Science World Journal Vol. 19(No 3) 2024 https://dx.doi.org/10.4314/swj.v19i3.13
www.scienceworldjournal.org
ISSN: 1597-6343 (Online), ISSN: 2756-391X (Print)
Published by Faculty of Science, Kaduna State University

Full Length Research Article

SOCIOECONOMIC FACTORS RESPONSIBLE FOR HEART DISEASE AMONG OBESE-HYPERTENSIVE ADULTS

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ABSTRACT
For this analysis data were collected from 995 Bangladeshi adults of ages 18 years and above. Data were recorded by some medical staffs working in diabetic centres, when the respondents were visiting the centres, located in urban and semi-urban areas. There were 50.1% males; 30.2% obese; 5.9% hypertensive adults; and 3.2% were obese and hypertensive. Among obese-hypertensive adults 50.0% were patients of heart. The overall percentage of patients of heart including obesity and hypertension was 1.6%. The prevalence of these three diseases were noted in 3.6% elderly people; in 4.0% adults of higher economic condition; in 3.6% smokers, in 2.9% adults involved in sedentary activity and in 8.5% diabetic patients suffering for 15 years and above. The last three variables had significant impacts on simultaneous prevalence of three non-communicable diseases. Elderly people and people of higher economic condition had more than 200% risk of prevalence. The prevalence risk was 6.07 times in smoker adults; 5.42 times in adults involved in sedentary activity and 7.81 times among diabetic patients suffering 80 for 15 years and more. Discriminant analysis showed that body mass index, diabetes duration, smoking habit, sedentary activity, and age were important in discriminating patients from others.

Keywords: Obesity, Hypertension, Heart disease, Socio-economic factors, Risk ratio, Discriminant analysis

INTRODUCTION

Obesity is the risk factor for development of many non-communicable diseases, viz. hypertension, diabetes, cardiovascular diseases, retinopathy, disability, etc. creating poor health conditions for the people (Mokdad et al., 2003; Davy & Hall, 2004; Krzysztof, 2006; Skliros et al., 2008; Kotchen, 2010; Barnes, 2011; Bhuyana,b, 2020). Obesity and diseases developed due to obesity are in increasing trend as society is moving towards upward direction in terms of education and economic activities and people in the society are depending on mechanical movements and becoming physically inactive. As a result, the extent of health hazard is in increasing trend (Bhuyan & Fardus, 2019) and more people are becoming obese hypertensive and obese diabetic.

Obesity, diabetes, hypertension, and cardiovascular disease are inter-associated non-communicable diseases. Obesity is the risk factor for diabetes and hypertension; diabetes and hypertension are the risk factor for cardiovascular diseases. These facts were reported in many research papers in both home and abroad (WHO, 2001; Narkiewicz, 2002; Mokdad et al., 2003; Goatmellec et al., 2003; Davy & Hall, 2004; Krzysztop, 2006; Wang et al., 2014; Gary & Borhade, 2020; Bhuyan, 2021). For Bangladeshi adults the reported significant socioeconomic risk factors for obesity hypertension were gender, occupation, sedentary activity, marital status, etc. (Bhuyana, 2020). Again, prevalence of diabetes, smoking habit, obesity, physical inactivity were the risk factors for prevalence of hypertensive heart disease (Bhuyan, 2021). In this paper, an attempt was made to identify the responsible variables for prevalence of heart disease in obese-hypertensive adults.

World Health Organization reported that around 650 million people worldwide were obese, and 1.9 billion adults were overweight [WHO, 2020; WHO, 2024). It was also reported that 1.28 billion adults ages 30 - 79 years worldwide were in hypertension (WHO, 2023). Almost 75% hypertensive people reside in low-and-middle income countries including Bangladesh (Chowdhury et al, 2017; Benjamin et al., 2019). The prevalence rate of hypertension in adults of Bangladesh was reported as around 25% (Islam et al,2016). It was also reported that the estimated death from cardiovascular disease were 17.9 million worldwide. Among these deaths 85% were due to heart attack and stroke (WHO,2021). It was also reported that simultaneous prevalence of obesity and hypertension in the same person had 100% more risk of cardiovascular diseases (Mahler,1990; Bernard & Chao, 2012). Thus, these two non-communicable diseases create major threat throughout the world and the problem is in increasing trend (Krzysztof, 2006; Theodore, 2010; Hall et al., 2015; Nielson & Lange, 2015).

The above discussion indicate that the major health hazard occurs in people if obesity, diabetes, and hypertension prevail simultaneously in persons. The simultaneous prevalence of these non-communicable diseases in the same person doubles the risk of cardiovascular deaths (Mahler, 1990). These diseases create the threat to global health (Theodore, 2010). The responsible socioeconomic factors for these diseases were reported in many studies in both home and abroad (Mokdad et al., 2003; Dinsa et al., 2012; Hall et al., 2015; Bhuyan & Bhuiyan, 2019; Bhuyan & Fardus,

https://dx.doi.org/10.4314/swj.v19i3.13

2019; Monteiro, 2019; Bhuyan, 2020a,b) .In this study, an attempt was made to identify responsible socioeconomic variables for the prevalence of heart disease among obese-hypertensive adults.

MATERIALS AND METHODS

The results presented here was based on data collected from 995 adults of ages 18 years and above who were interviewed by some nurses and medical assistants working in some diagnostic centres located in both urban and semi-urban areas in Bangladesh. The data were collected from the adults during the session 2018 – 2019. These adults were visiting the diagnostic centres for blood and urine screening test.

It was decided to cover 50.1% males and 49.9% females to maintain the sex ratio of the country which was 50.1:49.9 according to Bangladesh Bureau of Statistics, during the study period 2018-2019. Accordingly, we had 498 males and 497 females in the sample. The information related to the health conditions and socioeconomic condition of these respondents was collected through a pre-designed and pre-tested questionnaire. The data were related to demographic characteristics of the respondents including economic condition of the family, the duration of the suffering from the diseases, the period of suffering from the diseases, the stage of treatment by the registered medical practitioner / rural medical assistants, the lifestyle of the respondents. Most of the collected information were qualitative in character and these qualitative characters were recorded in nominal scale. The economic condition of any of the family was decided as lower (if monthly income of a family was < Tk.50 thousand and expenditure was < Tk. 40 thousand), medium (if income was Tk. 50 - 100 thousand and expenditure was between Tk.40 - < 80 thousand), upper medium (if income was 50 – 100 thousand taka and expenditure was between Tk. 80 - < 100 thousand taka) and higher (if income was Tk. 150 and above and expenditure was Tk.120 thousand and above). For the decision of the obesity, the body mass index, (BMI weight in kg divided by height in meter2) was measured and any respondent was identified as underweight (if BMI < 18.5), normal (if 18.5 < BMI < 23.0), overweight (if 23.0 < BMI < 27.5) and obese (if BMI ≥ 27.5) (WHO, 2004; Biswas et al., 2017). The respondents were classified into four groups according to level of blood pressure (BP, mmHg) of them. The first group was of optimal blood pressure (BP < 120/80), the second group was of normal blood pressure (BP < 130/85), the third group was of high normal blood pressure (BP < 140/90), and the fourth group was of hypertensive blood pressure (BP≥140/90) (Jan et al., 2017; Jessica et al., 2018).

The study variable was prevalence of heart disease in obese-hypertensive adult; the sample adults possessing this characteristic were 16 (1.6%). These adults were discriminated from others by performing discriminant analysis (Bhuyan, 2004; McLachlan, 2004; Garson, 2008; Bhuyan, 2019) The analysis provided the information on responsible variables for discrimination, where most responsible variable was one which provided the absolute value of highest correlation coefficient of the variable with discriminant function score. According to the objective of the study, association of the study variable with other socio-demographic variables were investigated. Irrespective of significance of the association, the responsible level of a variable for the prevalence of the study variable in higher rate was identified by calculating risk ratio (Bhuyanc,2020; Bhuyan, 2022).

RESULTS AND DISCUSSION

Out of 995 investigated adults 53.4% were from rural areas; the ratios of Muslim and non-Muslim, married and single respondents were 85.2: 14.8 and 93.1: 6.9, respectively. The prevalence rate of heart disease in obese- hypertensive adults was 1.6%. This rate was 2.2% in urban adults, though this rate was not significantly different from that prevailed in rural adults (1.1%) [= 1.645, p-value=0.200].

However, urban adults had 91% more risk of prevalence [R.R.=1.91, C.I. (0.70, 5.21)]. Among the male respondents the prevalence rate was1.8%. This rate was slightly more than the rate prevailed in all adults and the male adults had 28% more risk of prevalence [R.R.=1.28, C.I. (0.48, 3.41)]. But the prevalence rates in males and in females were not significantly different [=0.250, p-value=0.617]. Prevalence rates in Muslims (1.5%) and in non-Muslims (2.00) were statistically similar [=0.204, p- value= 0.651]. Due to higher rate in non-Muslim adults, they had 33% more risk of prevalence [R,R.=1.33, C.I.(0.38, 4.61)]. There were 93.1% married adults; prevalence rate in them was 1.6%, which was higher than it was in single adults (1.4%). These two rates were not significantly different [= 0.012, p- value= 0.913], still married adults had 12% more risk of prevalence [R.R.=1.12, C.I. (0.15, 8.33)]. The number of elderly adults [age 50 years and above] was 195; the prevalence rate in them was 3.6%. This rate was different from the rates in adults of other ages at 5.9%level of significance [= 7.446, p-value = 0.059]. This high rate resulted in higher risk of prevalence in elderly people by 3.19 times compared to the risk of other adults [R.R.=3.19, C.I. (1.20, C.I. (8.47)].

There were 57.5% higher educated respondents; 2.3% of them were suffering from heart disease in addition to obesity and hypertension. This prevalence rate was not significantly different than those prevailed in other educated adults [=4.451, p-value = 0.217]. However, higher educated adults had 220 % [R.R.= 3.20, C.I. (0.92,11.15) more risk of prevalence than the risk of other educated adults. There were 5 groups of adults who had 5 different occupations. These were farming (10.5%), business (23.5%), service (30.7%), retirement (12.3%), and housewife (23.1%). All these professionals had almost similar prevalence rates [= 0.276, p- value = 0.991]. However, farmers had 22% more risk of prevalence [R.R.= 1.22, C.I. (0.28, 5.30)]. Respondents belonged to high economic group of families were 12.6%. The prevalence rate in these adults was 4.0% creating a risk of 3.16 times for prevalence [R.R. = 3.16, C.I. (0.28, 5.30)] and this rate was different from that of other adults at 5.5% level of significance [= 7.612, p- value = 0.055].

Among the respondents 33.1% were smokers and 3.6% of them were suffering from the diseases under consideration. This prevalence rate was significantly different than the rate prevailed in non-smoker adults [= 12.921, p – value= 0.000]. The smoker adults had 6.07 times risk of the diseases [R.R.= 6.07, C.I. (1.97, 18.67)]. The percentage of physically inactive adults was 51.7% and prevalence rate in them was 2.1%. But this rate was not significantly different than it prevailed in physically active adults [= 1.902, p-value= 0.168], though physically inactive adults had 106% more risk of prevalence [R.R. = 2.06, C.I. (0.72, 5.89)]. There were 36.5% adults who were habituated in taking process food. Consumption of process food had no impact on prevalence rate as the rates for consumers (2.5%) and non- consumers (1.1%) were

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www.scienceworldjournal.org
ISSN: 1597-6343 (Online), ISSN: 2756-391X (Print)
Published by Faculty of Science, Kaduna State University

statistically similar [= 2.742, p- value = 0.098]. But consumers had 2.24 Out of 16 patients of heart disease in addition to obesity and hypertension 13 were involved in sedentary activities and 3 were free of sedentary activity. This differential in proportions of sedentary activists were significant [= 8.933, p- value= 0.003]. Sedentary activity was the risk factor for the prevalence of the diseases and the risk was 442% more than it was for other adults [R.R.5.42,C.I.(1.56,18.09)].

There were 30.2% obese adults and 5.3% of them were patients of heart disease along with obesity and hypertension. This proportion was significantly different [z=6.13, p- value=0.0000. It was noted that all 16 patients were obese. There were 67.0% diabetic patients who were suffering for different periods. The percentage of patients of longer duration of suffering (15 years and above) was 7.1 and 8.5% of them were patients of heart disease along with prevalence of obesity- hypertension. This proportion of prevalence was significantly different from proportions prevailed in adults suffered for other periods [=25.362, p-value = 0.000]. For this group, the risk of prevalence was 7.81 times compared to the risk of prevalence among other adults [R.R.=7.81, C.I. (3.05, 19.97)].

Table 1: Distributions of patients of heart disease in presence of obesity hypertension according to different socioeconomic variables

Socioeconomic variables	Prevalence of heart disease in presence of obesity hypertension				Total	
	Yes		No			
	Number	%	Number	%	Number	%
Residence						
Rural	6	1.1	525	98.9	531	53.4
Urban	10	2.2	454	97.8	464	46.6
Total	16	1.6	979	98.4	995	100.0
Religion						
Muslim	13	1.5	835	98.5	848	85.2
Non-Muslim	3	2.0	144	98.0	147	14.8
Gender						
Male	9	1.8	489	98.2	498	50.1
Female	7	1.4	490	98.6	497	49.9
Marital status						
Married	15	1.6	911	98.4	926	93.1
Single	1	1.4	68	98.6	69	6.9
Age In years)						
< 25	1	0.5	195	99.5	196	19.7
25 – 40	4	1.0	397	99.0	401	40.3
40 – 50	4	2.0	199	98.0	203	20.4
50+	7	3.6	188	96.4	195	19.6
Education						
Illiterate	1	0.5	64	99.5	65	6.5
Primary	0	0.0	121	100.0	121	12.2
Secondary	2	0.8	235	99.2	237	23.8
Higher	13	2.3	559	97.7	572	57.5
Occupation						
Farming	2	1.9	102	98.1	104	10.5
Business	4	1.7	230	98.3	234	23.5
Service	4	1.3	301	98.7	305	30.7
Retire	2	1.6	120	98.4	122	12.3
Housewife	4	1.7	226	98.3	230	23.1
Economic condition						
Low	2	0.5	383	99.5	385	38.7
Medium	8	1.9	416	98.1	424	42.6
Upper medium	1	1.6	60	98.4	61	6.1
High	5	4.0	120	96.0	125	12.6
Smoking habit						
Yes	12	3.6	317	96.4	329	33.1
No	4	0.6	662	99.4	666	66.7
Habit of taking process food						
Yes	9	2.5	354	97.5	363	36.5
No	7	1.1	625	98.9	632	63.5

Science World Journal Vol. 19(No 3) 2024 https://dx.doi.org/10.4314/swj.v19i3.13
www.scienceworldjournal.org
ISSN: 1597-6343 (Online), ISSN: 2756-391X (Print)
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Habit of doing physical work						
Yes	5	1.0	476	99.0	481	48.3
No	11	2.1	503	97.9	514	51.7
Involvement in sedentary activity						
Yes	13	2.9	429	97.1	442	44.4
No	3	0.5	550	99.5	553	55.6
Body mass index						
Underweight	0	0.0	38	100.0	38	3.8
Normal	0	0.0	233	100.0	233	23.4
Overweight	0	0.0	424	100.0	424	42.6
Obese	16	5.3	284	94.7	300	30.2
Duration of diabetes (in years)						
Dose not arise	3	0.9	325	99.1	328	33.0
< 5	2	0.7	289	99.3	291	29.2
5 – 10	2	1.0	204	99.0	206	20.7
10 – 15	3	3.0	96	97.0	99	9.9
15+	6	8.5	65	91.5	71	7.1
Total	16	1.6	979	99.4	995	100.0

It was noted that smoking habit, sedentary activity, body mass index and duration of diabetes were significantly associated with prevalence of heart disease in obese hypertensive adults. Besides these 4 variables, age and economic condition were also the risk factors for prevalence of the above mentioned 3 diseases. Out of these 6 variables some might be responsible in discriminating patients' group of 16 adults from other 979 adults. To identify the responsible variables discriminant analysis was performed. The analysis well discriminated these two groups. This was observed from the results of Wilk's Lambda= 0.948, =52.907, and p-value=0.000. To discriminate the two groups of adults, the variables included in discriminant analysis were residence, religion, gender, marital status, age, education, occupation, economic condition, smoking habit, habit of taking process food, habit of doing physical work, sedentary activity, body mass index and duration of diabetes. From the analysis, it was noted that body mass index was the most responsible variable in discriminating patient group from other adults. The second most responsible variable was duration of diabetes followed by smoking habit and sedentary activity. Age and economic condition also played a role to discriminate two groups of adults. The detail results were presented in Table 2.

Table 2: Results of Discriminant analysis

Variables	Correlation coefficient (r) of variable with discriminant function score	Discriminant function coefficient	Λ =	F	p-value
Body mass index	0.670	0.475	0.976	24.599	0.000
Duration of diabetes	0.515	0.261	0.986	14.515	0.000
Smoking habit	-0.489	-0.462	9.987	13.064	0.000
Sedentary activity	0.405	0.356	0.991	8.996	0.003
Age	0.358	0.105	0.993	7.015	0.008
Economic condition	0.358	0.393	0.993	7.013	0.008
Habit of taking process food	0.224	-0.115	0.997	2.744	0.098
Education	0.215	0.068	0.997	2.537	0.111
Habit if doing physical work	-0.186	0.037	0.998	1.902	0.168
Residence	0.173	0.176	0.998	1.644	0.200
Gender	-0.068	0.279	1.000	0.250	0.617
Religion	0.061	0.078	1.000	0.204	0.652
Marital status	-0.015	0.058	1.000	0.012	0.914
Occupation	-0.007	-0.014	1.000	0.002	0.961

Out of 995 respondents 16 (1.6%) were suffering from heart disease along with obesity and hypertension. These 16 respondents were considered as patient group and the remaining 979 were termed as non-patient group. The objective of this analysis was to discriminate these two groups so that some variables were identified as responsible for the discrimination. Among the 16 patients 10 were from urban area and they had 91% more risk of prevalence of the above -mentioned diseases. The ratio of males and females among the patients was 56.25:43.75. Male respondents were at higher risk of prevalence by 28%. Non-

Muslim patients were only 18.75%; for them the risk of prevalence was 33% more. Most of the patients (93.75%) were married personals, but the proportions of patients among married and among single adults were almost similar. Married adults and single adults were almost similarly exposed to the diseases [R.R.=1.12]. The percentage of elderly patients was 43.75% and they had more than three times risk of prevalence. Among the patients 13 were higher educated and they were more exposed to the diseases by 220% [R.R.= 3.20]. The sample farmers were 10.5%; among the patients there were 12.75% farmers. These farmers had 22% more risk of prevalence. There were 12.6% adults from families of higher economy. The corresponding percentage in patient group was 31.25 and this group had 3.16 times risk of prevalence.

The lifestyle factors considered in this analysis were smoking habit, physical activity, sedentary activities, and food habit. Out of these four factors smoking habit and sedentary activity were significantly associated with prevalence of heart disease among obese-hypertensive adults. The prevalence rate among smokers was 3.6% which was very high compared to the overall prevalence rate in investigated adults. Smokers had 507% more risk of prevalence than non-smokers. Similarly, adults involved in sedentary activities were at higher risk of prevalence by 5.42 times. The prevalence rates (2.1%) in physically inactive adults and in process food consumers (2.5%) were higher than it was in all adults. But these higher rates were not significantly more than it was in all adults. Still, physically inactive adults and process food consumers were at higher risk by around 100%.

As heart disease was noted in obese-hypertensive adults, it was quite natural that all patients were obese. The prevalence rate in obese adults was more than 3 times than it was observed in all adults. Duration of diabetes had significant impact on prevalence rate and the rate was 8.5% in diabetic patients who were suffering for 15 years and above. For this group the risk of prevalence was 681% more than it was for others.

Conclusion

In this paper the analytical results which focused the responsible socioeconomic variables for prevalence of heart disease among obese-hypertensive Bangladeshi rural and urban adults of 18 years and above were presented. The analysis was done using the data collected from 995 adults. Among these adults 1.6% were suffering from heart disease in addition to obesity and hypertension. These patients were significantly different from the remaining 98.4% respondents. It was noted in discriminating patient group from others. The discrimination was observed due to the variables body mass index, duration of diabetes, smoking habit, sedentary activities, age, and economic condition. Out of these variables body mass index was the most responsible one in discriminating the two groups of adults. The second most responsible variable was duration of diabetes followed by smoking habit and sedentary activity. These 4 variables were significantly associated with prevalence of heart disease in addition to obesity-hypertension. The other two variables were associated with the prevalence at around 6% level of significance. The influencing levels of the above responsible variables were obesity, longer duration of diabetes for 15 years and above, smoking habit, involvement in sedentary activity, old age of 50 years and above, and higher economic condition of family. These findings were noted from the results of risk ratios calculated for the prevalence of the diseases.

The variables residence, gender, religion, marital status, education, occupation, physical work, and process food consumption were not significantly associated with prevalence of the diseases. But some of the level of each of the variables is risky for the prevalence. The risk level of any of the variables was explained below. Among the respondents, there were 46.6% urban people who had 91% more risk of prevalence of the diseases. Percentage of male respondents was 51.1 and they had 28% more risk of prevalence; non-Muslim adults were 14.8% and for them the risk was 33% more; higher educated people were 57.5% and they had 3.20 times risk of prevalence; physically inactive adults were 51.7% and for them the risk of prevalence was 106% more; process food consumers were 36.5% having 124% more risk of prevalence.

Due to upward trend in economic growth in both developed and developing countries, lifestyle of the inhabitants is changing. This upward movement in socioeconomic conditions creates health hazard in different groups of people. As a result, the severity of non-communicable diseases is increasing. Some of these non-communicable diseases are obesity, diabetes, hypertension, cardiovascular diseases, etc. In most cases the health hazard initiated from obesity and diabetes, and it enhances the degree of other non-communicable diseases.

Recommendations

To get rid of this health hazard people should change their attitude in their lifestyle. For the better lifestyle pattern people should follow some norm in leading their normal life. This can be attained if people should follow some norm in leading their normal healthy life.

(i) People of ages 40 years and above should consult a doctor for regular check -up of their health condition so that high body mass can be avoided.
(ii) People should avoid restaurant and process food so that general health conditions is not deteriorated.
(iii) People should be involved in physical work to maintain their healthy life.
(iv) People should consult a registered health worker and should follow the instruction suggested by him/her.
(v) People should join the blood screening program so that blood sugar level and blood pressure level are in control.

The above steps are important to avoid some of the non-communicable diseases. Government can encourage rural and urban health services providers to suggest people so that they can follow the above steps.

REFERENCES

Bangladesh Bureau of Statistics (2018): Statistical Yearbook of Bangladesh, 2017, BBS, Dhaka.

Barnes, S.A. (2011): The epidemic of obesity and diabetes: Trends and treatments, Tex Heart Inst Jour, 38(2), 142 – 144.

Benjamin, E.J.; Muntner, P.; Alonso, A.; Bittencourt, M.S. et al (2019): Heart disease and stroke statistics – 2019: A report from the Heart Association Circulation 2019,139(10), e56 – 528.

Bernard, M.V. and Chao, Li. (2012): Diabetes and hypertension: Is there a common metabolic pathway? Curr Atheroscler, Rep, 14(2), 160 – 166.
Bhuyan, K.C. (2004): Multivariate Analysis and Its Applications, New Central Book Agency (P) Ltd.
Bhuyan, K.C. (2019): A note on the application of discriminant analysis in medical research, Archives of Diabetes and Obesity, 2(2), 142 – 146.
Bhuyan, K.C. (2020) [a]: Identification of responsible variables for obesity hypertension among Bangladeshi adults, Archives of Diabetes and Endocrine System, 3(1,) 27 – 34, ISSN 2638- 4981.

Bhuyan, K.C. (2020) [b]: Discriminating Bangladeshi adults by simultaneous prevalence of obesity diabetes, Series of Endocrinology Diabetes and Metabolism, 2(2), 19 – 26.
Bhuyan, K.C. (2020) [c]: Introduction to Meta Analysis, Lap Lambert Academic Publishing.
Bhuyan, K.C. (2021): Socioeconomic variables responsible for hypertensive heart diseases among Bangladeshi adults, Jour Heart and Vasculature, 1(5), 1 – 7, DOI:10.31579/JHV- 2021/021.
Bhuyan, K.C. (2022): Risk Factors for Simultaneous prevalence of two Non-communicable Diseases in Bangladeshi Males and Females, Lambert Academic Publishing.
Bhuiyan, D. and Bhuyan, K.C. (2019): Discriminating Bangladeshi adults by non-communicable diseases, Rehabilitation Science, 4(3), 35– 43.
Bhuyan, K.C. and Fardus, J. (2019): Level of obesity and socioeconomic factors of a group of adults people of Bangladesh: A Factor analysis approach, Amer Jour Data Mining and Knowledge Discovery, 4(1), 8 – 14.
Biswas, T.; Garnett, P.; Sarah and Rawal; B. Lal (2017): The prevalence of underweight, overweight, and obesity in Bangladesh: Data from a national survey, PLoS One, 12(5), e0177395.
Chowdhury, M.A. Uddin, M.J.; Haque, M.R. and Ibraimou, B. (2017): Hypertension among adults in Bangladesh: Evidence from a National Cross-section Study, BMC Cardiovascular disorder, 6: 22, https://doi.org/10.1186/s12872 - 016 - 0197 – 3.
Davy, K.P.; Hall, J.E. (2004): Obesity and hypertension: two epidemics or one? Amer Jour Physiol Regular Integer Com Physiol, 286, R803 – 813, doi: 10.1152/ajpregu.00707.2003.

Dinsa, G.D.; Goryakin, Y.; Fumagalli, E. and Suhrcke, M. (2012): Obesity and socioeconomic status in developing countries: A systematic review, Obesity Reviews, 13(11), 1067 – 1079.
Goatmellec – Taglioni, G. and Ribiere, C. (2003): Factor that influence the risk of hypertension in obese individuals, Curr Nephrol Hypertense, 12(3), 305- 308.
Garson, G.D. (2008): Discriminant Function Analysis, https://web.archive.org/web20080312065328

Gary, T. and Borhade, M.B. (2020): Hypertensive heart disease, Stat Pearls Publishing LLC.
HalL John E; Jussara, M.; do Carmo; Alexandre, A. da Silva; Zhen Wang and Michael, E. Hall (2015): Obesity induced hypertension: Interaction of Neurohumoral and Renal. Mechanisms, Circulation Research, 116, 991- 1006.
Islam, Monowarul, A.K.M.; Mohibullah,A. K.M. and Paul, T. (2016): Cardiovascular disease in Bangladesh: A review, Bangladesh Heart Journal, 31(2), 80 – 99.

Jan, A.S.; Yan, Li; Azusa, H.; Kei, A.; Eamon, D. and O'Brien, E. (2017): Blood Pressure measurement anno 2016, Amer Jour Hypertension, 30(5), 453 – 463.
Jessica, Y,I.; Zaman, M.M.; Haq, S.A.; Ahmed, S. and Al-Quadir, Z. (2018): Epidemiology of Hypertension among Bangladeshi adults using the 2017 ACC/AHA Hypertension Clinical Guidelines and Joint National Committee 7 Guidelines, Jour Hypertension, 32, 668 – 680.
Kotchen, T.A. (2010): Obesity related hypertension: epidemiology, pathophysiology, and clinical management, Amer Jour Hypertension, 23(11), 170 – 178.
Krzysztof, N. (2006): Obesity and hypertension- The issue is more complex than we thought, Nephrology Dialysis Transplantation, 21(2), 264-267,doi.org/10.1093/ndt/gfi290.
McLachlan, G.J. (2004): Discriminant Analysis and Statistical Pattern Recognition, Wiley Inter-science, ISBN 978-0-471- 69115-0.
Mahler, R.J. (1990): Diabetes and hypertension, Horm Metab Res, 22(12), 599 – 607.
Mokdad, A.H.; Ford, E.H.; Bowman, B.A. et al (2003): Prevalence of obesity, diabetes, and obesity-related health risk factors, JAMA, 289(1), 76 – 79.
Monteiro, C.A.; Moura, E.C.; Condel, W.L. and Popkin, B.M. (2019): Socioeconomic status and obesity in adult populations of developing countries, Bull WHO, 82, 940 - 946
Narkiewicz, K. (2002): Obesity – related hypertension: relevance of vascular responses to mental stress, Jour Hypertension, 20, 1277 – 1278.
Nielson, C. and Lange, T. (2005): Blood glucose and heart failure in diabetic patients, Diabetic Care, 28, 607 – 661.
Skliros, E.A.; Merkoures, P.; Sotiropoulos, A, et al (2008): The relationship between body mass index and hypertension in elderly Greeks: The Nemea primary care study, Jour Amer Geriatr Soc. 56(5), 954 – 955.
Theodore, A.K. (2010): Obesity related hypertension: Epidemiology, Pathophysiology and clinical management, Amer Jour Hypertension, 23(1),1170 –1178.
Wang Dhu-King; Wei, Ma.; Shumei, W.; Xiang-Ren, Ti; Hong Ying Jia; and Fuzhong, Xue (2014): Obesity and its relationship with hypertension among 50 years and older in Jinan, China, PLOSONE, https://dio.org/10.1371/journal. Pone.0114424.

WHO (2001): Prevalence, awareness, treatment and control of hypertension among elderly in Bangladesh and India, a multicentric study. WHO (2004): Appropriate body mass index for Asian population and its implications for policy and intervention strategies, Expert Consultation, Public Health, Lancet 363.

WHO (2020): Obesity and overweight, who.int/news-room/fact-sheets/detail/obesity-and overweight.

WHO (2021): Cardiovascular diseases, who.int/news-room/fact-sheets/detail/cardiovascular diseases.

WHO (2023): Hypertension is major cause of premature death, who.int/news-room/factsheets/detail/hypertension.

WHO (2022): World obesity day 2022 – Accelerating action to stop obesity, https://www.who.int/news/item/04-03-2022-world-obesity-day-2022-accelerating-action-to-stop-obesity