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Cardiovascular Disease Risk Factors and Socioeconomic Status: A Cross Sectional Study of Children and Adolescents from Western India

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Abstract

Background: Socio-economic status isknown to possess an inverse relationship with cardiovascular disease risk. *Aims:* We aimed to investigate the prevalence of cardiovascular disease risk factors in children and adolescents of Western India and examine its association with the socio-economic status of the population. *Materials and Methods:* In this cross sectional, observational study,3543 children and adolescents of 4-18 years of age were enrolled. Blood pressure (BP), body mass index (BMI) and anthropometric parameters were recorded according to the standardized protocols. Details of socio-economic status (SES), physical activity and stress were obtained from a questionnaire for each individual. Based on the SES, study population was divided into–group I (low-middle SES) and group II (high SES). *Results:* Overall, the prevalence of prehypertension, hypertension, sedentary life style and type A personality was 14.6%, 33.9%, 58.2%, 53.7% respectively. Obesity was observed in 13.4% and 22.3% of the individuals were malnourished. Prevalence of hypertension (35.21 vs 28.53%), obesity (7.44% vs 2.1%), high waist circumference (WC-58.82±20.34 vs 53.78±15.74) andhigh mid-arm circumference (MAC-21.87±5.3 vs 20.11±5.77) weresignificantly higher in group II as compared to group Ipopulation. *Conclusion:* The study observation suggests deadly coexistence of hypertension, obesity, sedentary life style and stress in Gujarati Asian Indian children and adolescents. These risk factor prevalence was more in population from high socio-economic class.These observations would contribute in development of appropriate preventive public health policy to efficiently manage these health and social issues early in life.

Keywords: Gujarati Asian Indians; Children; Adolescent; Risk Factors; Socio-Economic Status, Cardiovascular Disease.

Introduction

A strong foundation of health behaviours and approaches is established during the formative years of childhood and adolescent. It is also evident that prevalence of life style risk factors such as obesity, poor nutritional habits and sedentary life style in childhood years denotes great tendency for the development of non-communicable diseases in adulthood [1]. Epidemiological evaluation of cardiovascular diseases (CVD) due to demographic shift in the population age profile combined with life style, supports the concept of atherosclerosis inception in childhood [2].

India is a country having greatest young man power, where population below the age of 18 constitutes around 35% of the whole population. According to ICMR and WHO, by the year 2020 India will witness CVD epidemic and will have considerable annual income loss due to mortality and morbidity associated with CHD [3].

In contrast to their Caucasian counterparts a decade early onset of CVD in Indians had been reported by many which enforces the need for health promoting educational interventions [4]. Rise in prevalence of risk factors like hypertension, obesity, smoking, alcohol consumption and lack of physical activity could be blamed for the CHD epidemic in Indians [5].

The socio-economic status (SES) of an individual often contribute significantly for the development of CVD as obesity, chronic malnutrition, hypertension and diabetes are often associated with the socio-economic condition [6]. Several studies from high-income settings have investigated the association between socio-economic position and cardiovascular risk in children and adolescents, and found an inverse association between SES and adiposity, however no clear association was observed with other conventional cardiovascular risk factors [7]. In India, 32.7% of the population are belonging to the extremely low socio-economic class, where malnourishmentprovides possible link to CVD.

The present study was designed to evaluate the prevalence of risk factors of non-communicable diseases in children and adolescents of Gujarati Asian Indian community. We also aimed to investigate the influence of SES of an individual on various risk factors.

Materials and Methods

Design and Data Collection

To determine prevalence of various risk factors of non-communicable disease in children and adolescents, we designed population-based epidemiological study at U.N. Mehta Institute of cardiology and research centre, Gujarat. The study was approved and cleared by institutional ethics committee (UNMICRC/CARDIO/14/62). A total of 3543 children and adolescents from 50 public and private schools of Gujarat state who were ranging in age 7-18 years were prospectively enrolled in the study. The data regarding parental education, occupation and family income along withother demographic characteristics of students were collected according to the pre-standardised questionnaire. The study population was categorized into two groups (group I – lower and middle class; group II – high class) based on the socio-economic status as per Prasad's guidelines (2013). Race-ethnicity was determined by self-identification in response to a questionnaire [8].

Physical Examination

After collecting the questionnaires, data of anthropometric parameters (height, weight, waist- and mid-arm circumference) and blood pressure were measured using standard techniques for each student by trained observers using previously reported methodology. Weight was measured by making each student stand on the bathroom weighing machine straight, without their shoes, all pockets empty and nearest 100 gram was taken into consideration.

Height was measured by makingthe child stand erect, heels, buttocks and back in contact with the height measuring rod. Waist measurement (WC) was performed using a non-stretch steel tape measure at the mid-point of lower ribs and iliac crest in mid expiration in standing position. Mid arm circumference (MAC) measurements were taken in centimetres with non-elastic tape to the nearest 0.1 mm on the upper left arm (halfway between the acromion process and the olecranon process). The children/adolescent stood relaxed with his/her side to the trained technician and the arm hanging freely at the side; the tape was passed around the arm at the level of the mid-point of the upper arm. Weight height ratio (WHtR) was determinedby dividing waist circumference by height.

Blood pressure (BP) was recorded using a standard mercury sphygmomanometer with the subject seated and rested for five minutes. At least two readings at 5 minute interval were recorded and in case of an abnormal reading, another reading was obtained after 30 minutes. A paediatric cuff was used for those with circumferences equal to or smaller than 22 centimetres. In this way, we ensured that the cuff covered two-thirds of the length of the upper arm. Systolic and diastolic BP were defined on the basis of phase-1 and phase-5 Korotkoff sounds, respectively.

Elevated BP was defined as BP levels greater than 95th percentile by gender, age, and height based on tables for Indian children. Basal metabolic rate (BMI - kg/m2) was calculated as weight (kg) divided by thesquare of the height (m^2). Children with 95th percentile of BMI were taken as cut-off point. Children with BMI more than this cut-off point with respect to age and sex were considered as obese.

Data Analysis

The collected data was entered into Microsoft Excel spreadsheet and statistical analysis was performed using Statistical Package for Social Sciences (SPSS) software version 20 (Chicago, IL, USA) for Windows. Quantitative data was expressed as mean±SD whereas qualitative data was expressed as percentage.

Univariate analysis of the continuous data was performed using student's t-test, whereas chi-square test was used for the categorical data.

Results

The demographic and clinical characteristics of overall study cohort is presented in Table 1. Out of 3543 individuals having mean age of 13±1.97 years, 59.4% were male and 40.5% were females. The prevalence of prehypertension and hypertension was 14.6% and 33.9% respectively, whereas sedentary life style and type A personality was recorded in 58.2% and 53.7% of the population. Based on BMI 22.3% of the children and adolescent were malnourished and were underweight. Higher spectrum of BMI was observed in overall 13.4% of the study cohort as prevalence of overweight and obesity was found in 6.8% and 6.4% of the population respectively. Table 2 compares the distribution and prevalence of risk factors of non-communicable diseases in students of lower-middle and higher income group.Results showed that hypertension (35.21%), overweight (7.89%), obesity (7.44%), WC (58.51±20.49 cm)and MAC (22.2±7.81 cm) were significantly (p=0.0012, p<0.0001 and p<0.0001) higher in group II as compared to group I (hypertension – 28.53%; overweight – 2.25%, obesity – 2.1%, WC-53.64±15.67 cm, MAC-20.56±10.15 cm). In the same line, mean systolic BP (117.8±14.5 vs 113.45 ± 13.52; p<0.0001) and diastolic BP (72.58±12.9 vs 74.63±12.4; p<0.0001)were also elevated in students of higher socio-economic class. However WHtR, sedentary life style (p=0.3167) and stress (p=0.7566) were comparable in both the groups. The shunted growth of the population of group I was reflected in terms of lower mean height weight and BMI of the students and hence the only risk factor found significantly prevalent in group I was low BMI as compared to group II (32.28% vs 19.95%; p<0.0001). The evaluation of risk factors found in children and adolescent are tabulated in Table 3. More children were underweight (34.6% vs 21.8%) whereas more number of adolescent were obese (6.7% vs 2.3%) and hypertensive (34.2% vs 27.8%). Moreover adolescent were carrying higher burden of more than one risk factor as the students having all four risk factors were all adolescent. Effect of gender on the risk factors distribution are presented in Table 4.

Table 1:

Variables	Total (3542)
Age	13 ± 1.97
Children	133 (3.8)
Adolescent	3409 (96.2)
Gender	Males- 2105 (59.43%) Females- 1437 (40.57%)
Height (cm)	150.39 ± 13.61
Weight (kg)	43.05 ± 52.518
BMI (kg/m^2)	18.28 ± 4.3
Underweight	789 (22.3%)
Normal	2284 (64.4%)
Overweight	242 (6.8%)
Obese	228 (6.4%)
Waist Circumference (cm)	57.87 ± 19.65
Mid Arm Circumference (cm)	21.54 ± 5.44
Waist Height Ratio	0.384 ± 0.123
WHR	488 (13.77%)
Systolic BP(mm Hg)	117.8 ±14.5
Diastolic BP (mm Hg)	74.25 ± 12.5
Normal BP	1822 (51.4%)
Prehypertensive	518 (14.6%)
Hypertensive	1203 (33.9%)
Personality Type	A- 1639 (46.2%) B- 1904 (53.7%)
Sedentary Life	2064 (58.2%)

Table 2:

Variables	Group I (n=666; 18.8%)	Group II (n=2876; 81.2%)	Significance
Age	11.45 ± 1.92	13.36 ± 1.98	<0.0001
Children	118 (17.7)	15 (0.5)	<0.0001
Adolescent	548 (82.3)	2861 (99.5)	<0.0001
Gender	Males- 360 (54.05%) Females- 306 (45.94%)	Males- 1130 (39.27%) Females- 1745 (60.65%)	<0.0001
Height (cm)	140.11 ± 11.97	152.77 ± 12.85	<0.0001
Weight (kg)	37.22 ± 53.67	44.40 ± 52.93	0.0017

BMI (kg/m²)	16.31 ± 3.36	18.73 ± 4.33	<0.0001
25	14.22	15.78	
50	15.61	17.8	
75	17.76	20.8	
Underweight	215 (32.28%)	574 (19.95%)	<0.0001
Normal	422 (63.36%)	1862 (64.72%)	0.539
Overweight	15 (2.25%)	227 (7.89%)	<0.0001
Obese	14 (2.1 %)	214 (7.44%)	<0.0001
Waist Circumference (cm)	53.78 ± 15.74	58.82 ± 20.34	<0.0001
25	50	50	
50	57	63	
75	63	73	
Mid Arm Circumference (cm)	20.11 ± 5.77	21.87 ± 5.30	<0.0001
25	18	20	
50	19	22	
75	22	25	
Systolic BP(mm Hg)	113.45 ± 13.52	118.81 ± 14.53	<0.0001
25	104	109	
50	112	118	
75	121	128	
Diastolic BP (mm Hg)	72.58 ± 12.9	74.63 ± 12.4	<0.0001
25	65	67	
50	71	74	
75	79	81	
Normal BP	382 (57.35%)	1440 (50.05%)	0.0008
Prehypertensive	94 (14.14%)	424 (14.73%)	0.7267
Hypertensive	190 (28.53%)	1013 (35.21%)	0.0012
Personality Type	A- 304 (45.6%) B- 362 (54.35%)	A- 1335 (46.4%) B- 1542 (53.6%)	0.724
Sedentary Life	376 (56.46%)	1688 (58.67%)	0.296
No risk factor	114 (17.12%)	393 (13.66%)	0.0257
1 risk factor	552 (82.88%)	2483 (86.33%)	0.0257
2 risk factor	129 (19.36%)	829 (28.8%)	<0.0001
3 risk factor	54 (8.12%)	348 (12.1%)	0.0043
4 risk factor	1 (0.15%)	36 (1.25%)	0.021

Table 3:

Variables	Children (N=133)	Adolescent (N=3409)	P value
Female	52(39.1%)	1385(40.6%)	0.792
Male	81(60.9%)	2024(59.4%)	
Public	118(88.7%)	548(16.1%)	<0.0001
Private	15(11.3%)	2861(83.9%)	
Height (cm)	128.93±8.708	151.22± 13.077	<0.0001
Weight (kg)	25.23±6.80	42.82±13.62	<0.0001
BMI (kg/m²)	14.95±2.54	18.91±28.78	<0.0001
Underweight	46 (34.6%)	742(21.8%)	0.0021
Normal	84(63.2%)	2200(64.5%)	0.8156
Overweight	03(2.3%)	239(6.7%)	0.0503
Waist Circumference (cm)	50.69±13.69	58.12±19.85	<0.0001
Mid Arm Circumference (cm)	18.13±2.66	21.89±8.41	<0.0001
Waist Height Ratio	0.393 ± 0.10	0.384 ± 0.124	0.3684
WHR	10 (7.52%)	478 (14.02%)	0.0448
Systolic BP(mm Hg)	108.41±12.48	118.17±14.45	<0.0001
Diastolic BP (mm Hg)	70.49 ± 15.61	74.39 ± 12.36	<0.0001
Normal BP	79 (59.4%)	1742 (51.1%)	0.1677
Prehypertensive	17(12.8%)	501(14.7%)	0.6256
Hypertensive	37(27.8%)	1166(34.2%)	0.1522
Personality type	71(53.4%)	1832(53.7%)	0.9939
	62(46.6%)	1577(46.3%)	
Sedentary lifestyle	84 (63.2%)	1980 (58.1%)	0.2823
No risk factor	18 (13.53%)	489 (14.34%)	<0.0001
1 risk factor	115 (86.47%)	2920 (85.66%)	<0.0001
2 risk factor	31 (23.31%)	927 (27.19%)	<0.0001
3 risk factor	13 (9.8%)	389 (11.41%)	<0.0001
4 risk factor	0 (0)	37 (1.09)	<0.0001

Table 3:

Variables	Female (N = 1437)	Male (N = 2105)	P Value
Age	12.91 ± 1.93	13.05 ± 1.99	
Children	52 (3.6)	81 (3.8%)	0.7929
Adolescent	1385 (96.4%)	2024 (96.2%)	
Public	306 (21.3)	360 (17.1%)	0.002
Private	1131 (78.7)	1745 (82.9%)	
Height (cm)	148.10 ± 11.32	151.95 ± 14.77	< 0.0001
Weight (kg)	40.97 ± 12.64	42.98 ± 14.54	< 0.0001
BMI (kg/m^2)	18.38 ± 4.29	18.20 ± 4.27	0.524
Underweight	300 (20.9%)	488 (23.18)	0.1143
Normal	931 (64.9%)	1353 (64.3%)	0.7818
Overweight	097 (6.8%)	145 (6.9%)	0.9265
Obese	109 (7.6%)	119 (5.7%)	0.0375
Waist Circumference (cm)	57.93 ± 18.97	57.84 ± 20.10	0.8935
Mid Arm Circumference (cm)	21.40 ± 5.15	21.63 ± 5.62	0.2162
Waist Height Ratio	0.39 ± 0.12	0.38 ± 0.124	0.0176
WHR	213 (14.82%)	275 (13.06%)	0.0159
Systolic BP(mm Hg)	116.75 ± 13.82	118.53 ± 14.90	< 0.0001
Diastolic BP (mm Hg)	73.93 ± 12.42	74.47 ± 12.58	0.2074
Normal BP	791 (55%)	1030 (48.9%)	0.0004
Prehypertensive	179 (12.5%)	339 (16.1%)	0.003
Hypertensive	467 (32.5%)	736 (35.0%)	0.1374
Personality type	798 (55.5%) 639 (44.5%)	1105 (52.5%) 1000 (47.5%)	0.0807
Sedentary lifestyle	888 (61.8%)	1176 (55.9%)	0.0005
No risk factor	210 (14.61%)	297 (14.12%)	0.7098
1 risk factor	1227 (85.38%)	1808 (85.59%)	0.7098
2 risk factor	386 (26.86%)	572 (27.17%)	0.8676
3 risk factor	167 (11.62%)	235 (11.16%)	0.7132
4 risk factor	22 (1.53%)	15 (0.7%)	0.029

Discussion

To the best of our knowledge this is the first ever large cross sectional study designed to investigate the prevalence of modifiable risk factors of non-communicable diseases in apparently healthy, disease free Gujarati Asian Indian children and adolescent cohort. We aimed to provide some of the most relevant findings in terms of specific risk factors involved with SES of the study group.

Elevated BP, either systolic or diastolic at any age, in either sex is a contributor for all forms of CVD [9]. According to this study results,alarming high number (33.9%) of Gujarati children and adolescents suffer from undiagnosed prehypertension and hypertension which was greatly associated with higher SES. Reports from various ethnic groups showedinterlinking between socioeconomic differences, blood pressure and BMI as noted in the current study also [10,11]. Age appropriate blood pressure values tend to be more among boys than girls throughout childhood and adolescence as documented by many [12]. Though not clearly studied the mechanism behind this could be increased levels of androgens in boys. Studies using ambulatory blood pressure monitoring techniques in children showedthat with increasing age, blood pressure increases in both boys and girls [13]. However, after the onset of puberty, boys have higher blood pressure than do age-matched girls [14]. The Gujarati children and adolescent showed high degree of correlation between obesity and hypertension. The strong association of BMI and hypertension was explained by John F Hall by the fact that chronic obesity causes structural changes in kidneys that eventually leads to loss of nephron functions, further increasing arterial pressure [15]. Though statistically not different (p=0.1677) incidence of hypertension, significantly higher mean value (p<0.0001) of isolated BP in adolescent establishes the fact that it has roots in childhood for the development of hypertension. Dalili et al. showed that BP in Indian children is closely related to mid-arm circumference which is in concordance with our study as indicated by ROC analysis [16].

We have observed that paediatrics with low socio-economic background had higher cases of undernourishment, whereas high socio-economic class was significantly associated with overweight and obesity. Other observational studies have shown that the high socioeconomic position in adults is associated with behaviourssuch as smoking and high fat diets that may increase the risk of CVD, whereas the long term effect of under-nutrition, higher incidence of chronic inflammation, psychological stress and greater usage of high carbohydrate diet in earlylife are some of the proposed mechanisms for the associationof low BMI with low socio-economic group [17].

Our study results reports that obesity prevalence was higher in girlsas compared to boys which could be contributed by the sedentary life style and obesity. However other factors could be the influence of gonadal steroids on body composition, appetitebehavioural, socio-cultural and chromosomal factors. In developing countries like India lesser consumption of milk could also be playing role in obesity in girls.

The detection of obesity during childhood is more difficult than during adulthood due to developmental changes occurring in children. Hence, along with BMI other anthropometric indices are needed to describe accurately the body fat distribution as BMI merely indicates body fat reservoir. A number of prospective studies have shown that adiposity, especially central adiposity and mid upper arm circumference in childhood and adolescence is linked to adverse cardio-metabolic riskprofile and metabolic consequences such as negative lipid profile, hypertension and insulin resistance in later life [18]. There hasbeen recent interest in the use of the waist-to-height ratio (WHR) for identifying excessive central adiposity in children and adolescents [19].

It has been suggested that a WHR ≥ 0.5, irrespective of age, sex or ethnicity, is a valid predictor of higher cardio-metabolic risk [20]. Children with a WHR ≥ 0.5, had two tofive times higher odds of cardio-metabolic risk co-occurrence compared to children who had a WHR <0.5 and children who were overweight or obese had two to four times higher odds compared to normal weight children. A relation between BMI, WHR and cardio-metabolic risk was earlier reported in US adolescent and young adults also [21].

As reflected in results of obesity higher SES was strongly associated with higher waist, mid arm circumference and WHR suggesting overall higher body fat content in this population. One of the key finding of the study was the population being affected by all five risk factors were more female, adolescent and were from affluent families. These finding were supported by various individual studies, where gender, age and socioeconomic status driven risk factors distribution was observed.

Conclusion

Developing countries like India are facing dual burden of under nutrition and overnutrition.From this study results it is clearly evident that prevalence of hypertension and obesity are directly associated with socio-economic status of the children and adolescent in India, providing support to the existing literature.

Additionally, the recorded inverse relationship between lower-middle socio-economic class andlow BMIshows impending nutrition transition happeningin India, a pattern that has a socio-economic dimension. This recommends an urgent need to improve maternal and childhood nutrition to prevent childhood stunting and malnutrition related diseases.

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