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Determinants of blood pressure among *Bidi* workers of Sagar District of Madhya Pradesh, India

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ABSTRACT

For present cross sectional study 253 Bidi workers of 18-75 years of age were selected randomly from 119 household of Bidi workers of district Sagar of M.P. Out of 253 samples 114 were male and 139 were female. A pre tested, semi structure schedule was used for collecting information by physiological and anthropometric measurement. Before taking measurements the instruments were standardized. Technical error of measurement (TEM) was calculated to remove the error. After collecting data, indices were computed and statistical analysis was done by using SPSS 16.0 and MS excel software. Linear bivariate and multivariate regression analysis was done using Systolic and Diastolic blood pressure as dependent variable. The main objective of present study was to find out the extent and determinants of Blood pressure among Bidi worker of Sagar district of M.P. On the basis of systolic blood pressure majority (66.18%) of bidi worker were found as pre hypertensive out of which (39.1%) were male and (33.8%) were female. Only 2.3% of Bidi worker were suffering with hypertensive emergency crises. The highest mean systolic blood pressure (135.0±16.1mmHg) was found among male of 30-34 years of age; whereas among female the highest mean systolic blood pressure (138.6±23.61mmHg) was found among female of above 50+ years of age. According to age wise diastolic blood pressure the mean diastolic blood pressure of male was higher than female in all age group except 40-45 year of age. It can be concluded that majority of Bidi worker (50-60%) were pre hypertensive. A small proportion (2.3%-3.2%) was suffering with hypertensive emergency. As per bivariate and multivariate regression analysis the blood pressure is determined by age, body fat, BMI, body weight, height and BMR.

Keywords: BMI, Blood Pressure, Basal Metabolic Rate, Pulse Rate.

INTRODUCTION:

High blood pressure is common and universal health problem. It varies with the strength of the heartbeat, the elasticity of the arterial walls, the volume and viscosity of the blood, age, sex, level of physical activity, socio economic condition, life style, dietary and smoking habits etc. It depends upon systole and diastole mechanism of heart. It varies between low blood pressure (Hypotension $<90/60$ mmHg) and high blood pressure (Hypertensive $\geq 180/110$ mmHg). Around the globe, one billion people are affected by hypertension or high blood pressure leading to heart attack and strokes. And every year 9 million people are dying due to high blood pressure or hypertension (WHO report 2013). In Africa the prevalence of high level of blood pressure is ranging from 16.5 % to 33.4% depending on region. (Agyeman 2006; Edward 2000; and Fezeu ,2010). The study on hypertensive subjects of Cameroonian regional hospital show that 40.2% were aware of their high blood pressure (hypertensive stage) and 65.8% were on treatment (Mbouemboue, 2012). The increasing prevalence of hypertension or high blood pressure is attributed to population growth, aging and behavioral risk factors such as unhealthy diet, uses of alcohol, Lack of physical activity, excess weight or obesity, exposure to persistent stress, socioeconomic condition and demographical variables etc. High blood pressure was found as greater with high BMI $\geq 27kgm^{-2}$ (Obesity) among male (35%) and female (27%) (Bruce, 1992). Increased risk of cardiovascular disease has been found in individuals have high blood pressure with contribution of excess fat in the abdominal region (Larsson 1984; and Lapidus 1984). The problem is widely addressed by various scholar and scientist namely Dobbelsteyn et al.(2001); Mohan et al. (2007); Mbouemboue et al. (2012); Bruce et al. (1992); JNC VII (2003), and others. Similarly there are studies on nutritional status and anthropometric characteristics (Khongsdier, 2001; Gautam et al. 2006 & 2007; Gautam et al. 2009 and Gautam et al. 2013), but there is very few studies on correlation of blood pressure and body dimension as well as nutritional status. Therefore, there is an attempt to find out the anthropometric determinants of blood pressure. Hence the main objective of present study was to find out the extent and determinants of Blood pressure among Bidi worker of Sagar district of M.P.

MATERIAL AND METHODS:

For the present cross sectional study 253 Bidi workers of 18-75years of age were selected randomly from 119 household of Bidi workers of district Sagar of M.P. Out of 253 samples 114 were male and 139 were female. A pre tested semi structure schedule was used for collecting information via interview, observation, anthropometric and physiological measurements. Standardized anthropometric and physiological instruments were used for taking measurements. Anthropometer rod, digital weighing machine, measuring tape and sphygmomanometer were used. All the anthropometric instruments were standardized following Zerfas (1985).

Technical error of measurements (TEM) was calculated to remove the error, which was within the limit 0.97 as suggested by (Ulijaszek & Kerr 1999). Anthropometric and physiological measurements i.e. body weight, heights, sitting height, acromian height, waist circumference, hip circumference, systolic blood pressure, diastolic blood pressure, pulse rate were recorded for each individual and body mass index, body fat, and basal metabolic rate were computed following WHO (2013). The statistical analysis were done by using SPSS 16.0 and MS excel. Frequency distribution, student t test, F-test, bivariate linear and multivariate regression analysis was computed using Systolic and Diastolic blood pressure as dependent variable.

RESULTS:

It is apparent from the table 1 that as per systolic blood pressure 38.2% male and 60% female were normal followed by 39.1% male and 33.8% female were found as pre-hypertensive whereas 21.7% male and 15.0 % female were found hypertensive; and a total of 2.3% were found as severe hypertensive, whereas on the basis of diastolic blood pressure 12.2% male and 6.5% female were hypotensive and majority 48.7% male and 56.6% female were reported as normal.

Table1: Distribution of sample as per systolic blood pressure

Systolic blood pressure (mm hg)						
Blood Pressure	Male		Female		Total	
	N	%	N	%	N	%
Hypotension (<90)	-	-	2	1.4	3	1.18
Normal (90-119)	44	38.2	69	60.0	113	44.5
Pre hypertension (120-139)	45	39.1	47	33.8	92	66.18
Hypertension - I(140-159)	20	17.4	10	7.19	30	21.5
Hypertension – II (160-179)	3	2.6	7	5.1	10	3.9
Hypertension emergency(≥180)	2	1.7	4	2.8	6	2.3
Diastolic blood pressure (mm hg)						
Hypotension (<60)	13	12.2	10	6.5	24	9.1
Normal (60-79)	56	48.7	78	56.5	134	53.0
Pre hypertension (80-89)	22	19.1	31	22.5	53	20.9
Hypertension - I(90-99)	15	13.0	13	9.4	28	11.1
Hypertension – II (100-109)	2	1.7	5	3.6	7	2.8
Hypertension Emergency (≥110)	6	5.2	2	1.4	8	3.2

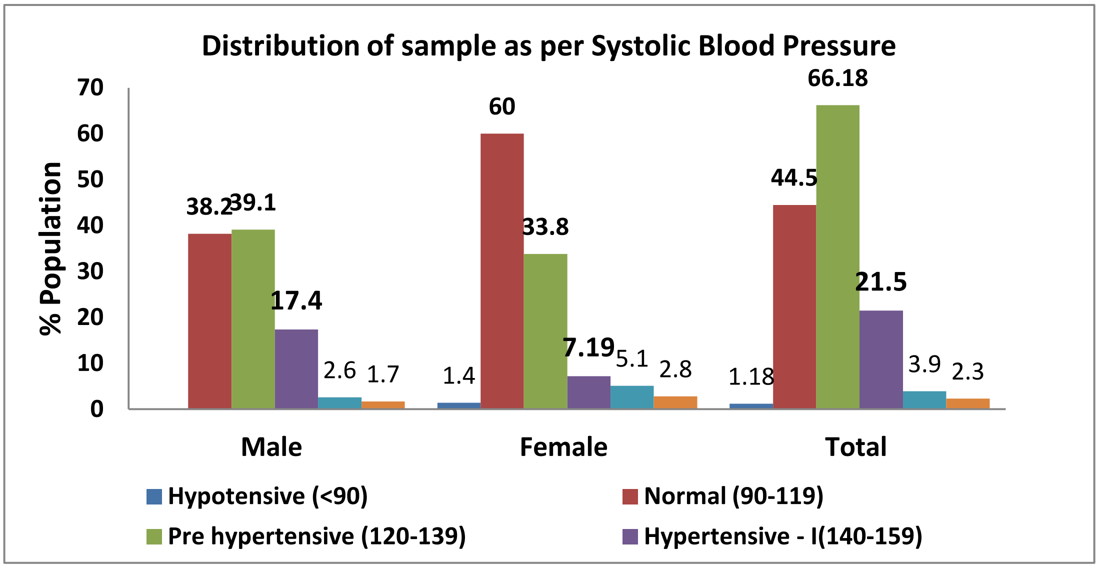

Figure 1. Distribution of sample as per prevelance of sysytolic blood pressure.

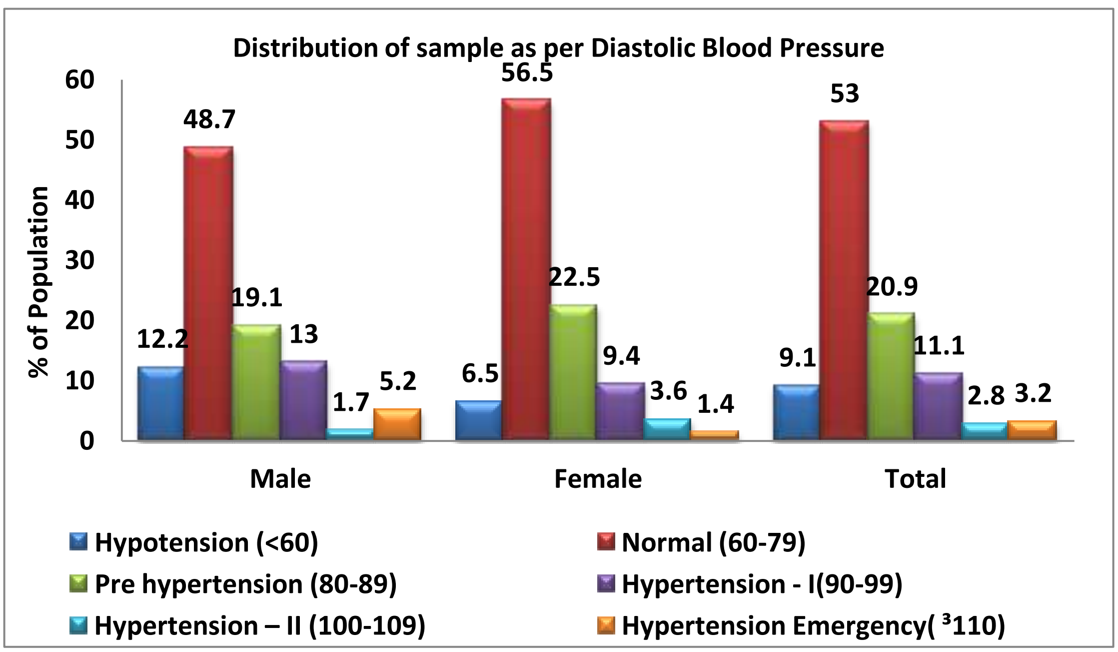

Figure 2. Distribution of sample as per prevelance of diastolic blood pressure.

Similarly 19.1% male and 22.55% female were pre hypertensive, followed 14.7% male and 13.0% female were hypertensive; whereas remaining 5.2% male and 1.4% female have a hypertensive emergency (Figure 1 & 2).

Table 2. Age and Blood Pressure (Systolic) wise distribution of sample

Age group	No. Of Subject	Mean Blood Pressure (S)	State of Systolic blood pressure			
			Hypotensive (<90 mmHg)	Normal (90-119 mmHg)	Pre hypertensive (120-139 mmHg)	Hypertensive (140-180+ mmHg)
For Male						
18-29	44	122.0(14.8)	-	47.7	38.6	13.6
30-34	13	135.07(16.1)	-	30.8	30.8	38.5
35-39	15	130.1(27.6)	-	46.7	40.0	13.3
40-44	3	121.0(36.05)	-	33.3	66.7	-
45-49	7	123.7(13.4)	-	14.3	85.7	-
50+above	32	129.4(20.5)	3.1	28.1	31.2	37.5
For Female						
18-29	41	115.3(17.3)	4.9	61.0	29.3	4.9
30-34	23	116.82(12.84)	-	60.9	34.8	4.3
35-39	14	117.0(8.94)	-	64.3	35.7	
40-44	11	124.4(20.47)	-	45.5	27.3	27.3
45-49	17	124.70(26.90)	-	52.9	23.5	23.5
50+above	33	138(23.61)	-	21.2	45.5	33.3

Table 3. Distribution of population according to age and diastolic Blood Pressure.

Age group	**No. of Subjects**	**Mean Blood Pressure (D)**	**State of Diastolic blood pressure**			
			Hypotension (<60)	**Normal (60-79)**	**Pre hypertension (80-89)**	**Hypertension (90-110 above)**
For Male						
18-29	44	75.02(17.9)	18.2	52.3	13.6	15.9
30-34	13	84.8(21.3)	15.4	15.4	46.2	23.1
35-39	15	83.7(24.1)	-	66.7	13.3	20.0
40-44	3	80.6(23.0)	-	33.3	66.7	-
45-49	7	76.5(13.45)	-	71.4	14.3	14.3
50+above	32	78.06(13.03)	12.5	43.8	15.6	28.1
For Female						
18-29	40	73.2(18.6)	20.0	52.5	15.0	12.5
30-34	23	75.82(11.4)	4.3	56.5	30.4	8.7
35-39	14	74.71(9.77)	7.1	57.1	28.6	7.1
40-44	11	81.4(13.8)	-	45.5	27.3	27.3
45-49	17	77.7(15.01)	5.9	70.6	5.9	17.6
50+above	33	77.39(11.3)	6.1	45.5	30.3	18.2

Age and systolic blood pressure wise distribution of sample is presented in Table 2. It is apparent that the highest mean systolic blood pressure (135.0±16.1 mmHg) was found among male of 30-34 years of age; whereas among female the highest mean systolic blood pressure (138.6±23.61 mmHg) was found among individuals of above 50 years of age. The proportions of young male of 18-29 years were more pre-hypertensive (38.6%) to hypertensive (13.6%) as compared to female of the same age group. In preceding age group 30-34 years the proportion of hypertensive male (38.5%) is quite higher than the female (4.3%). At age group of 40-49 years the proportion of pre hypertensive is higher in male (66.7% and 85.7%) than female (27.3 and 23.5 %). In preceding age group the proportion of hypertensive male is higher in all age group except age of 40+ years. Similarly after 40+years of age the proportion of female (29.5%) was slightly higher than male (28.6%).

Cross tabulation of the sample as per age and diastolic blood pressure is presented in Table 3. It is apparent that mean diastolic blood pressure of male was higher than female in all age group except 40-45 years of age. At age 18-29, the proportion of normal individuals is same for male (52.3%) and female (52.5%); but males are more hypertensive (15.9%) as compared to female (12.5%).

Table 4. Bivariate regression analysis among male and female keeping systolic blood pressure as dependent variable.

Sr.No	Independent variable	Coefficient variable					F statistics		
		R	R^2	ß	SE	t value	F change	DF	P value
For Male									
1	Height	0.008	0.000	-0.019	0.216	-0.089	0.008	114	0.929
2	Sitting height	0.112	0.013	-0.528	0.442	-1.194	1.425	113	0.235
3	Acromian height	0.009	0.00	0.023	0.230	0.099	0.010	113	0.921
4	Weight	0.233	0.054	0.399	0.157	2.545	6.47	114	0.012
5	Waist circumference	0.279	0.087	0.456	0.148	3.087	9.529	114	0.003
6	Hip Circumference	0.229	0.052	0.542	0.217	2.501	6.253	114	0.14
For Female									
1	Height	0.288	0.083	-1.083	0.309	-3.509	12.31	137	0.001
2	Sitting height	0.200	0.040	-1.099	0.462	-2.379	5.659	137	0.019
3	Acromian height	0.238	0.057	-0.946	0.329	-2.872	8.249	138	0.005
4	Weight	0.097	0.009	0.208	0.183	1.13	1.295	138	0.257
5	Waist circumference	.267	0.072	0.540	0.166	3.249	10.55	138	0.001
6	Hip Circumference	0.140	0.019	0.307	0.186	1.649	2.72	138	0.101

Table 5. Bivariate regression analysis among male and female keeping diastolic blood pressure as dependent variable.

Sr.No	Independent variable	Coefficient variable					F statistics		
		R	R^2	ß	SE	t value	F change	DF	P value
For Male									
1	Height	0.010	0.000	0.021	0.203	0.102	0.010	114	0.919
2	Sitting height	0.024	0.001	-0.104	0.418	-0.249	0.062	113	0.804
3	Acromian height	0.002	0.000	0.005	0.216	0.021	0.00	113	0.983
4	Weight	0.328	0.108	0.528	0.143	3.96	13.640	114	0.001
5	Waist circumference	0.318	0.101	0.484	0.137	3.560	12.677	114	0.001
6	Hip Circumference	0.260	0.084	0.645	0.200	3.22	10.380	114	0.002
For Female									
1	Height	0.262	0.069	-0.664	0.211	-3.154	9.949	136	0.002
2	Sitting height	0.024	0.001	-0.089	0.321	-0.021	0.077	136	0.782
3	Acromian height	0.245	0.065	-0.681	0.22	-3.068	9.413	137	0.003
4	Weight	0.115	0.013	0.167	0.124	1.352	1.827	137	0.179
5	Waist circumference	0.201	0.040	0.274	0.114	2.392	5.723	137	0.018
6	Hip Circumference	0.202	0.041	0.301	0.125	2.405	5.783	137	0.018

Similarly at age of 30-34 years, the proportion of pre hypertensive (46.2%) and hypertensive (23.1%) were higher in male as compare to female. Further the proportion of individuals of normal diastolic blood pressure is increased among males and females with succeeding age group, whereas the proportion of hypertensive among male was higher than female in all preceding age group. After 40+ years of age the proportion of male were (23.8%) is higher than female (19.7%).

To understand the relationship between Systolic blood pressure and anthropometric variables regression analysis were computed and presented in Table 4. The systolic blood pressure is determined by anthropometric characteristics such as: body weight, height, acromian height, sitting height, waist circumference and hip circumference. It is apparent from the table that there is low degree of correlation between systolic blood pressure and these variables. Among bidi workers the regression coefficient r^2 varies between (0.00 to 0.87). There is significant regression between systolic blood pressure and height, acromian height and waist circumference with positive correlation among both sexes.

Table 6. Stepwise multivariate regression analysis keeping systolic blood pressure as dependent.

Model	Predictor	R^2	ß	SE	df	F value	t value	P value
For Female								
1	Age	0.185	0.590	0.106	137	30.920	5.561	0.001
2	Age	0.229	0.373	0.130	137	20.004	2.872	0.005
	Body fat		0.936	0.340			2.755	0.007
3	Age	0.263	0.294	0.131	137	15.945	2.241	0.027
	Body fat		0.967	.334			2.898	0.004
	Height		-0.725	0.294			-2.503	0.013
For Male								
1	Body fat	0.086	0.087	0.269	112	10.455	3.233	0.002
After Removal of Body fat (common in male and female)								
For Female								
1	Age	0.185	0.590	0.106	137	30.920		0.001
2	Age	0.228	0.589	0.104	137	19.95		0.001
	BMI		1.118	0.408				
3	Age	0.263	0.517	0.106	137	15.904		0.001
	BMI		1.154	0.401				
	Height		-0.725	0.290				
For Male								
1	Waist circumference	0.078	0.458	0.150	112	9.346		0.003
After Removal of Age, BMI, Height and Waist circumference								
For female								
1	Education level	0.057	-1.22	0.425	137	8.270	-2.876	0.005
2	Education level	0.108	-1.151	0.415	137	8.160	-2.77	0.001
	Acromian Height		-0.894	0.323			-2.763	
3	Education Level	0.140	-1.064	0.411	137	7.243	-2.586	0.001
	Acromian Height		-1.180	0.344			--3.432	
	Body weight		0.413	0.186			2.221	
4	Education Level	0.240	-0.118	0.432	137	11.824	-0.274	0.001
	Acromian Height		-0.813	0.323			-2.470	
	Body weight		1.596	0.305			5.23	
	BMR		-0.115	0.024			-4.705	
5	Acromian Height	0.262	-0.810	0.328	0.274137	15.849	-2.471	0.001
	Body weight		1.63	0.022			5.950	
	BMR		-0.118	0.158			-5.479	
For male								
1	Body weight	0.054	0.400	0.158	112	6.378	2.526	0.013
2	Body weight	0.11	0.597	0.171	112	6.850	3.486	0.002
	Sitting height		-1.24	0.471			-2.642	

To understand the relationship between diastolic blood pressure and anthropometric characteristics, regression analysis were computed and presented in Table 5. Alike systolic the diastolic blood pressure determined by anthropometric characteristics such as: body weight, height, acromian height sitting height, waist circumference, hip circumference. It was found that there is low degree of correlation between diastolic, blood pressure and these variables. Waist circumference and hip circumference have positive correlation with diastolic blood pressure for male and female, whereas height and acromian height have inverse correlation with diastolic blood pressure. The regression coefficient varies between (0.001to 0.101).

Step wise multivariate regression analysis of systolic blood pressure is presented in Table 6. It is evident from the table that in first instance there are three models for female and one for male. According to the first model the age is sole predictor and accounts 18.5% variability in systolic blood pressure among female, whereas among male there is only one model; and according to that model the sole predictor is body fat which account 8.6% variability in systolic blood pressure. Similarly in second model, there are two predictors of systolic blood pressure one is ‘age’ and second is ‘body fat’. These two predictors account 22.9 % variability in systolic blood pressure among females. According to third model age, body fat and height are predictors and they together account 26.3 % variability; although height has inverse correlation with systolic blood pressure. In second step, after removal of common predictors i.e. ‘Body fat’ the remaining probable predictors provide three models for female and one for male. According to first model, age alone account 18.5 % variability among female. Similarly in second model age and body mass index together account 22.8 % variability in systolic blood pressure. In successive model, remaining predictor i.e. age, body mass index and height together account a total of 26.3 % variability among females; whereas, among male again there is only one model according to which waist circumference is a predictor and accounts 7.8% variability in systolic blood pressure. Further, after removal of age, Body mass index, height and waist circumference the remaining variable provide five models for female and two for male. According to first model education level account 5.7% variability in systolic blood pressure among female. Although among male according to first model, the predictor is body weight which accounts 5.4 % variability. Similarly among female according to preceding model; two predictors of systolic blood pressure are education level and acromian height, they together account 10.8 % variability whereas among male in second model the two predicators of systolic blood pressure are body weight and sitting height and both account 11 % variability. According to third model; Education level, acromian height and body weight among female account 14.0 % variability; and on the basis of fourth model there are four predictors of systolic blood pressure: these are education level, acromian height, body weight and basal metabolic rate and they together account 24% variability. Similarly according to the fifth model there are four predictors of systolic blood pressure and these are such as; acromian height, body weight and basal metabolic rate and these predictors account 26.2 % variability.

CONCLUSION:

On the basis of present cross sectional study, it can be concluded that *Bidi* worker are deprived occupational group suffering with many health and nutritional problems. Blood pressure is also one of the health problem found existing among them. There is large proportion of pre hypertensive were found among both the sexes. As per systolic blood pressure, majority of male (85.7 %) of age 45-49 years were pre hypertensive. The old aged males (28.6%) are more hypertensive than females. Only 2.3 % were having hypertensive emergency crises, out of them only few male were aware about their present hypertensive status. The maximum cases of low blood pressure or hypotensive are found among young individuals. From the bivariate regression analysis and stepwise multivariate regression analysis it is clear that the blood pressure is being determined by biosocial, demographical, anthropometric and nutritional indicators namely age, body fat, height, body mass index (BMI), level of education, basal metabolic rate (BMR) and body weight.

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