▼ Journal of Research (Science), Bahauddin Zakariya University, Multan, Pakistan.
Vol.12, No.2, December 2001, pp. 207-213 ISSN 1021-1012

THE EFFECTS OF FAMILY SIZE ON THE RELATIONSHIP OF BLOOD PRESSURE WITH CIRCUMFERENCES IN THE FEMALE STUDENTS OF BAHAUDDIN ZAKARIYA UNIVERSITY, MULTAN, PAKISTAN

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Abstract: A randomly selected sample of 600 female students of Bahauddin Zakariya University, Multan, Pakistan, aged between 18 – 25 years belonging to different socio-economic group was examined. This sample was divided into 5 groups having different family sizes. Mean (± SEM) values for age, arm, waist, neck, total circumferences, systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) in different groups were calculated and it was found that these groups do not differ from each other in these parameters. The correlation coefficients between different independent (age, arm, neck, waist and total circumference) and dependent (SBP, DBP and MAP) variables were also calculated and it was found that age had a strong association ($P < 0.05$; $P < 0.01$; $P < 0.001$) with all type of blood pressure in all the groups. Moreover all the circumferences had a strong relationship ($P < 0.05$ at least) with blood pressure in all the groups except waist circumferences in the family size of < 4. The regression coefficients of age were highly significant for SBP, DBP and MAP in all groups. The regression coefficients of all the circumferences were non-significant ($P > 0.05$) in family size of < 4 individuals, arm circumference in a group having < 10 and arm and waist circumferences in a group having a family size of > 10 whereas these were significant in all other groups ($P < 0.05$ at least). The results of present study demonstrate that neck and total circumferences could be but arm and waist could not be used for the prediction of hypertension in young female having family size of > 4 and < 10 individuals.

INTRODUCTION

Hypertension is one of the major risk factors for stroke and coronary heart disease in adults [Wilson *et al*. 1987]. Ahrens [1979] has reported that high blood pressure is the third most important diet related disease, which is responsible for more than 50% of deaths in developed countries. Moreover, the results of the earlier work suggested that hypertension occurs ten times more frequently in persons 20% or more above their ideal body weight and reduction in body weight decreases blood pressure in obese persons [Kannel *et al*. 1967]. It has been reported that in adults the blood pressure is related inversely to aerobic fitness and directly to fatness especially to fat deposited centrally rather than peripherally [Blair *et al*. 1984].

Body mass index (BMI) and other weight for height indices have stronger association with blood pressure than does either weight alone or skin-fold measurements [Harlan *et al*. 1984]. The use of BMI or different other type of indices poses problems for investigators seeking to determine the average differences in blood pressure associated with given differences

in weight. One of the problems with common weight-height tables and indices is their failure to discriminate between muscle and fat weight in individuals and is based on ideal proportion of weight to height [Hodgdon and Backett 1984]. When people exceed certain cut-off points, they are assumed to be fat. But this assumption is not true for lean individuals who are especially muscular and therefore, weigh more than average people of equivalent height (e.g. players, labors). Conversely, weight-height indices may not identify some individuals who fall within acceptable weight ranges but truly have excess body fat relative to their lean mass [Hodgdon and Backett 1984].

It has been suggested that circumference methods better estimate the percentage of body weight attributable to fat than do weight-height measures [Hodgdon and Backett 1984]. Estimates of percentage body fat are made with equations based on circumference measures typically involving area prone to excess fat accumulation, such as the upper arm, waist and thigh [Hodgdon and Backett 1984].

Social class differences in height and weight of children are well known from many studies in a wide variety of diverse societies. It has been shown that children in least developed countries, socialist countries and capitalist countries vary in the extent of social class differences, but in all studies, the higher the social class, the larger the children [Bogin and MacVean 1978, Johnston 1986, Masscie-Taylor 1985].

Both cross sectional and longitudinal studies in developed and developing countries have shown consistently, an association between obesity and hypertension, independent of age but such type of studies are only few in Pakistan [Khan *et al*. 1993,1994,1996, Mahmud and Khan 1998] mainly deals with BMI. Association of circumferences with blood pressure in population having different family size is not worked out in Pakistan.

This study was carried out to determine the association of age and circumferences (arm, neck, waist and total) with systolic, diastolic and mean arterial blood pressure in families having different family size.

MATERIALS AND METHODS

A sample of 600 female students of Bahauddin Zakariya University, Multan Pakistan, ageing from 18 to 25 years and having different family size (parents and children, 2 – 14) were examined.

The blood pressure (mm Hg) was measured using sphygmomanometer (Hawksly random zero) and stethoscope (Littmann) with standard blood pressure cuff as described by Khan *et al.* [1993]. The first korotkoff sound was considered to be the systolic blood pressure (SBP) and the fourth as the diastolic blood pressure (DBP). The difference between SBP and DBP was pulse pressure (PP) whereas DBP plus one third of PP was taken as mean arterial pressure (MAP).

The circumferences of upper arm, waist and neck were measured in cm with the help of measuring tape as per method of Conway *et al*. [1989].

The measurement in the upper arm was taken at a point where it has maximum circumference, waist was measured at the spot of umbilical chord whereas neck circumference was taken just below the larynx. The sum of all these circumferences was considered as total circumference.

The results are expressed generally as mean ± SEM along-with their ranges and 1st (Q_1) and 3rd (Q_3) quartiles. The basic statistical constants (mean, SEM, Q_1, Q_3) and association indices (correlation and regression coefficients) were calculated using Minitab. The differences were considered significant at $P < 0.05$.

RESULTS

Tables 1-5 present mean ± SEM of all dependent and independent parameters along-with their ranges and Q_1 and Q_3 in a sample of female students having different family size.

The results of the correlation between independent and dependent parameters are shown in Table 6. The table suggests that age is significantly correlated with systolic, diastolic and mean arterial pressure in all the groups ($P<0.05$). The present results also suggest that there is a significant correlation ($P<0.05$ or $P<0.01$ or $P<0.001$) of all the circumferences with systolic, diastolic and mean arterial pressure, except for circumference of waist in family size of < 4 individuals.

The results regarding the regression coefficient between independent and dependent parameters are shown in Table 7. The regression coefficient

Table 1: Descriptive statistics of female students of B.Z. University, Multan having family size of < 4 individuals (n=59).

Parameters	Mean ± S.E.M.	Range	Q_1	Q_3
Age (year)	22.2 ± 0.4	21-26	21-75	22.0
Family income (Rs./month)	6370.0 ± 856.0	3000-10000	3525.0	9250.0
Family size	2.5 ± 0.2	2-3	2.0	3.0
Arm Circumference (cm)	23.4. ± 0.6	19-25	22.75	25.0
Neck circumference (cm)	31.2. ± 0.4	29-33	30.0	32.25
Waist circumference (cm)	82.2 ± 1.8	71-89	77.75	87.25
Total circumference (cm)	136.8 ± 2.8	119-146	130.5	143.0
SBP (mm Hg)	114.3 ± 1.2	97-126	107.5	118.0
DBP (mm Hg)	77.8 ± 1.6	65-90	75.0	85.0
MAP (mm Hg)	90.4 ± 1.3	74-104	85.0	95.0

Table 2: Descriptive statistics of female students of B.Z. University, Multan having family size of < 6 individuals (n=165).

Parameters	Mean ± S.E.M.	Range	Q_1	Q_3
Age (year)	21.0 ± 0.3	18-25	20.0	22.0
Family income (Rs./month)	9773.0 ± 866.0	2000-25000	5000.0	14250.0
Family size	4.75 ± 0.1	4-5	4.25	5.0
Arm Circumference (cm)	23.6. ± 0.4	20-32	22.0	25.0
Neck circumference (cm)	31.0 ± 0.3	28-36	30.0	32.0
Waist circumference (cm)	78.1 ± 1.1	67-103	71.25	82.75
Total circumference (cm)	132.8 ± 1.5	118-162	125.0	138.0
SBP (mm Hg)	115.8 ± 1.2	98-133	105.5	116.0
DBP (mm Hg)	79.6 ± 0.7	65-96	76.0	85.6
MAP (mm Hg)	91.5 ± 0.8	75-108	86.0	97.0

Table 3: Descriptive statistics of female students of B.Z. University, Multan having family size of < 8 individuals (n=174).

Parameters	Mean ± S.E.M.	Range	Q_1	Q_3
Age (year)	21.1 ± 0.2	18-25	20.0	22.0
Family income (Rs./month)	10605.0 ± 922.0	3500-30000	8000.0	17550.0
Family size	6.5 ± 0.1	6-7	6.0	7.0
Arm Circumference (cm)	23.6. ± 0.4	18-34	22.0	25.0
Neck circumference (cm)	31.4 ± 0.2	28-38	30.0	32.0
Waist circumference (cm)	78.7 ± 0.8	62-112	74.0	83.0
Total circumference (cm)	133.6 ± 1.2	110-178	127.0	140.0
SBP (mm Hg)	118.2 ± 1.1	102-140	105.0	125.0
DBP (mm Hg)	79.8 ± 1.0	68-95	75.0	86.
MAP (mm Hg)	93.3 ± 0.7	82-113	85.5	98.0

Table 4: Descriptive statistics of female students of B.Z. University, Multan having family size of < 10 individuals (n=145).

Parameters	Mean ± S.E.M.	Range	Q_1	Q_3
Age (year)	21.6 ± 0.3	19-25	21.0	23.0
Family income (Rs./month)	8705.0 ± 602.0	3500-1500	6000.0	10250.0
Family size	8.5 ± 0.1	8-9	8.0	9.0
Arm Circumference (cm)	23.6 ± 0.3	19-31	22.0	26.0
Neck circumference (cm)	31.5 ± 0.2	23-37	30.0	32.0
Waist circumference (cm)	79.4 ± 0.8	66-105	75.0	84.0
Total circumference (cm)	134.5 ± 1.1	109-175	127.0	142.0
SBP (mm Hg)	118.5 ± 1.0	102-140	106.0	125.0
DBP (mm Hg)	80.8 ± 0.9	72-108	75.0	85.5
MAP (mm Hg)	93.4 ± 1.1	83-121	86.0	99.0

Table 5: Descriptive statistics of female students of B.Z. University, Multan having family size of > 10 individuals (n=57).

Parameters	Mean ± S.E.M.	Range	Q_1	Q_3
Age (year)	21.6 ± 0.3	19-25	21.0	23.0
Family income (Rs./month)	8652.0 ± 1065.0	20000-60000	20000.0	16250.0
Family size	11.0 ± 0.2	10-14	10.0	12.0
Arm Circumference (cm)	23.4. ± 0.4	19-32	21.0	26.0
Neck circumference (cm)	32.6 ± 0.4	27-37	30.0	33.0
Waist circumference (cm)	80.3 ± 1.3	67-105	73.0	84.0
Total circumference (cm)	136.3 ± 1.5	121-168	127.0	142.0
SBP (mm Hg)	120.6 ± 1.2	100-141	110.0	125.0
DBP (mm Hg)	80.6 ± 1.1	73-107	84.0	95.0
MAP (mm Hg)	94.5 ± 1.3	90-130	104.0	115.0

for age and SBP, DBP and MAP are significant for all the groups ($P < 0.05$; $P < 0.01$; $P < 0.001$). The regression coefficients of arm, neck, waist and total circumferences and all the blood pressures are non-significant ($P > 0.05$) in a group having family size of < 4, arm circumference and all type of blood pressure in family size group of < 10 and arm and waist circumference in a group with > 10 individuals. The regression coefficient of all the circumferences and blood pressures are significant ($P < 0.05$ at least).

DISCUSSION

The purpose of this study was to collect basic data about family size, circumferences (arm, waist, neck and total) and blood pressure, including

systolic, diastolic and mean arterial pressure, and to establish relationship between independent (age and circumferences) and dependent (SBP, DBP and MAP) variables in groups having different family size. Moreover, it was also assumed that this association might have a potential in the prediction of hypertension in female students.

Table 6: Correlation coefficient of systolic, diastolic and mean arterial pressure with age, arm, neck, waist and total circumference in female students of B. Z. University, Multan having different family size.

Variable	Age	Arm Circumference	Neck Circumference	Waist Circumference	Total Circumference
<4	(n = 59)				
SBP	0.136[a]	0.262[a]	0.347[b]	0.041[NS]	0.234[a]
DBP	0.125[a]	0.243[a]	0.329[b]	0.093[NS]	0.165[a]
MAP	0.127[a]	0.261[a]	0.273[b]	0.054[NS]	0.136[a]
< 6	(n=165)				
SBP	0.165[a]	0.263[a]	0.113[a]	0.352[b]	0.436[c]
DBP	0.171[a]	0.269[a]	0.119[a]	0.291[b]	0.281[b]
MAP	0.168[a]	0.274[a]	0.109[a]	0.341[b]	0.365[c]
< 8	(n=174)				
SBP	0.142[a]	0.205[a]	0.297[b]	0.214[a]	0.217[a]
DBP	0.147[a]	0.231[a]	0.283[b]	0.175[a]	0.193[a]
MAP	0.136[a]	0.243[a]	0.302[b]	0.186[a]	0.148[a]
< 10	(n=145)				
SBP	0.139[a]	0.169[a]	0.294[b]	0.297[b]	0.355[c]
DBP	0.142[a]	0.158[a]	0.305[b]	0.283[b]	0.342[c]
MAP	0.127[a]	0.146[a]	0.289[b]	0.301[b]	0.437[c]
>10	(n=57)				
SBP	0.137[a]	0.194[a]	0.153[a]	0.215[a]	0.227[a]
DBP	0.162[a]	0.126[a]	0.169[a]	0.192[a]	0.161[a]
MAP	0.138[a]	0.139[a]	0.155[a]	0.203[a]	0.188[a]

NS = Non significant, a = P < 0.05, b = P < 0.01 and c = P < 0.001

Table 7: Regression coefficient of systolic, diastolic and mean arterial pressure on age, arm, neck, waist and total circumference in female students of B. Z. University, Multan having different family size.

Variable	Age	Arm Circumference	Neck Circumference	Waist Circumference	Total Circumference
<4	(n = 59)				
SBP	0.211[a]	0.052[NS]	0.103[NS]	0.083[NS]	0.073[NS]
DBP	0.174[a]	0.061[NS]	0.106[NS]	0.092[NS]	0.067[NS]
MAP	0.192[a]	0.061[NS]	0.112[NS]	0.078[NS]	0.081[NS]
< 6	(n=165)				
SBP	0.245[a]	0.187[a]	0.211[a]	0.201[a]	0.399[a]
DBP	0.264[a]	0.191[a]	0.203[a]	0.209[a]	0.247[a]
MAP	0.228[a]	0.182[a]	0.209[a]	0.213[a]	0.268[a]
< 8	(n=174)				
SBP	0.346[a]	0.213[a]	0.218[a]	0.206[a]	0.263[a]
DBP	0.321[a]	0.218[a]	0.225[a]	0.159[NS]	0.189[a]
MAP	0.336[a]	0.189[a]	0.199[a]	0.201[a]	0.212[a]
< 10	(n=145)				
SBP	0.567[b]	0.162[NS]	0.214[a]	0.215[a]	0.226[a]
DBP	0.436[b]	0.171[NS]	0.195[a]	0.191[a]	0.197[a]
MAP	0.531[b]	0.168[NS]	0.178[a]	0.188[a]	0.179[a]
>10	(n=57)				
SBP	0.419[c]	0.169[NS]	0.191[a]	0.165[NS]	0.197[a]
DBP	0.525[c]	0.112[NS]	0.188[a]	0.131[NS]	0.192[a]
MAP	0.542[c]	0.133[NS]	0.179[a]	0.137[NS]	0.189[a]

NS = Non significant, a = P < 0.05, b = P < 0.01 and c = P < 0.001

It is relatively easy to use tables or indices of weight and height to identify obesity in a population but the problem with common weight-height tables and indices is that they do not discriminate between muscle and fat weight in individuals and are based on an ideal proportion of weight to height. When people exceed some proportion, it is assumed that they are overly fat. However, this assumption could be inaccurate for lean individuals who are muscular and therefore, weigh more then average people of equivalent height. Conversely, weight-height indices may not identify some individuals who fall within acceptable weight ranges but they have excess body fat relative to their lean mass [Conway *et al*. 1989].

Obesity is an important public health problem, which could be reduced by preventive measures in early childhood. Some measurements can provide useful information and most frequently used measurements are weight, height and skinfold (SF) thickness generally triceps and biceps [Poskit and Cole 1977]. Although, the skinfold thickness is very strongly associated with obesity but subjected to higher measuring error, while circumference methods such as those used in present study are better estimates of percentage of body weight attributable to fat than do weight-height measures. If excessive fatness rather than greater weight may be a critical factor influencing physical work capacity and increasing health risks, the accuracy of the circumference method to measure over fatness should be an important concern to public health [Blair *et al*. 1984, Fagard 2000].

The significant correlation of age with SBP, DBP and MAP revealed during present study (Table 6) in all groups, non-significant association of waist circumferences and blood pressure in a group having family size of < 4 individuals and significant correlation of all the circumferences and blood pressure in all other groups partially confirmed the earlier report of Blair *et al*. [1984].

The results of present study regarding regression coefficients between independent and dependent variables (Table 7) indicate that age has significant regression coefficients with all the blood pressures in all groups. Although, arm, waist, neck and total circumference had non-significant regression coefficient with SBP, DBP and MAP in a group having < 4 individuals, arm circumference in < 10 group and arm and waist in a group having family size of > 10. In all other groups regression coefficients are significant ($P< 0.05$ or $P< 0.001$). These results suggest that total circumference had a significant regression coefficient in all the group except a family size of < 4 individuals.

In conclusion, the results of present study demonstrate that neck and total circumference may be used for the prediction of hypertension in stead of and/or along with height-weight and skinfold tables in young female having family size of > 4 and < 10 individuals.

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