Human Biology Review (ISSN 2277 4424) 1(3) 2012
Original scientific paper (Kaur and Mehta pp 235-247
Revised and accepted on 07.07.2012

Prevalence of hypertension and its association with body fat percentage among government and private schoolgirls in Ludhiana

Jaspreet Kaur* and Promila Mehta**

*Govt. College for Women, Ludhiana
**Department of Human Biology, Punjabi University Patiala.

Corresponding author: Jaspreet Kaur, Govt. College for Women, Ludhiana
Email: Jaspreet71@gmail.com

ABSTRACT

Primary hypertension among children and adolescents is on the rise. To analyze the prevalence of primary hypertension in children and its association with body fat percentage, a study was conducted where 1049 girls aged between 10-16 years studying in private schools and government schools were examined. The study was based on the premise that the girls in private schools belong to more affluent families as compared to their counterparts in government schools. The body density was determined by using appropriate regression equations given by Durnin and Wormersley (1974) and body fat percentage was calculated from body density equation by using Siri (1961) criteria. Blood pressure was recorded and prevalence of hypertension was determined by using the fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents suggested by U.S. Department of health and human services (2004). This study found that the systolic and diastolic blood pressure of richer girls from private schools was higher than their relatively poorer counterparts studying in government schools. The difference between the systolic blood pressure of these groups was significantly higher at all age groups in private school girls and similarly diastolic blood pressure difference was significant at all age groups except at 14 years with the private school girls showing higher values as compared to the government school girls. The private school girls also possessed higher body fat percentage than government school girls. Positive association of increase in blood pressure with increase in body fat percentage was also found.

Keywords: Hypertension, Body fat, Schoolgirls, Ludhiana, Life style, Social stratification

INTRODUCTION

Developing countries like India are undergoing demographic and socioeconomic transition. This rapidly changing scenario has resulted into epidemiological transition where the nation is struggling with the dual burden of under and over nutrition. In our country, the economic transition has increased the availability of food and purchasing power which has resulted in over nutrition in neo rich populations leading to overweight, obesity and many life style disorders (Jafar et al., 2005; Rao et al., 2007; Singh et al., 2007; Sidhu and Prabhjot, 2007; Kaur et al. 2009a, 2009b, Kaur and Mehta, 2012). The often ignored but potentially dangerous malady of hypertension has been on the rise all over the world. The trend has been highly marked amongst the adolescents because of a variety of reasons, the most common ones being the increasing popularity of fast foods and lack of exercise, with T.V and computer having stolen the space of outdoor activities. These lifestyle trends lead to increased incidence of obesity and overweight amongst school going children. Once considered rare, primary hypertension in children has been increasingly common in association with obesity and overweight as reported in a study on rural Canadian children by Salvadori et al. (2008) and on Brazilian children by Ferreira and Aydos (2010). The role of hypertension, especially at a young age, as a risk factor for cardiovascular and cerebrovascular diseases later on in life is well documented (WHO Expert Committee Report, 1978; Yamani and Massie, 1994; and Petrovich et al., 1995). There is, however, very little data available on the incidence of sustained hypertension as on date even though population based epidemiological studies have conclusively shown primary hypertension to be predominant among apparently healthy children (Hari et al., 2000). Further, it is important to find a relation between prevalence of hypertension and the lifestyle of an individual as hypertension is known to be a lifestyle related disease.

With these aims in mind, this study undertook to determine the hypertension and association of hypertension with body fat in adolescent school going girls in Ludhiana with their socio economic status.

MATERIAL AND METHODS

The present study is based on a cross sectional sample of 1049 school going girls between 10-16 years of age, residing in urban Ludhiana (Punjab). It is a well known fact that girls studying in private school girls are from sound socioeconomic background as economically weaker families

cannot afford to send their children to expensive schools and usually send their children to government schools. In this study the blood pressure of the government and private school going girls was taken along with the body density, which was determined by using appropriate regression equations given by Durnin and Wormesley (1974). The body fat percentage was calculated from body density equation given by Siri (1961).

By using the fourth report on the diagnosis, evaluation and treatment of high blood pressure in children and adolescents suggested by U.S. Department of Health and Human Services (NHBPEP, 2004) criteria, the subjects of the study were characterized as non hypertensive, prehypertensive and hypertensive according to the B.P percentiles.

For interpretation of hypertension, children below 90^{th} percentile were considered normal; between 90^{th} - 95^{th} percentile pre hypertensive. Blood pressure equal to or exceeding 120/80 mmHg was considered pre hypertension, even if this figure was less than the 90^{th} percentile. Blood pressure greater than the 95^{th} percentile was considered Stage-I hypertension and above 99^{th} percentile was considered Stage-II hypertension. For the purpose of finding relationship between body fat and hypertension, the children above 90^{th} percentile were included in hypertensive category.

The mean pressure for establishing the relationship between body fat and hypertension was calculated by using the following formula:

MAP= {(2 × diastolic blood pressure) + systolic blood pressure} / 3

RESULTS AND DISCUSSION

The present study is based on the premise that the girls in private and government schools belong to distinctly different socioeconomic strata. It was seen during interaction with these girls that those studying in private schools belong to relatively affluent families as compared to their counterparts in government schools who mostly came from lower end of the socioeconomic strata.

Comparison of Hypertension profile of government and private school girls:

Tables 1 and 2 show the comparison of systolic and diastolic blood pressure between 10-16 years. The results indicate that private schoolgirls show higher values of systolic and diastolic blood pressure at all age groups studied. The difference between the systolic blood pressure of

these groups is significant at all age groups and diastolic blood pressure difference is significant at all age groups except at 14 years.

In the private school girls, the percentage of pre- hypertensive girls as per systolic blood pressure (90-95th percentile of NHBPEP reference tables) was found between 2.19% and 30% with the lowest (2.19%) being at 10 years of age and the highest of 30% at 15 years of age. The percentage of hypertensive girls (>95th percentile) was the highest (11.1%) at 13 years and the lowest (3.29%) at 10 years. These results were in contrast to those of government school girls where the percentage of pre-hypertensive children was between 1.53% and 8.10% with the lowest being at 10 years and the highest at 14 years. The comparison of percentage of hypertensive children (>95th percentile NHBPEP reference tables) between the two groups also yielded marked differences, with the highest being 9.45% at 15 years in private school girls and the lowest being as low as 0% at 10 years of age in case of government school girls (Table 4).

Table 1 Systolic blood pressure (mm of Hg) of girls studying in private and government schools

SYSTOLIC BLOOD PRESSURE (mm of Hg)										
Age Group (Years)	**PRIVATE**				**GOVERNMENT**				**D**	**t-value**
	N	**Mean**	**SD**	**SEM**	**N**	**Mean**	**SD**	**SEM**		
10	91	96.64	11.94	1.25	65	88.72	13.30	1.65	7.92	3.89**
11	66	105.97	17.15	2.11	75	96.33	15.41	1.78	9.64	3.51**
12	66	110.55	9.64	1.19	82	95.17	14.56	1.61	15.38	7.37**
13	72	113.19	12.46	1.47	100	97.93	14.60	1.46	15.26	7.18**
14	65	112.22	8.53	1.06	74	106.68	16.18	1.88	5.54	2.47*
15	70	121.54	5.59	0.67	74	104.95	14.16	1.65	16.59	9.16**
16	71	117.89	9.50	1.13	65	110.43	12.37	1.53	7.46	3.96**

* $p< 0.5$, ** $p< 0.001$ D- actual difference

The values of diastolic blood pressure in case of pre-hypertensive girls in private schools increased from 3.29% to 27.77% with the lowest at 10 years and the highest at 13 years of age. The percentage of hypertensive girls (>95th percentile NHBPEP reference tables) in this group was the highest (30%) at 15 years and the lowest (3.29%) at 10 years of age (Table4).

Table 2 Diastolic blood pressure (mm/Hg) of girls studying in private and government schools

DIASTOLIC BLOOD PRESSURE (mm of Hg)										
Age Group (Years)	PRIVATE				GOVERNMENT				D	t-value
	N	Mean	SD	SEM	N	Mean	SD	SEM		
10	91	61.47	8.8	0.92	65	56.71	14.05	1.74	4.76	2.60*
11	66	72.70	8.84	1.09	75	66.27	12.58	1.45	6.43	3.47**
12	66	72.62	8.25	1.02	82	64.26	10.29	1.14	8.36	5.36**
13	72	73.64	9.60	1.13	100	66.60	11.21	1.12	7.04	4.31**
14	65	72.78	7.54	0.94	74	71.11	11.88	1.38	1.67	0.98
15	70	79.94	4.68	0.56	74	70.62	10.75	1.25	9.32	6.68**
16	71	77.18	6.56	0.78	65	72.34	8.89	1.10	4.84	3.64**

* p< 0.5, ** p< 0.001 D- actual difference

The comparison of diastolic blood pressure of pre-hypertensive girls of both types of schools was not as contrasting as in case of hypertensive girls (>95th percentile NHBPEP reference tables) .The percentage of hypertensive girls studying in private schools was maximum (15.27%) at13 years and minimum (3.29%) at10 years (Table 4). In government

school girls, these values were much lower (lowest 1.53% at 10 years and highest 13.51% at 14 years).

Body fat in relation to hypertension:

The body fat percentage was calculated by Siri (1961) equation using density estimation by Durnin and Wormesley (1974) linear regression equations. The values obtained were on higher side and therefore used for comparing the fatness of private and government school girls (Table 3).

Table 3 Body fat percentage of girls studying in private and government schools

Age Group years	Type of school		Body fat % According to Siri's equation (1961)			D	t-value
		N	M	SD	SEM		
10	Private	91	27.72	6.87	0.72	9.72	10.01*
	Government	65	18	4.42	0.55		
11	Private	79	31.14	6.26	0.7	10.98	11.22*
	Government	75	20.16	5.85	0.68		
12	Private	66	35.24	5.79	0.71	13.09	14.23*
	Government	82	22.15	5.37	0.59		
13	Private	72	33.7	6.32	0.75	9.81	10.85*
	Government	100	23.89	5.49	0.55		
14	Private	65	32.52	5.7	0.7	6.97	6.96*
	Government	74	25.23	6.53	0.76		
15	Private	70	35.25	5.78	0.69	9.07	9.59*
	Government	74	26.18	6.72	0.78		
16	Private	71	36.1	5.84	0.69	7.9	7.70*
	Government	65	28.82	5.09	0.63		

* $p < 0.001$ D - actual difference

The mean body fat percentage of hypertensive group was observed between 24.28% to 34.61% according to Siri's equation. The maximum fat percentage was recorded at 15 years in this group.

Table 4. Percentage of pre-hypertensive, hypertensive-1 and Hypertensive 11 private and government school girls According to NHBPEP guidelines(2004). NHBPEP (National High Blood Pressure Education Program) – *Pediatrics*

AGE IN YEARS	**TYPE OF SCHOOL**	**Systolic Blood Pressure**			**Diastolic Blood Pressure**		
		Pre-hypertensive	HT-1*	HT-11**	Pre-hypertensive	HT-1*	HT-11*
10	PRIVATE	2.19	3.29	0	3.29	3.29	0
	GOVT	1.53	0	0	7.69	1.53	0
11	PRIVATE	5.06	3.79	6.32	20.25	3.79	6.32
	GOVT	4	6.66	1.33	4	5.33	5.33
12	PRIVATE	16.66	3.03	3.03	19.69	9.09	6.06
	GOVT	3.65	3.65	0	7.31	6.09	0
13	PRIVATE	4.16	5.55	5.55	27.77	11.11	4.16
	GOVT	2	1	3	10	10	1
14	PRIVATE	7.69	4.61	1.53	13.84	7.69	1.53
	GOVT	8.10	4.05	2.70	17.56	13.51	0
15	PRIVATE	30	10	1.42	21.42	30	0
	GOVT	4.05	6.75	2.7	24.32	10.81	0
16	PRIVATE	16.9	2.81	1.40	25.35	11.26	0
	GOVT	6.15	3.67	1.53	24.61	6.15	0

(*Hypertension stage-1, **Hypertension stage-11)

The average body fat percentage of non hypertensive group was found to be between 23.63% and 32.52 %. Maximum body fat in this group was recorded at 16 years.

The comparison of body fat percentage of hypertensive and non hypertensive group is shown in Table 5. The hypertensive group had higher body fat percentage as compared to non hypertensive group. These differences are statistically significant in all age groups except at 16 years.

Table 5: Body fat percentage of Hypertensive and non hypertensive group (Siri criteria, 1961)

Age Group (Years)	Hypertensive group				Non hypertensive group				D	t-value
	N	Mean	SD	SEM	N	Mean	SD	SEM		
10	10	24.28	9.75	3.08	146	23.63	7.52	0.62	0.65	9.21**
11	43	29.28	8.46	1.29	110	24.39	7.65	0.72	4.89	3.94**
12	28	34.07	7.61	1.43	120	26.57	8.16	0.74	7.50	2.43*
13	32	34.01	7.68	1.35	139	26.57	6.86	0.58	7.44	7.42**
14	29	29.44	7.32	1.35	110	28.43	7.11	0.67	1.01	5.58**
15	47	34.61	6.31	0.92	97	28.64	6.89	0.69	5.97	3.18**
16	15	33.41	7.45	1.92	121	32.52	6.49	0.59	0.89	1.25

* p< 0.01, **p< 0.001 D - actual difference

However, all these findings are in marked variance to certain other studies on adolescent children where the prevalence of hypertension varied from 0.5% to 2% (Agarwal et al., 1983; Gupta and Ahmad, 1990; Chadha et al. 1999). In a study conducted by Mohan et al. (2004) the prevalence of sustained hypertension in urban school going children from Ludhiana was found to be as high as 6.69% whereas Anjana et al. (2005) found the prevalence of hypertensive children as 7.5% in Amritsar. Similarly this high trend witnessed in the present study could probably be a reason for the increasing incidence of cardiovascular diseases among adults. Lifestyle changes and increasing obesity amongst adolescents, especially from affluent families, could be a

contributing factor towards this increasing prevalence of hypertension. The significant difference between private and government school girls could be attributed to the higher consumption of junk food and relatively sedentary lifestyle of the more affluent private school girls.

A positive correlation was found between the body fat percentage and hypertension at all age groups and in both the study groups, i.e. private and government school girls (Figure 1). The hypertensive group possessed higher body fat than non hypertensive group. The difference between the mean body fat percentages is statistically significant at all ages except at 16 years. The maximum differences between the body fat percentage of hypertensive and non hypertensive groups was observed at 12 and 13 years and minimum difference was found at 10 years. This inference appears to be in agreement with a majority of the studies conducted worldwide to study the correlation of high body fat percentage or BMI with hypertension in children. Most of the studies found adolescent or preadolescent children with higher BMI to be at a higher risk for hypertension (Ribeiro et al., 2003; Uscategui et al., 2003; Pandher et al., 2004; Sorof et al., 2004; Moura, 2004; Mohan et al., 2004; Manzoli et al., 2005; Monyeki et al., 2006; Soudarssanane et al., 2006; Rojas et al., 2006; Raj et al., 2007; Singh et al., 2007; Sidhu and Prabhjot, 2007; Taksande et al., 2008; Badaruddoza et al., 2009; Costanzi et al. 2009; Ferreira and Aydos, 2010). An extensive study by Rao et al. (2007) found that prevalence of high blood pressure increased with increasing levels of BMI, weight, triceps skin fold thickness and per cent body fat. Jafar et al. (2005), after studying White and Pakistani children in U.S.A concluded that South Asian children had higher body mass adjusted B.P levels as compared to that of White children. One of the most important and worrying trends is that the number of children falling prey to the malady of hypertension in Ludhiana and its surroundings has been fast increasing in the recent past as is seen from the results of some studies conducted in this region (Verma et al., 1994-1.1%; Mohan et al., 2004-6.69%; Anjana et al., 2005-7.5% and an even higher prevalence in this study). This clearly shows the negative impact of changing lifestyles and dietary habits on the children of our society.

Increased body fat and hypertension is becoming a hallmark in the urban elite of Ludhiana whose consequences would lead to increased mortality and morbidity. The epidemic of increasing body fat and hypertension in children as a result of faulty lifestyle is bound to

manifest itself in adult population too. The mushrooming of heart care and slimming centers is an additional evidence of a scary picture of lifestyle diseases.

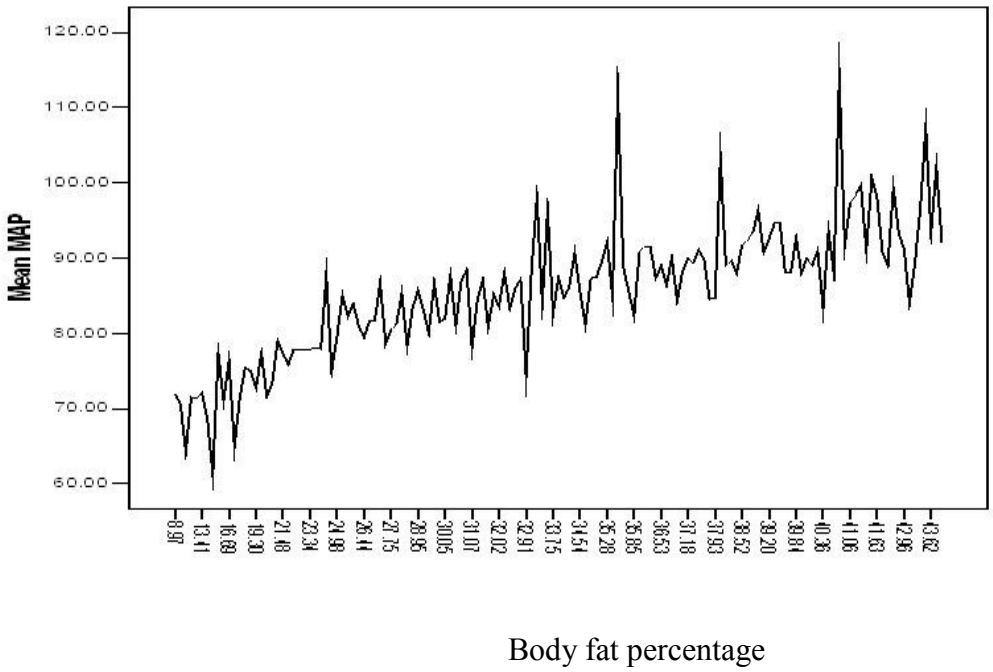

Figure 1: Regression lines for relationship between body fat percentage and Hypertension according to Siri Criteria, 1961.

The comparative data clearly delineates that primary hypertension is an increasing malady of affluent populations; A problem which need immediate attention of researchers, doctors and policy makers.

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