates following standard equation. All statistical analyses were performed on IBM SPSS (version 25) with level of significance was set at $p<0.05$ (two tailed).

RESULTS

The frequency of children and adolescents falling under the three categories by age and sex are given in Table I. The descriptive and inferential statistics of the children (5-9 yrs) are given in Table II. The ANCOVA test with age as covariate, showed that there exist a statistically significant difference in mean BMI, % body fat, and somatotypes among both boys and girls of Group I as compare to their counterparts, particularly Group III. Similarly, among adolescents (10-17 yrs.) there also exist a statistically significant difference in mean, % body fat ($p<0.001$), endomorphy ($p<0.001$), mesomorphy ($p=0.026$), and ectomorphy ($p<0.001$) between the groups with group I significantly higher as shown in Table III. The ANCOVA test also resulted that Group I children had significantly higher ($p<0.001$) mean endomorphy, and significantly lower mean ectomorphy, among both males and females.

Table I. Frequency (%) of study participants by FHD and LTA

		Both FHD & LTA >1h	Either FHD or LTA>1h	Neither FHD nor LTA>1h	Total
Children (5-9 years)	Male	143	122	206	471
	Female	137	120	160	417
Adolescent (10-17 years)	Male	244	157	287	688
	Female	243	182	266	691
	Total	767	581	919	2267

Table II. Descriptive and inferential statistics of the studied children by FHD & LTA

Children	Group I Mean ($\pm$ SD)	Group II Mean ($\pm$ SD)	Group III Mean ($\pm$ SD)	Wilk's λ	F value	P	Partial η²
Boys (471)	143	122	206				
BMI (kg/m²)	16.98 (2.46)	16.52 (2.59)	15.49 (2.15)		18.13	< 0.001	
WC (cm)	46.92 (3.90)	46.71 (3.73)	46.61 (4.04)		0.271	0.763	
Body fat (%)	22.06 (1.76)	21.23 (2.41)	19.17 (2.92)		62.42	< 0.001	
Endomorphy	5.10 (0.91)	3.83 (1.06)	2.71 (0.63)		371.32	< 0.001	
Mesomorphy	4.31 (1.24)	4.72 (1.44)	4.16 (1.40)		11.53	< 0.001	
Ectomorphy	2.25 (0.95)	3.32 (1.63)	4.33 (1.44)		92.27	< 0.001	
Somatotype*				0.349		< 0.001	0.409
Girls (417)	137	120	160				
BMI (kg/m²)	17.01 (2.76)	16.48 (2.73)	15.95 (2.50)		5.801	0.003	
WC (cm)	47.12 (4.00)	46.54 (3.88)	46.62 (3.87)		0.858	0.425	
Body fat (%)	22.87 (2.04)	22.10 (2.42)	20.67 (2.94)		29.13	< 0.001	
Endomorphy	5.34 (0.98)	3.81 (0.97)	2.86 (0.56)		336.37	< 0.001	
Mesomorphy	4.50 (1.17)	5.19 (1.23)	4.63 (1.08)		14.52	< 0.001	
Ectomorphy	2.49 (1.17)	3.51 (1.74)	4.13 (1.82)		37.36	< 0.001	
Somatotype*				0.344		< 0.001	0.414

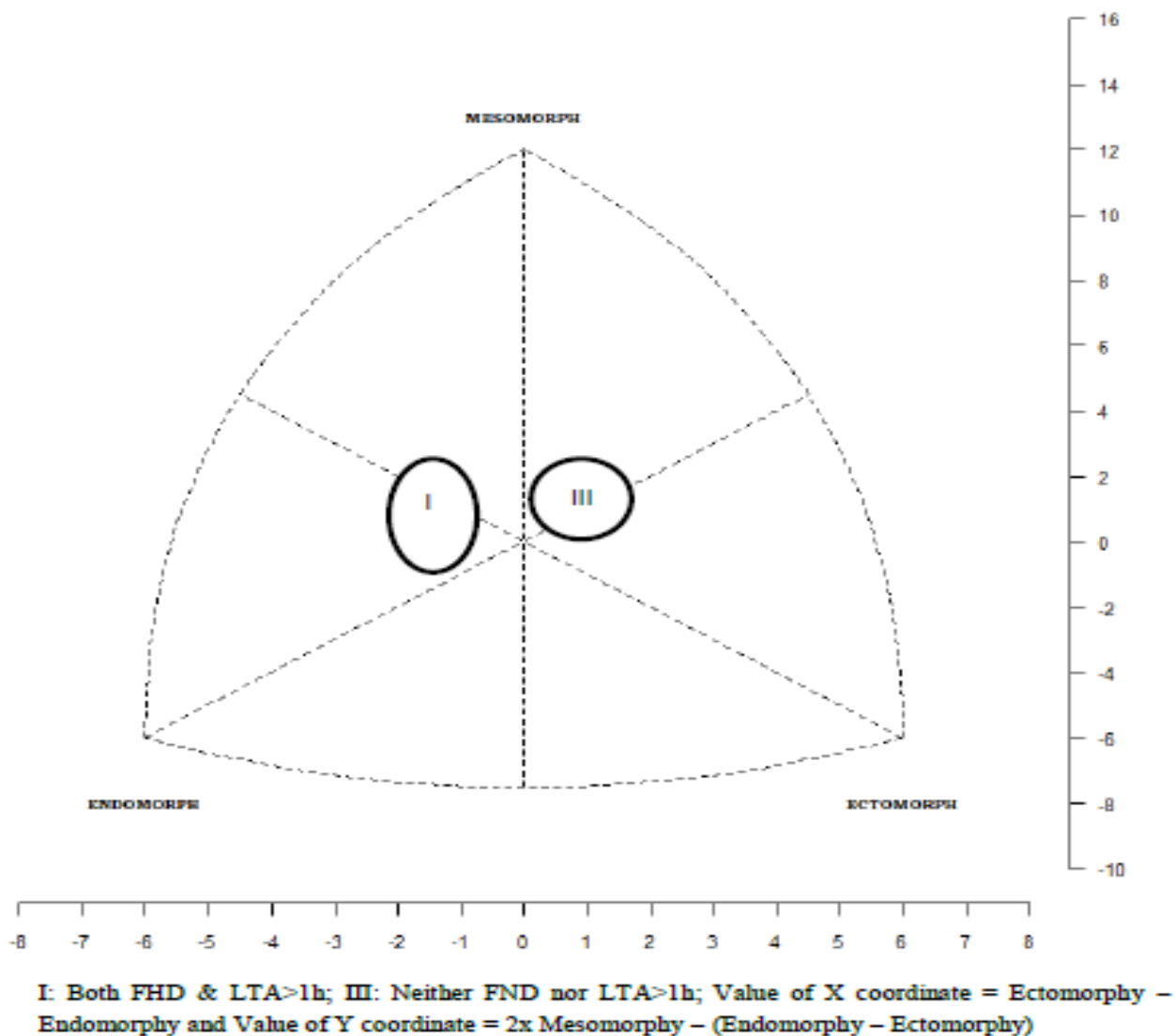Group I: Both-FHD & LTA; Group II: Either-FHD or LTA; Group III: Neither-FHD nor LTA.   *Statistical differences in overall somatotype tested by MANCOVA, with age as the covariate; differences in BMI (body mass index), WC (waist circumference), body fat, somatotype components determined by ANCOVA, with age as the covariate; LTPA – leisure time physical activity, SD – standard deviation, p – probability, and η2 is the partial eta squared value explaining the effect size.

In MANCOVA test, statistically significant differences were noticed in the combined somatotype components between LTA levels, after controlling for age in both children and adolescent, irrespective of sex. Among children, the significant difference between groups on the combined somatotype components after controlling for age for males were Wilks' λ = 0.349, p < 0.001, and partial η² = 0.409, indicating that ~40% of the total variance is explained by FHD+LTA>1h out of the total variance in the model. Similarly among girls, the difference between groups had significant difference on the combined somatotype components were Wilks' λ = 0.334, p < 0.001, and partial η² = 0.414 explaining ~42% of the total variance by FHD+LTA out of the total variance in the model as shown in Table II.

Table III. Descriptive and inferential statistics of the studied adolescents by FHD & LTA

Adolescents	Group I Mean ($\pm$ SD)	Group II Mean ($\pm$ SD)	Group III Mean ($\pm$ SD)	Wilk's λ	F value	P	Partial η^2
Boys (688)	244	157	287				
BMI (kg/m^2)	19.92 (3.68)	19.79 (4.60)	19.49 (3.93)		9.99	< 0.001	
WC (cm)	68.88 (9.00)	69.65 (9.56)	66.72 (10.19)		5.798	0.003	
Body fat (%)	28.98 (4.56)	27.04 (5.03)	24.66 (5.55)		47.71	< 0.001	
Endomorphy	6.04 (1.11)	4.28 (1.42)	2.69 (0.71)		666.93	< 0.001	
Mesomorphy	4.12 (1.38)	5.05 (1.53)	3.80 (1.38)		37.68	< 0.001	
Ectomorphy	2.81 (0.93)	3.69 (1.44)	4.86 (1.14)		21.28	< 0.001	
Somatotype*				0.256		< 0.001	0.486
Girls (691)	243	182	266				
BMI (kg/m^2)	19.50 (3.47)	18.85 (3.29)	18.97 (3.44)		2.383	0.093	
WC (cm)	68.16 (9.72)	68.63 (9.43)	67.91 9.96		0.293	0.746	
Body fat (%)	29.80 (4.86)	27.14 (5.02)	26.74 (5.94)		23.45	< 0.001	
Endomorphy	5.71 (0.98)	4.05 (1.15)	2.73 (0.73)		627.65	< 0.001	
Mesomorphy	4.22 (1.39)	4.85 (1.45)	4.08 (1.47)		16.206	< 0.001	
Ectomorphy	2.82 (1.05)	4.00 (1.71)	4.62 (1.47)		104.28	< 0.001	
Somatotype*				0.301		< 0.001	0.451

Group I: Both-FHD & LTA>1h; Group II: Either-FHD or LTA>1h; Group III: Neither-FHD nor LTA>1h. *Statistical differences in overall somatotype tested by MANCOVA, with age as the covariate; differences in BMI (body mass index), WC (waist circumference), body fat, somatotype components determined by ANCOVA, with age as the covariate; LTPA – leisure time physical activity, SD – standard deviation, p – probability, and η2 is the partial eta squared value explaining the effect size.

Figure 1: Somatochart of the children and adolescents by groups.

I: Both FHD & LTA>1h; III: Neither FND nor LTA>1h; Value of X coordinate = Ectomorphy – Endomorphy and Value of Y coordinate = 2x Mesomorphy – (Endomorphy – Ectomorphy)

Similarly, among adolescents, as shown in Table III, , the significant difference between groups on the combined somatotype components after controlling for age for males were Wilks' $\lambda = 0.256$, $p < 0.001$, and partial $\eta^2 = 0.486$, indicating that ~49% of the total variance is explained by FHD+LTA>1h out of the total variance in the model. Similarly among girls, the difference between groups had significant difference on the combined somatotype components were Wilks' $\lambda = 0.301$, $p < 0.001$, and partial $\eta^2 = 0.451$ explaining ~45% of the total variance by FHD+LTA out of the total variance in the model. It was found that FHD+LTA was significantly associated with somatotype and explained almost half of the total variance after controlling for age, and irrespective of sex. The somatochart with mean somatotype of the groups are illustrated in Figure 1. It clearly indicates that children with both FHD+LTA > 1h had developed more endomorphic physique – a sign of relative fatness than children with neither FHD nor LTA > 1h group who had more ectomorphic physique – a sign of leanness.

DISCUSSION

Sedentary lifestyle perhaps mediated through LTA which require less or no physical activity at all had increased over last the two decades. It is the most leading modifiable risk factors for poor cardiovascular health and all-cause mortality worldwide (Lavie et al., 2019). Adapting sedentary lifestyle during childhood and adolescent has stronger modifying effect later on activity patterns. Significant association were found between low levels of activity and high risk factors

of CVD in children driven by body fat composition (Tanha et al., 2011). In a nation-wide survey in Germany it was found that children with congenital heart disease (CHD) had significantly lower physical activity (Siaplaouras et al., 2020). Manifestation of metabolic syndrome in adulthood usually starts from early childhood. Development of obesity and sedentary lifestyle are known to represent major contributing factors (Olsen et al., 2017). Children across the globe, now-a-days are spending most of their leisure time indoors with less or no physical activity at all, as compared to the past. They are spending more time in watching television, surfing internet and smart phones, and playing video games, which hardly require any physical activity (Pathak et al., 2021). The World Health Organization has recommended recommends 60 minutes of moderate to vigorous-intensity physical activity on regular basis, for children (WHO, 2021). Unfortunately, only one-fifth of the children are estimated to meet the guidelines. The transition from childhood to adulthood is a developmentally sensitive time during which if adopted sedentary behaviour, may lead to overweight, which last further into later adulthood and perhaps making them more vulnerable to lifestyle-driven co-morbidities (Anderson & Butcher, 2006) than children with physically active behaviour.

Family history of chronic disease (FHD) is not only a risk factor for the disease but is also significantly associated with risk reducing behaviours and risk awareness. Moreover, lower cost, greater acceptability, and reflection of shared genetic and environmental factors makes the study of FHD more advantageous over other genomic tools (Valdez et al., 2010). In clinical medicine, family history has been recognized as an important, yet non-modifiable disease risk factor that when present the probability of a suspected diagnosis might get influenced.

The present study was therefore undertaken to find out the synergistic effect of FHD + LTA on adiposity and cardiovascular health among the Bengali children and adolescent. It was found that children and adolescent with both positive FHD and LTA > 1 hour (i.e. more leisure activities with less or nor physical activity at all had significantly higher BMI, % body fat, and endomorphy- a sign of relative fatness than those who neither had FHD nor LTA >1 hour. Conversely, children and adolescent having neither FHD nor LTA>1 hour had significantly higher Ectomorphy – a sing of leanness than their counterparts, irrespective of sex. This shows that FHD when coupled with sedentary activity during childhood and adolescent disrupts the adiposity and body composition and it further indicates that children and adolescent with FHD & LTA >1 hour having significantly higher fat mass could lead to greater susceptibility of chronic diseases. Since, the health consequences do persist into adulthood it therefore increases the susceptibility towards greater risk of metabolic syndrome, CVD, and diabetes later in adulthood (Yeung et al., 2010). Longer duration of LTA was found to be significantly associated with poor cardiovascular health and marked endomorphy has been found to be associated with such co-morbidities (Buffa et al., 2007).

CONCLUSION

The present population-based study confirms that children (below 10 years) who were spending long hours of leisure-time with no or limited physical activity had adverse cardiovascular health as manifested through somatotypes. Children spending more leisure time had significantly higher endomorphy than their counter, irrespective of sex. This could severely affect their cardiovascular health by the time they reach adulthood and could become more susceptible to chronic diseases. Hence, early intervention of physical activity level and its promotion among the children is of utmost importance for withstanding against the future threat of CVD risk among them.

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CONFLICT OF INTEREST

The authors declare that they do not have any conflicts of interest among them.

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The study involved no external funding.

AUTHORS CONTRIBUTION

Puja Pathak did the necessary field work, data collection, verification and data entry. Anup Adhikary provided necessary instrumental support and somatotype calculation. Mithun Das primarily designed the study, did necessary statistical analyses, and writing of the manuscript.

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