Assessment of risk factors for hypertension and obesity among adolescents

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Abstract

Introduction: The rising trend of non-communicable diseases (NCDs) globally and their associated mortality and morbidity, with a shift to the younger population is a matter of concern.

Objective: To study the risk factors for hypertension and obesity among adolescents

Design and setting: Hospital based cross sectional study in the paediatric outpatient department (OPD) of a tertiary care hospital.

Subjects: Adolescents in the age group 10-18 years presenting to the paediatric OPD from 13th January 2013 to 14th December 2014.

Results: There were 218 such adolescents of whom 51% were female. Of the 218, 37% had a family history (F/H) of hypertension, 27% a F/H of diabetes mellitus, 17% a F/H of obesity, 17% a F/H of cardiovascular diseases and 4% a F/H of cerebrovascular accidents. There was a history of passive smoking in 41%, consumption of aerated drinks in 73% and fast food consumption in 92%. Tobacco consumption was recorded in 1.8% and alcohol consumption in 2.9%. Fifteen (6.9%) subjects were found to be overweight and one (0.4%) subject was obese. Twenty two (10%) had systolic hypertension and 23 (10.5%) diastolic hypertension. BMI had a significant correlation with systolic and diastolic hypertension.

Conclusions: Fast food consumption was present in 92% of adolescents and physical activity with duration less than 30 minutes in 44.5% of adolescents in this study. BMI was significantly associated with both systolic and diastolic hypertension in this study.

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Introduction

Non-communicable diseases (NCDs) such as diabetes, hypertension, cardiovascular diseases, stroke, obesity, dyslipidaemia and malignancy account for 60% of deaths and 47% of the global burden of disease[1]. Prevalence of childhood hypertension is noted to be 5-10% in developing countries and 1-2% in developed countries[2]. In India, adolescents account for almost 20% of its population[3]. Risk factors like fast food consumption, low physical activity, high level of experimentation with alcohol and smoking have led to a high prevalence of obesity and hypertension in adolescents[4]. All these risk factors are preventable and modifiable.

Moderate to vigorous physical activity like brisk walking, dancing, swimming or cycling, if done regularly (≥3 times per week) decreases risk of NCDs by weight loss, reduction of visceral fat with lowering of blood pressure and improved glucose control by increased insulin sensitivity[5]. Tobacco use among adolescents can be initiated by its use by elders in the family, peer influence, experimentation, underlying emotional and psychological factors, risk taking behaviour and aggressive marketing stratergies[6]. Family history of hypertension is an important non modifiable risk factor for hypertension[7]. Having a parent with non-insulin dependent diabetes mellitus (NIDDM) increases two to fourfold an offspring's chance of developing this condition[8].

Objectives

To study the risk factors for hypertension and obesity among adolescents.

Method

This study was conducted in the paediatric outpatient department (OPD) of Sri Guru Ramdas Institute of Medical Sciences & Research (SGRDIMSR), Amritsar, a tertiary care centre in India, from 13th January 2013 to 14th December 2014. Adolescents aged 10-18 years attending paediatric OPD during the study period, after taking informed consent from their parents or guardian, were enrolled. Study was approved by the Ethics Committee of SGRDIMSR. Children suffering from chronic cardiovascular, respiratory, endocrine, musculoskeletal and renal disorders, obesity due to hereditary, genetic and metabolic

disorders and children on medication known to affect blood pressure were excluded from the study.

It was a cross sectional hospital based study. A pretested structured, close ended questionnaire was used for data collection after explaining in vernacular language. Questionnaire sought information regarding demographic details, dietary practices, physical activity, time spent on television, video games, computer, history of smoking, family history of hypertension, diabetes, obesity, stroke or malignancy in parents. Weight was recorded with minimal permissible clothes with accurate standard electronic weighing scale with a precision of ±10 grams. Height was measured with stadiometer to the nearest 0.1 cm. BMI was calculated using the formula weight (kg) /height (m^2). According to CDC 2000, BMI for gender and age >85th percentile was considered overweight and BMI >95th percentile was considered obese[9]. Blood pressure was recorded in the right arm in the sitting position with appropriate cuff size by auscultatory method with sphygmomanometer. Sufficient time was given to allay anxiety and fear. First and fifth phases of Korotkoff sounds was taken as systolic and diastolic blood pressure. Two more measurements were taken at 15 and 30 minutes and mean of three readings was taken as final observation. BP was classified as normal, prehypertension, stage 1 and stage 2 hypertension with respect to age, sex and height percentile[10].

Observations were expressed as frequency distribution. Statistical significance was evaluated using Pearson's Chi-square and, Student's t-test. Comparison of mean BMI across stages of SBP and DBP was carried out by using one way ANOVA. All analysis were performed using SPSS 18.0 (SPSS Inc) software and statistical significance was evaluated at 5% value.

Results

Two hundred and eighteen adolescents in the age group 10-18 years were enrolled for the study. Of them 107 (49%) were male and 111 (51%) were female. One hundred and fifty three (70%) were in the 10-14 year age group. Males outnumbered females in 10-14 year age category whereas females outnumbered males in the over 14 year age category. Majority of participants were of normal stature but 37% had short stature. Whilst 78% of participants had a normal BMI, around 15% were underweight and 07% were overweight. Distribution of age, stature and BMI according to gender is shown in Table 1. Distribution of participants according to risk factors and risk score within family is shown in Table 2.

Table 1: ***Distribution of age, stature and BMI according to gender***

	Male *(n=107)* **Number (%)**	**Female** *(n=111)* **Number (%)**	**Total** *(n=218)* **Number (%)**
Age (years)			
10-14	93(86.9)	60 (54.1)	153 (70.1)
>14	14 (13.1)	51 (45.9)	65 (29.9)
Stature (cm)			
<5th centile	33 (30.8)	48 (43.2)	81 (37.2)
5th-95th centile	74 (69.2)	62 (55.9)	136 (62.3)
>95th centile	0 (0)	01 (0.9)	01 (0.5)
Body mass index (BMI)			
Underweight (<5th centile)	19 (17.8)	13 (11.7)	32 (14.7)
Normal (5th-84th centile)	80 (74.8)	90 (81.1)	170 (78.0)
Overweight (85th-95th centile)	08 (07.4)	07 (06.3)	15 (06.9)
Obese (>95th centile)	0 (0)	01 (0.9)	01 (0.4)

Table 2: ***Distribution according to risk factors and risk score within family***

Risk factors	**Number (%)**	**Risk score**	**Number (%)**
Hypertension	81 (37.2)	0	46 (21.1)
Cardiovascular disease	38 (17.4)	1	76 (34.9)
Diabetes mellitus	60 (27.5)	2	53 (24.3)
Cerebrovascular accident	09 (04.1)	3	35 (16.0)
Obesity	37 (17.0)	4	07 (03.2)
Passive smoking	90 (41.3)	5	01 (0.5)

Family history of passive smoking, hypertension and diabetes mellitus were the 3 most common risk factors (Table 1). Forty six (21%) had no family history of risk factors and a risk score of zero. Whilst 76 (35%) of the participants had a risk score of one, 96 (44%) had risk scores ranging from 2 to 5. Distribution of participants according to physical activity and dietary habits is shown in Table 3.

Table 3: ***Distribution of participants according to physical activity and dietary habits***

	Male *(n=107)* **Number (%)**	**Female** *(n=111)* **Number (%)**	**Total** (n=218) **Number (%)**
Physical activity duration: <30 mins	48 (44.9)	49 (44.1)	97 (44.5)
30 mins or >	59 (55.1)	62 (55.9)	121 (55.5)
Type of activity: Indoor	-	-	42 (19.3)
Outdoor	-	-	176 (80.7)
Fast food consumption: No	13 (72.2)	05 (27.8)	18 (08.3)
Yes	94 (47.0)	106 (53.0)	200 (91.7)
Frequency: 3-6 days/week			115 (57.5)
Daily			85 (42.5)
Type of diet: Vegetarian	-	-	100 (45.9)
Non vegetarian	-	-	118 (54.1)
Aerated drinks: No	-	-	58 (26.6)
Yes	-	-	160 (73.4)
Frequency: 0-2 days/week			81 (50.6)
3-6 days/week			76 (47.5)
Daily			03 (01.9)

There was no gender difference in the duration of physical activity. Two hundred 200 (92%) children consumed fast food, 85 (42.5%) consuming them daily. History of aerated drink consumption was present in 160 (73%) subjects of whom 76 (47.5%) consumed them 3-6 times per week. BMI and its relation to various factors is shown in Table 4.

Table 4: ***BMI and its relationship to various factors***

	BMI		**p value**
	<85th centile	**≥85th centile**	
Family history of obesity: Absent	167	14	
Present	35	02	0.8814
Duration of activity min / day	54.38 ±15.37	43.94 ±18.60	0.0188 9 (<0.05)
Meal skipped: Absent	104	11	
Present	98	05	0.284
Fast food consumption: Yes	17.90 ± 2.552 (mean ± SD)		
No	17.76 ± 2.999 (mean ± SD)		0.0819

Family history of obesity and skipping of meals were not significantly associated with BMI. Mean duration of physical activity was significantly higher in those with lower BMI ($p<0.05$). Consumption of fast food did not have a significant correlation with BMI. Distribution of participants according to systolic and diastolic blood pressure is shown in Table 5.

Table 5: ***Distribution of participants according to systolic and diastolic blood pressure***

Blood pressure centile	**Male** (n=107) **Number (%)**	**Female** (n=111) **Number (%)**	**Total Number (%)**	**P value**
Systolic blood pressure (mm Hg)				
<90th (normal)	96 (89.7)	90 (81.1)	186 (85.3)	
90th-95th (Prehypertension)	07 (06.5)	03 (02.7)	10 (04.5)	0.011 (<0.05)
96th–99th (Stage 1 hypertension)	03 (02.8)	09 (08.1)	12 (05.5)	
>99th (Stage 2 hypertension)	01 (0.9)	09 (08.1)	10 (04.5)	
Diastolic blood pressure (mm Hg)				
<90th (normal)	88 (82.2)	90 (81.1)	178 (81.6)	
90th-95th (Prehypertension)	07 (06.5)	10 (09.0)	17 (07.8)	0.832 (>0.05)
96th–99th (Stage 1 hypertension)	09 (08.4)	07 (06.3)	16 (07.3)	
>99th (Stage 2 hypertension)	03 (02.8)	04 (03.6)	07 (03.2)	

Majority of the subjects had normal systolic and diastolic blood pressures. Females outnumbered males in stage 1 and 2 systolic hypertension. The distribution of participants in relation to systolic BP stages between two genders was statistically significant. Difference of diastolic BP between males and females was not statistically significant. The association of systolic/diastolic BP with BMI, risk score and physical activity is shown in Table 6.

Table 6: ***Association of SBP/DBP with BMI, risk score and physical activity***

	Normal	Pre-hypertension	Stage 1	Stage 2	p value
BMI (kg/m^2)					
mean ± SD (SBP)	17.69 ± 2.277	17.45 ±3.596 18.39	19.05 ± 3.778	20.72 ± 3.510	0.001
mean ± SD (DBP)	17.64 ± 2.362	± 3.608	18.72 ± 2.366	21.62 ± 3.558	0.002
Risk score					
< 2 (SBP)	148	07	11	09	
3-4 (SBP)	37	03	01	01	0.436
>5 (SBP)	01	0	0	0	
< 2 (DBP)	138	15	15	07	
3-4 (DBP)	39	02	01	0	0.691
>5 (DBP)	01	0	0	0	
Physical activity					
Indoor (SBP)	39	02	0	01	0.288
Outdoor (SBP)	147	08	12	09	
Indoor (DBP)	36	0	03	03	0.083
Outdoor (DBP)	142	17	13	04	

SBP: Systolic blood pressure DBP: Diastolic blood pressure BMI: Body mass index SD: Standard deviation

Maximum mean BMI (20.72 ± 3.510) was observed for stage 2 systolic hypertension and minimum mean BMI (17.45 ± 3.596) was observed for pre-hypertension. Using one way ANOVA method, relation between BMI and systolic BP categories was found to be significant (p =0.001). Similarly maximum mean BMI (21.62 ± 3.558) was observed in stage 2 diastolic hypertension and minimum mean BMI (17.64 ± 2.362) was observed in subjects with normal DBP. Relation between BMI and DBP stages was significant (p =0.002).

Systolic and diastolic BP did not show a significant association with risk score categories using Pearson's Chi square test resulting in p values of 0.436 and 0.691 respectively. Systolic and diastolic BP did not show a significant association with type of physical activity (indoor or outdoor) resulting in p values of 0.288 and 0.083 respectively. Table 7 shows SBP/DBP categories according to BMI, diet and family history of hypertension.

Table 7: ***SBP/DBP categories according to BMI, diet and family history of hypertension***

	Normal	Pre-hypertension	Stage 1 HT	Stage 2 HT	p value
BMI					
≤ 85th centile (SBP)	178	08	10	06	<0.0001
> 85th centile (SBP)	08	02	02	04	
≤ 85th centile (DBP)	170	15	14	03	<0.0001
> 85th centile (DBP)	08	02	02	04	
Diet					
Vegetarian (SBP)	90	04	05	01	0.0364
Non-Vegetarian (SBP)	96	06	07	09	
Vegetarian (DBP)	85	04	10	01	0.3172
Non-Vegetarian (DBP)	93	13	06	06	
Family history of HT					
Yes (SBP)	118	05	10	09	0.8091
No (SBP)	68	05	02	06	
Yes (DBP)	111	09	13	04	0.8956
No (DBP)	67	08	03	03	

Obtained using Chi square test

SBP: Systolic blood pressure DBP: Diastolic blood pressure BMI: Body mass index HT: Hypertension

BMI centile showed a highly significant association with various stages of SBP and DBP. Association of SBP with type of diet was significant whereas the association of DBP with type of diet was not significant. No statistically significant association was observed between family history of hypertension and SBP/DBP.

Discussion

Increasing prevalence of NCDs due to rapid urbanisation and globalisation in India is a cause of great concern. A rising trend is being observed in adolescents with its serious consequences in future adulthood. It is pertinent to investigate preventable risk factors in order to implement integrated preventive strategies.

Gender distribution of 218 adolescents enrolled in the present study was almost equal and 153 (70%) were in 10-14 year age group. Similar gender distribution was observed by SV Mane *et al* in 2012[11]. AK Singh *et al* and Ali Khuwaja *et al* observed slight preponderance of boys[4,12]. One hundred and twenty one subjects fulfilled the requirement of physical activity of more than 30 minutes as per WHO recommendations and there was no significant difference in males and females. Shah *et al* in 2005 in a study done across 81 regions of India showed inactivity levels as 12.6% in males and 18.9% in females[13].

SV Mane et al in 2012 observed a F/H of diabetes in 30% adolescents, a F/H of hypertension in 26.5% and a F/H of heart diseases and obesity in 20.5% each[11]. AK Singh *et al* in 2006 reported a F/H of hypertension in 50% each of boys and girls and a F/H of obesity in 23% of boys and 30% of girls[4]. In the present study, 37% had a family history (F/H) of hypertension, 27% had a F/H of diabetes mellitus, 17% a F/H of obesity, 17% a F/H of cardiovascular disease and 4% a F/H of cerebrovascular accidents. AK Singh *et al* in 2006 and Khan H *et al* in 2010 reported a positive correlation of hypertension in those adolescents who had positive F/H of hypertension[4,14]. No significant association was found between a F/H of hypertension and BP profile of adolescents in the present study.

Joshi H et al 2014 reported that 23.5% adolescents consumed junk food twice or more per week[15]. In the study by Rani et al 2013, 85% students reported eating fast food with 22% eating it for more than three days a week[16]. In our study 200 (91.7%) adolescents consumed fast food with a frequency of 3-6 times per week in 57.5% and daily consumption in 42.5%. A matter of grave concern was that fast food consumption was in addition to their regular meals in 145 out of 218 adolescents in the present study. In the present study, 106 (53%) girls had a history of fast food consumption compared with 94 (47%) boys. Ranjit et al 2010 and Vereecken et al 2005 made observations to the contrary[17,18]. Smoking prevalence has varied from 8.8% to 13.1% in different studies[19]. Tobacco consumption was low (1.8%) in the present study. Alcohol consumption was recorded in 2.9% in our study. A higher prevalence (7.4%) was reported by Tsering et al in 2010[20].

Overweight and obesity was found in 3.1% and 2.1% respectively by Bharati et al 2008[21]. Out of 218 adolescents, 15 subjects (6.88%) were found to be overweight with equal distribution among both genders. Only 1 subject (0.4%) was obese. Chandla et al in 2009 revealed similar prevalence as was found in present study[22]. Laxmaiah A et al 2007 reported higher prevalence in females (8.2%) as compared to males (6.1%)[23]. A higher prevalence of overweight and obesity was reported by AK Singh et al 2006 (18.6% boys and 16.5% girls)[4]. Lack of correlation of fast food consumption and obesity in present study was probably because duration of physical activity as recommended by WHO was fulfilled by half of the study population.

Out of 218 subjects, 22 (10%) had systolic hypertension. Females outnumbered males (18 vs 4) and the difference was statistically significant. Diastolic hypertension was detected in 23 subjects (10.5%) but gender difference was not significant. Prevalence of hypertension of 8.5% has been reported by Demirci H et al 2013[24], 5.4% by Patel et al 2014[25], 9.78% by Khan M et al 2010[13] and 10.91% by Borade et al 2011[26]. Durrani et al 2011 found lower prevalence of hypertension in boys (9.36%) as compared to girls (9.4%)[27]. Lower prevalence in females (11.76%) has been reported as compared to boys (13.79%) by Lone et al 2015[28]. Association between systolic and diastolic hypertension and family history of hypertension was not statistically significant in present study. However AK Singh et al 2006 highlighted such association in their study[4]. Family history of obesity which was present in 37% of subjects was not statistically significant in relation to both systolic and diastolic hypertension in present study. BMI had a statistically significant correlation with SBP/DBP. Systolic Prehypertension was found in 10 (4.5%) and diastolic prehypertension was found in 17 (7.75%) subjects. Similar observations were made by Patel et al in 2014[25]. Higher prevalence of 15.7% and 24.5% was reported by Mc Niece KL et al 2007 and Madhavikutty Amma GD et al 2015[29,30]. AK Singh et al 2006 found more prevalence in males (11.82%) than females (3%) and overall prevalence of systolic hypertension was lower (7.84%)[4]. High prevalence of isolated systolic hypertension (37.4%) was reported by Khan M I et al 2010[14].

Conclusions

- Fast food consumption was present in 92% of adolescents in this study.
- Physical activity with duration less than 30 minutes was present in 44.5% of adolescents in this study.
- Systolic and diastolic hypertension were detected in 10% and 10.5% subjects respectively.
- BMI was significantly associated with both systolic and diastolic hypertension in this study.

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