The Internet Journal of Family Practice
Volume 7 Number 2

Impact of weight, height and age on blood pressure among school children

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Citation

A Patel, D Saxena, H Shah, V Sharma, D Singhal. *Impact of weight, height and age on blood pressure among school children*. The Internet Journal of Family Practice. 2008 Volume 7 Number 2.

Abstract

Present study was carried out among 500 school children (250 boys and 250 girls) above the age of 9 years from two randomly selected primary schools after selection of one zone randomly out of six administrative zones of Surat city. Objective of the study was to determine the strength of association and the variability of blood pressure (BP) with weight, height and age amongst school children. Correlation coefficient of Systolic blood pressure (SBP) with weight, height and age were 0.34, 0.32 and 0.24 respectively, while for Diastolic blood pressure (DBP) for the same variable it was 0.33, 0.22 and 0.03 respectively. All the correlation coefficients were found significant except for DBP with age. It was also found that the body weight was most significant predictor of BP. Hence by maintaining the body weight from early childhood , hypertension in community can be controlled.

INTRODUCTION

Blood pressure (BP) is the force exerted by the blood flow against unit area of the vessel wall. The arterial blood pressure is given as the product of the cardiac output and the total peripheral resistance. The three physiological determinants of blood pressure are stroke output, elasticity of the vessels and the peripheral resistance. The BP is controlled by the nervous and humoral mechanisms [1] . Most studies have found that BP levels in childhood are associated with several factors like age, sex, weight, and height. [23] Several studies have estimated association between BP and weight, height and age. But very few workers worked out a quantitative analysis of association between them. [456] Keeping this in mind, the present study was conducted to explore the presence or absence of any such association and the relative influences of the three anthropometric variables on BP levels, when all these are changing together in childhood and adolescence.

MATERIAL AND METHODS

The study subjects in the present study were children (9 years and above) of two primary schools from Surat city. Out of six administrative zones of the city, one zone was selected randomly . Considering limited logistics and needed assistance two primary schools were selected one each Surat municipal corporation governed schools and the other private run school from the selected zone by using simple random sampling technique. The objective of selection was to yield a total sample size of 500 children (250 boys and 250 girls) from both the school .

Permission to carry out the above study was obtained from the concerned authorities. The purpose and process of the study was explained to all the participants and school authorities. Age was verified from the school records and various measurements (height, weight, blood pressure) were taken by using standard techniques. To minimize instrumental and inter observers variation , all measurements on a single subject was carried by same investigator and instruments were calibrated from time to time.

For recording of BP efforts were done to allay anxiety and restlessness by recording the in a separate room for boys and girls. It was recorded in lying down position in right upper arm using a standard mercury sphygmomanometer with cuff of appropriate size. Systolic and diastolic BP was taken to correspond to the appearance and complete absence of Kortokoff’s sounds respectively. Second reading of BP was taken after 10-15 minutes of the first reading. The readings were noted in a pre-designed and pre-tested performa. Out of the two readings of BP, second being lower and more realistic was taken as the subject’s blood pressure. Data analysis was carried out in the computer by SPSS software package using various statistical methods such as Pearson’s correlation coefficients and multiple regression analysis.

RESULTS

In present study, association of weight, height and age with BP was explored and tested for their significance amongst school going children. Correlation coefficients were calculated for both systolic blood pressure (SBP) and diastolic blood pressure (DBP) with weight, height and age. It was calculated for all children and separately for both boys and girls.

Figure 1

Table 1: Correlation coefficients of systolic/diastolic blood pressure with weight, height and age

Explanatory variable	Systolic blood pressure (SBP)			Diastolic blood pressure (DBP)		
	Boys (n=250)	Girls (n=250)	Total (N=500)	Boys (n=250)	Girls (n=250)	Total (N=500)
Weight	0.32*	0.41*	0.34*	0.27*	0.33*	0.30*
Height	0.35*	0.33*	0.32*	0.19**	0.24*	0.22*
Age	0.32*	0.06	0.24*	0.03	0.05	0.03

*Significant at the 1% level
**Significant at the 5% level

The correlation coefficients were positive and highly significant for weight and height. Association of age was highly significant only with systolic blood pressure, though in girls it was not significant. Except for SBP in boys, the values of the correlation coefficients were in descending order for weight, height and age in both sexes .

Figure 2

Table 2: Regression equations for BP on weight, height and age

SBP/DBP for Boys/Girls	Regression equation	Adjusted R^2	F-statistic
Boy SBP	57.78 + 0.14 Weight + 0.14 Height + 0.20 Age	0.15	16.60*
Boy DBP	63.67 + 0.30 Weight – 0.02 Height - 0.06 Age	0.06	7.27*
Girl SBP	78.36 + 0.35 Weight + 0.10 Height - 0.02 Age	0.17	16.49*
Girl DBP	49.39 + 0.29 Weight + 0.06 Height - 0.01 Age	0.09	9.39*

*Significant at the 0.1% level
SBP = Systolic blood pressure
DBP = Diastolic blood pressure

All the linear multiple regression equations for both SBP and DBP in either sex were very highly significant. In all these equations, the coefficient of partial regression for weight was positive and had the highest value, varying from 0.35 for girl SBP to 0.14 for boy SBP. 15 percent or more of the variability in SBP was explained for either sex by weight, height and age. But only 6-9 percent variability in DBP was explained by these three factors. The coefficient for weight was very highly significant for both SBP and DBP in girls, while it was highly significant only for DBP in boys.

Figure 3

Table 3: t- statistics for the coefficients of partial regression in table 2

Explanatory variable	Responsible variable			
	Boy SBP	Boy DBP	Girl SBP	Girl DBP
Weight	1.56	3.26*	4.45**	3.57**
Height	1.49	0.23	1.31	0.72
Age	3.12*	0.89	0.26	0.21

*Significant at the 1% level
** Significant at the 0.1% level
SBP = Systolic blood pressure
DBP = Diastolic blood pressure

However, on drawing the coefficients of partial regression it was found that only in age for boy SBP was found to be highly significant.

DISCUSSION

With objective of finding out presence and strength of association between BP and weight, height and age among children, present study was carried out. It was found that correlation coefficients were positive and highly significant for weight and height. Though association does not mean causation, we might say statistically here that, as child is heavier and taller, higher would be his/her SBP and DBP. For age, correlation coefficient was significant only in boy SBP. In addition, it was seen that the values of the correlation coefficients were in descending order for weight, height and age in both sexes. This shows that weight and height, particularly weight was the best predictor of a child’s BP irrespective of sex and age had the weakest influence on a child’s BP level. A study from Calcutta also reported the same observations [6] . It also gave an idea that everything else remaining constant, an increase in weight would be associated with an increased BP. Other studies [57] had also observed an association of BP in school children with obesity.

For prediction or estimation of the response variable for given values of other explanatory variables, derivation of linear multiple regression equations are necessary. These equations help to assess the relative importance of variables related to response variable. In present study, to assess the relative importance of weight, height and age in relation to child’s BP, linear multiple regression equations were found out for both SBP and DBP in either sex. It was observed that all the equations for both SBP and DBP in both sexes were very highly significant. Adjusted coefficient of determination (R_2) showed that variability in SBP was explained well (15% or more) compared to DBP (6-9 %) by weight, height and age for either sex. It was revealed that weight was statistically only significant positive predictor of

SBP and DBP for either sex except in boy SBP. Other study [6] also reported weight as only significant positive predictor of SBP and DBP for either sex. The positive partial coefficients of regression for weight in all the equations mean that with height and age kept constant the heavier the child the higher would be his/her BP. For height, the coefficients of regression were positive in all the equations except for boy DBP. It means that at the same weight and age, the taller children will tend to have higher BP and it would be reverse in case of DBP in boys. The coefficients of regression for age were negative in all the equations except for boy SBP. It explained that when children at the same weight and height are considered, the older the child the lower would be the BP and the reverse will be for boy SBP.

The phenomenon of tracking demonstrates that the individuals whose BP are initially high, continue in the same track as adults and indicates that the process of development of hypertension sets in at an early age and manifests during childhood. The level of BP in children illustrates a stronger association with body weight than height or age. Also out of the three anthropometric determinants being considered namely weight, height and age, only weight can be brought down for an individual. Therefore it can be concluded that hypertension should be controlled in community by keeping an ideal body weight right from childhood and this strategy would be more cost effective in long run.

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