Factors Responsible for Obesity Neuropathy among Bangladeshi Adults

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ABSTRACT

The results presented here were found out in analysing the data collected from 960 adults of 18 years and above interviewed from both urban and rural areas of Bangladesh with an objective of identification of some socioeconomic variables responsible for the prevalence of obesity neuropathy. Among the adults 6.4% were the patients of obesity and neuropathy simultaneously. It was noted that urban people, males, Muslims, married persons, elderly people, illiterate people, physically inactive people, persons belonged to families of higher income and higher expenditure, adults involved in sedentary activity and habituated in taking restaurant food and hypertensive adults were more exposed to obesity neuropathy. The most responsible variable for this health hazard was smoking habit followed by physical inactivity, being male and housewife, can food user, and sedentary activity. These variables were identified by factor analysis.

Keywords: *Obesity, Neuropathy, Diabetes, Hypertension, Duration of disease, Factor analysis, Factor loading.*

INTRODUCTION

Obesity and overweight are the responsible factors for more than 30 chronic non-communicable diseases, including diabetes, hypertension, cardiovascular diseases, high cholesterol, neuropathic pain and inflammation, migraine, musculoskelated system disorders such as low back pain, osteoarthrities, neck pain and many others poor health conditions [1, 2, 3,4]. Neuropathic pain that does not arise from musculoskelated damage is high in the high body mass index case [5]. The prevalence of obesity was increasing in many countries due to upward social mobility and the problem was shifting towards lower socioeconomic group of people [6, 7, 8, 9]. The problem of obesity was also in increasing trend in developed countries [6, 7, 8, 9, 10, 11]. It is a growing problem worldwide and is associated with a range of comorbidities, including cognitive dysfunction [5, 12]. Obesity and high fat-feeding, lead to systematic inflammation and excess circulating free fatty acids. Central inflammation in obesity leads to negative outcomes on cognition. Migraine with aura, as obesity, is a risk factor for cardiovascular disease [5]. Again, obesity is associated with depression [13]. It is negatively correlated with quality life and physical activity [14].

In 2016, WHO reported that the overweight adults were 1.9 billion and obese adults were 650 million throughout the world [15]. Thus, World Health Organization considers this health hazard as an epidemic worldwide and it needs public health intervention to control those factors which are associated with obesity and hence with diabetes and its related health problem [16].

It had been observed in some studies, both in home and abroad, that behavioural factors, like dietary habit, physical inactivity, sedentary activity were the responsible factors for obesity and diabetes except the clinical and bi-clinical conditions [17, 18, 19, 20]. Beside these, some other socioeconomic variables and clinical factors were also associated with obesity, and neurological problem [20 - 31].

Keeping the above neuropathic problem originated from obesity in mind, the objective of this study was planned to identify some socioeconomic characteristics responsible for obesity and neuropathy simultaneously.

METHODOLOGY

For the present study, it was decided to cover a quota of 70% diabetic adults by convenient sampling plan so that sufficient number of obese and neuropathic patients would be included in

the sample [32]. The investigators who were doctors and nurses were instructed to collect data from and nearby their working places. But due to some social and physical constraints data were recorded from960 adults covering 66.9% diabetic patients instead of 70%. The remaining 33.1% were normal subjects. The sample respondents were of ages 18 years and above and they were interviewed from both urban and rural localities during academic session 2017 – 18. For data collection a pre-designed and pre-tested questionnaire had been utilized. Maximum questions in the questionnaire were related to different socioeconomic variables and lifestyle of the respondents including their existing medical condition and treatment status. Except personal socioeconomic information, data on monthly family income and monthly family expenditure were also recorded. The value of each of the variable was noted in nominal scale. The data of weight (in kg) divided by Height (in metre^2) was used to measure the value of body mass index (BMI) to identify obese adults(if BMI $\geq$ 27.5; underweight ,if BMI< 18.5; normal, if $18.5 \leq$BMI< 23.0; overweight, if 23.0 <BMI< 27.5) [33,34].They were also divided into 4 groups according to their blood pressure (B.P) level (mmHg). The 4 groups were identified as optimal (BP < 120/80), normal (BP <130/85), high normal (BP < 140/90) and hypertensive (BP $\geq$ 140/90)[35]

According to the objective of the study, association of each of the socioeconomic characteristics with prevalence of obesity neuropathy was examined. Significant association was decided if probability of any Chi-square test statistic used for observing association $\leq$ 0.05. Irrespective of significant or insignificant association, the odds ratio [O.R] in favour of a higher group (in percentage) of obese and neuropathic adults along with standard error of O.R. was calculated. Finally, factor analysis was done to identify responsible variables for obese and neuropathic adults. The responsible variables were identified depending on the higher absolute magnitude of factor loading [36,37]. All the statistical calculation was done using SPSS Version 25.

RESULT

The sample containeda total of 960 adults and 29.3% of them were obese [Table 1]. Among them 21.7% were the patients of obesity and neuropathy simultaneously as against 6.4% adults of this category in the sample. Majority (43.9%) of the respondents were overweight but none of them was the patient of this health hazard.

Table1. *Distribution of adults according to their level of obesity and prevalence of neuropathy*

Levelof Obesity	Prevalence of neuropathy				Total	
	Yes		No		n	%
	n	%	n	%		
Under-weight	0	0.0	29	100.0	29	3.0
Normal	0	0.0	229	100.0	229	23.9
Overweight	0	0.0	421	100.0	421	43.9
Obese	61	21.7	260	78.3	281	29.3
Total	61	6.4	899	93.6	960	

Similar was the case for adults of other two categories. However, level of obesity and prevalence of neuropathy was significantly associated [$\chi^2 = 157.400$,p-value=0.000].

The percentage of urban adults was 56.5 and prevalence of obesity neuropathy was noted among 7.7 % of them. The corresponding percentage among rural adults was 4.5. There was significant difference in the prevalence rates between urban and rural adults [Table 2, χ^2 =4.070, p -value = 0.042]. Prevalence rate was 1.76 times more in urban adults than in rural adults [O.R.=1.76,S.E.{ln(O.R.)}= 0.285].

More Muslim (82.6%) people were affected by (6.7%) the prevalence of the disease compared to their non-Muslim counterpart (4.8%). Muslim adults were 42% more exposed to this health problem, though religion was not associated with prevalence of obesity neuropathy [χ^2 =0.831, p - value= 0.362; O.R.= 1.42, S.E{ln(O.R.)}=0.389]. The percentage of female respondents was 44.8 and 8.8% of them were suffering from these diseases. The corresponding percentage for male was 4.3. The chance of prevalence in female was 2.14 times as it was in males. The proportions of prevalence in males and females were significantly different [χ^2 =8.070, p –value =0.004; O.R.= 2.14, S.E.{ln (O.R.)} =0.27 3].

Married (69.8%) and Single (30.2%) adults were not significantly different in respect of simultaneous prevalence rate of the diseases,

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Table2. *Distribution of adults according to prevalence of obesity neuropathy and socioeconomic characteristics*

Socioeconomic characteristics	Prevalence of obesity neuropathy				Total	
	Yes		No			
	n	%	n	%	n	%
Residence						
Rural	19	4.5	399	95.5	418	43.5
Urban	42	7.7	500	92.3	542	56.5
Total	61	6.4	899	93.6	960	100.0
Gender						
Male	23	4.3	507	95.7	530	55.2
Female	38	8.8	392	91.2	430	44.8
Religion						
Muslim	53	6.7	740	93.3	793	82.6
Non-Muslim	8	4.8	159	95.2	167	17.4
Marital status						
Currently married	47	7.0	623	93.0	670	69.8
Currently single	14	4.8	276	95.2	290	30.2
Age (in years)						
< 20	1	3.6	27	96.4	28	2.9
20 – 30	6	3.7	156	96.3	162	16.9
30 – 40	16	6.4	234	93.6	250	26.0
40 – 50	16	6.1	248	93.9	264	27.5
50$^+$	22	8.6	234	91.4	256	26.7
Education						
Illiterate	7	13.0	47	87.0	54	5.6
Primary	8	7.0	107	93.0	115	12.0
Secondary	21	9.2	208	90.8	229	23.9
Higher	25	4.4	537	95.6	562	58.5
Occupation						
Agriculture and unskilled labor	15	5.9	240	94.1	255	26.6
Business and skilled labor	7	4.3	154	95.7	161	16.8
Service	8	3.8	205	96.2	213	22.2
Housewives, students and unemployed	31	9.4	300	90.6	331	34.5
Income (in 000 taka)						
< 40	24	7.7	287	92.3	311	32.4
40 – 60	7	3.7	182	96.3	189	19.7
60 – 80	7	3.7	181	96.3	188	19.6
80 – 100	12	7.5	148	92.5	160	16.7
100$^+$	11	9.8	101	90.2	112	11.7
Smoking habit						
Yes	21	5.6	35	94.4	373	38.9
No	40	6.8	547	93.2	587	61.1

Table2. *Continued*

Socioeconomic characteristics	Prevalence of obesity neuropathy				Total	
	Yes		No			
	N	%	n	%	n	%
Family expenditure (in 000 taka)						
< 30	9	7.8	107	92.2	116	12.1
30 – 50	18	6.1	177	93.9	295	30.7
50 – 70	8	3.8	200	96.2	208	21.7
70 – 90	14	7.9	163	92.1	177	18.4
90$^+$	12	7.3	152	92.7	164	17.1
Taking restaurant food						
Yes	43	8.7	450	91.3	493	51.4
No	18	3.9	449	96.1	467	48.6
Use of can food						
Yes	37	6.3	547	93.7	584	60.8
No	24	6.4	352	93.6	376	39.2

Physical work						
Yes	18	5.1	333	94.9	351	36.6
No	43	7.1	566	92.9	609	63.4
Utilization of time						
Read and use mobile phone	2	1.4	137	98.6	139	14.5
Play and use mobile phone	8	3.3	233	96.7	241	25.1
Do household work and watch T.V.	22	8.9	225	91.1	247	25.7
Read paper and use mobile phone after office work	11	4.4	238	95.6	249	25.9
Watch T.V. and use mobile phone after office work	18	21.4	66	78.6	84	8.8
Prevalence of hypertension						
Optimal	14	3.2	422	96.8	436	45.4
Normal	26	6.9	353	93.1	379	39.5
High normal	5	5.6	85	94.4	90	9.4
Hypertensive	16	29.1	39	70.9	55	5.7
Prevalence of diabetes						
Yes	22	3.4	620	96.6	642	66.9
No	39	12.3	279	87.7	318	33.1
Duration of disease (in years)						
0	20	2.5	788	97.5	808	84.2
< 1	5	17.9	23	82.1	28	2.9
1 – 3	16	25.8	46	74.2	62	6.5
3 – 5	7	21.9	25	78.1	32	3.3
5^+	13	43.3	17	56.7	30	3.1
Total	61	6.4	899	93.6	960	100.0

though married persons were 49% more exposed to this health hazard [χ^2 =1.627,p – value=0.202; O.R.=1.49, S.E.{ln(O.R.)}=0.313]. There was an insignificant increase in prevalence rates with the increase in ages. Maximum prevalence rate was observed in adults of ages 50 years and above. This group was 60% more exposed to this health problem and they were 26.7% in the sample. The rate of prevalence of obesity neuropathy was not significantly increased with the increase in ages [χ^2 =4.474, p – value= 0.346; O.R.= 1.60,S.E.{ln (O.R.)}=0.277]. The percentage of illiterate people was only 5.6, but 13.0% of them were affected by these diseases. The chance of prevalence was 1.34 times more in illiterate adults as it was in educated people [O.R.=2.34, S.E.{ln(O.R}=0.429]. The decreasing trend in the rate of prevalence of obesity neuropathy was noted with the increase in level of education [χ^2 =10.516, p –value=0.015]. Housewives, students and unemployed people were higher (34.5%) in percentage in the sample and 9.4% of them were suffering from these two health problem simultaneously. The chance of prevalence of the problem among them was 2.06 times more as it was in other professional groups [O.R.=2.06, S.E.{ln(O.R)} = 0.266]. Significant differences in rates of prevalence in adults of different occupational patterns were

observed [χ^2 = 8.646, p –value= 0.034]. Again, it was noted that 63.4% respondents were not doing any physical labour and 7.1% of them were suffering from these diseases. The chance of prevalence in these group of respondents was 1.41 times more as it was in adults doing physical work. But there was insignificant differences in the proportions of prevalence between these two groups [χ^2 =1.398, p –value = 0.237; O.R.= 1.41, S.E.{ln(O.R.)}= 0.289].

Family income of 28.3% adults was Tk.80,000.00 and above and obesity neuropathy was prevailed among 8.5% of them. They were 58% more exposed to this health hazard [O.R.=1.58, S.E.{ln(O.R.)}=0.274]. However, significant differences in the rates of prevalence were not observed for adults belonged to families of different income levels [χ^2 =8.005,p-value=0.091]. Similar was the case for respondents belonged to families of different levels of expenditure [χ^2 = 3.69, p-value = 0.464]. But adults belonged to families spending Tk.70,000.00 and above were 38% more exposed to this health hazard [O.R.=1.38, S,E.{ln(O.R.)}= 0.268]. Again, the chance of prevalence was 1.28 times for adults belonged to families spending lowest amount of money as family expenditure [O.R.= 1.28].

The percentage of adults habituated in taking restaurant food was 51.4. The prevalence of obesity neuropathy was observed among 8.7% of them. The chance for this group of adults was 2.38 times as it was in other group of adults[O.R.=2.38, S.R.{ln(O.R.)}= 0.289]. Habit of taking restaurant food was significantly associated with the prevalence of obesity neuropathy [χ^2 = 9.550,p –value=0.002]. Insignificant association between habit of taking can food [χ^2 = 0.001, p –value=0.977] and prevalence of obesity neuropathy was noted, though 60.8% of the adults were used to take can food. Consumers and non-consumers of can food were similarly exposed to this health hazard [O.R.=1.01, S.E.{ln(O.R.)} = 0.271]. Similar insignificant association between smoking habit and prevalence of obesity neuropathy was also noted [χ^2 =0.54, p –value = 0.214]. From the sample, it was observed that 61.1% adults were non-smokers. But 6.8% of them were facing this health problem and they were 23% more exposed to this problem [O.R.= 1.23, S.E.{ln(R.R.)}=0.278]. Among the sample respondents 8.8% passed their time by observing television and gossiping with others over mobile phone and 21.5% of them were the patients of obesity neuropathy. The prevalence of the disease in them was 5.28 times as it was in others[O.R.=5.28, S.E.{ln (O.R.)} =0.308]. The prevalence of obesity neuropathy was significantly associated with utilization of time by the respondents [χ^2 = 45.726,p –value= 0.000].

Out of 960 respondents 66.9% were diabetic patients. But only 3.4% of them were suffering from obesity neuropathy.

The chance of prevalence for this latter group of persons was 3.94 times as it was for diabetic adults [O.R.=3.94, S.E.{ln (O.R.)}= 0.276] The prevalence of obesity neuropathy was significantly more among non-diabetic adults [= 27.912, p –value=0.000]. Significant association between level of hypertension and prevalence of obesity neuropathy was noted [= 55.281,p-value=0.000].The sample contained 5.7% hypertensive adults and 29.1% of them were suffering simultaneously from obesity and neuropathy. The corresponding figure for non-diabetic adult was 12.3%. The prevalence for them was 7.84 times more as it was for other adults [O.R.=7.84, S.E.{ln(O.R.)}=0.334]. Duration of disease was significantly associated with prevalence of obesity neuropathy[= 147.981,p-value=0.000]. Only 3.1% adults were suffering for 5 years or more from different diseases, but 43.3% were the patients of obesity and neuropathy simultaneously. The prevalence rate was 14.05 times for them as it was in others.[O.R.=14.05, S.E.{ln (O.R.)}=0.397].

FACTOR ANALYSIS

According to the objective of the study, factor analysis was done using the variables residence. religion, gender, age, marital status, education, occupation, income, expenditure, utilization of time, habit of taking restaurant food and can food, physical activity, smoking habit, prevalence of diabetes, hypertension and duration of disease. Some of the variables were dropped from the analysis at final stage when communality of those variables were found less than 0.40 [38]. The results were shown in Table3.It was seen that the most responsible variable for the prevalence of obesity neuropathy was smoking habit followed by physical activity, occupation, gender, habit of taking can food and utilization of time.

Table3. *Results of factor analysis*

Variable	Communality	Coefficient of		
		Factor - 1	Factor-2	Factor -3
Smoking habit	0.743	0.854	0.018	0.111
Physical activity	0.717	-0.845	-0.046	0.035
Occupation	0.747	0.807	0.252	0.178
Gender	0.645	0.767	-0.091	0.220
Habit of taking can food	0.582	0.573	-0.484	0.129
Utilization of time	0.625	-0.363	0.198	0.674
Hypertension	0.491	-0.223	0.482	0.457
Income	0.911	0.179	0.872	-0.344
Expenditure	0.932	0.134	0.901	0.320
Habit of taking restaurant food	0.758	0.015	-0.484	-0.724
Age	0.543	0.007	-0.108	0.729

DISCUSSION

Obesity is the cause of different types of non-communicable diseases, viz. diabetes, hypertension, cardiovascular disease, depression [1,2,8,10,13,31]. Except these, clinical and subclinical aspects, specially, neurological problem of the type migraine, neuropathic pain, nerve damage, osteoarthritis, etc. are the problems of obese and diabetic patients [1, 3, 5, 12,28,41,42]. Some of the demographic characteristics are also responsible for the prevalence of obesity neuropathy [1, 7, 8, 9, 11, 13, 18, 19]. Accordingly, an attempt was made to identify the most responsible socioeconomic variable for this health hazard. To fulfil the objective, the analysis was done using the collected data of 960 adults of ages 18 years and above from both urban and rural localities of Bangladesh. Out of 960 adults, 66.9% were diabetic and 3.4% of them were suffering from both obesity and neuropathy as against 6.4% obese neuropathic patients in the sample. The percentage of obese adults was 29.3 and 21.7% of them were also neuropathic. A big group of adults were obese and diabetic and these two clinical aspects were the responsible factors for peripheral neuropathy. This phenomenon was noted earlier also [11]. This study also indicated that obesity originated neuropathic problem was dominant among Muslims, females, illiterate people, married people , elderly people, physically inactive people, hypertensive adults and people from urban area. In earlier study it was noted that female and lower educated people were in depression due to obesity [13, 31].

Due to higher economy lifestyle usually changes. People from higher economic conditions have the scope to be habituated with restaurant food and can food. These phenomena are the lifestyle factors. From this study it was noted that people having upward lifestyle were more exposed to the problem of obesity neuropathy. In earlier study also it was reported that quality life was the risk factor for obesity neuropathy [13]. However, the most responsible factor for the prevalence of obesity neuropathy was smoking habit. The other responsible variables were physical inactivity in terms of physical labour and occupation and sedentary activity.

CONCLUSION

The information contained in the paper were the analytical results of data collected from some rural and urban people of Bangladesh. The respondents were adults of ages 18 years and above. Number of investigated persons were 960.Out of them, 6.4% were suffering from obesity and neuropathy simultaneously. The percentages of urban people, Muslims, females, married persons and elderly people were 56.5, 82.6, 44.8 , 69.8, and 26.7 respectively. All these 5 groups were more exposed to the prevalence of obesity neuropathy. There were only 5.6% illiterate adults and for this group the chance of prevalence was 2.34 times as it was in other educated adults. The chance of prevalence was more than two times in physically inactive adults and more than 5 times for adults involved in sedentary activities. Upward quality lifestyle in respect of economy and food habit were the risk factors for the prevalence of obesity neuropathy. The chances of prevalence were 7.84 and 14.05 in hypertensive adults and in adults suffering for longer duration, respectively.

Factor analysis identified some responsible factors for the prevalence of obesity neuropathy. The most responsible one was smoking habit followed by physical inactivity, gender, habit of taking can food and sedentary activity.

Due to upward social mobility, obesity and diseases related to obesity cannot be avoided. But there should be some measures so that the rate of obesity in people can be reduced. Some of the suggested measures are

(i)To control the body weight by doing some physical work and developing the habit of walking whenever it is possible,

(ii)To avoid restaurant and can food, salty and fatty food and to develop the habit of taking home made food as per as possible,

(iii)To avoid smoking and taking drugs and drinks,

Government agencies providing health services in both urban and rural areas, social workers and private practitioners can encourage the people to follow the above suggestions.

REFERENCES

[1] Mokdad, A.H.; Ford,E.S.; Bowman,B.A.; Dietz, W.H.; Vinicor,F.; Bales,V.S. and Marks,J.S.(2003): Prevalence of obesity , diabetes, and obesity-related health risk factors 2001, JAMA, 289,76 – 79.

[2] Barnes, S.A. (2011): The epidemic of obesity and diabetes: Trend and treatment, Tex Heart Inst.,38(2), 142 – 144.

[3] Bigal,M.E.; Lipton, R.B.; Holland, P.R. and Goadsby, P.J. (2007): obesity, migraine, and chronic migraine : Possible mechanisms of interaction, Neurology, 68(21), 1851- 1861.

[4] Miller, A.A.; Spencer, S.J. (2014): Obesity and neuroinflammation : a pathway to cognitive impairment, brain, behavior and immunity, 42, 10 – 21.

[5] Houzumi, J.; Sumitani, M.; Matsubayashi, Y. Abe, H.; Oshima, Y.; Chikuda, H.; Takeshita, K.; and Yamada, Y.(2016): Relationship between neuropathy pain and obesity, Pain Research Management, ArticleI.D. 2487924, https://doi.org/10.1155/2016/2487924

[6] Dhurandhar, N.V.(2001): Contribution of pathogene in human obesity. Drug News & Perspectives, 7(5), 307- 313.

[7] Berg, C.; Rosengren, A.; Aives, N. et al (2005): Trendis in overweight and obesity from 1985 to 2002 in Goteberg, West Sweden, Inter. Jour. Obesity, 29(8), 916- 924.

[8] 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 Geriatrics Society, 56(5), 954 – 955.

[9] Haslam, D.W. and James, W.P. (2005: Obesity, Lancet, 366, 1197 – 1209.

[10] John, E.H.; Jussara, M do, Carmo.; Alexander, A da Silva.; Zhen, W. and Michael, E.H. (2015): Obesity- Induced hypertension: Interaction of nuerohumoral and renal mechanisms, Circulation Research, 116, 991 –

[11] Theodore, A.K.(2010): Obesity-related hypertension: Epidemiology, Pathophysiology, and clinical management, Amer Jour Hypertension, 23(1), 1170 – 1178. https://doi.org/10.1038/ajh.2010.172.

[12] Singleton, J.; Volckmann, E.; Graham, T. and Smith, A. (2014): Neurology associated with non-diabetic obesity, 82(10), (s36.006).

[13] Lassarre, A.M. ; Glauss,J. ; vandeleur,C.L.; Vidal, M.P.; Voucher, J.; Bastardot, F. Waeber,G. and Vollenweider,P. (2014): Depression with atypical features and increase obesity, body mass index, waist circumference and fat mass: A prospective population –based study, JAMA, Psychiatry, 71(8), 880- 888.

[14] Neuman, L.; Lerner, E.; Glazer, Y.; Bolotin,A.; Shefer, A and Buskila, D. (2008): A cross-sectional study of the relationship between body mass index an clinical characteristics, tenderness measures, quality life, and physical functioning in fibromualgin patients, Clinical Rheumatology, 27(12), 1543 – 1547.

[15] WHO (2020): Fact Sheets/Detail/Obesity and overweight, March 2020.

[16] WHO (2007): The Challenge of obesity in the WHO European region and strategies for response; Edited by Branca, F. ; Nikogosian,H.; Lobstein, T.C. , Copenhagen.

[17] Weiss, R.; Dzria, J.; Burgert, T.S.et al (2014): Obesity and the metabolic syndrome in children and adolescents, N. Engl .J. Med.,350, 2362 – 2374.

[18] 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), 1067-79,.Doi:10.1111/j.1467-789X.2012.010.x.

[19] Misra, A. and Khurana, L. (2008): Obesity and the metabolic syndrome in developinf countries, J Clin. Endocrinal Metab, 93, 51 – 58.

[20] Mansion, J.E. ; Willett, W.C. ;Colditz, G.A.; Hunter, D.J. ; Hankinsom ,S.E. ; Hennekens, C.H. and Speizer, F.E. (1995): Body weight and mortality among women, N Engl J Med, 333, 677- 685.

[21] Redon, J., Cifkova, R.; Laurent, S. et al (2008): The metabolic syndrome in hypertension : European Society of hypertension position statement, *Journal of* Hypertension, 26(10), 1891 – 1900.

[22] Fardus,J. and Bhuyan, K.C. (2016): Discriminating diabetic patients of some rural and urban areas of Bangladesh: A discriminant analysis approach, Euromediterrean Bio. Jour.11(9), 134 – 140.

[23] 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.

[24] Appropriate Body Mass Index for Asian Population and its Implications for Policy and Intervention Strategies, WHO Expert Consultation, Public Health, Lancet 363, 2004.

[25] Jan, A.S. ; Yan, Li.; Azusa, H.; KEI, A.; Eamon, D. and O'Brien, E. : Blood pressure measurement anno 2016. Amer Jour Hypertens, 2017, 30(5), 453 – 463.https: //doi:org/10. 1093/ajh/hpw 148.

[26] Yotoka,T.(1983): Some criteria for variable selection in factor analysis, Behaviormetrika, 13,31 -45.

[27] Rusico, J. and Roche, B.(2012): Determining the number of factors to retain in an exploratory factor analysis using comparison data of known factorial structure, Psychological Assessment, 24(2), 282 – 292,doi:10.1037/a 0025697

[28] Bhuyan,K.C. (2020): Socioeconomic variables responsible for exclusively diabetes among Bangladeshi adults, Acta Scientific Nutritional Health, 4(3), 01 – 06.

[29] Grundy, S.M.(2004): Obesity, metabolic syndrome, and cardiovascular disease, Clin. Endocrinol Metab,89, 2595 – 2600.

[30] Felso, D.T.;Anderson, J.J.; Naimar, K.A.; Walker, A.M.; Meenan, R.F.(1998): Obesity and knee osteoarthirities: The Framingham Study, Ann. Int.Med., 109, 18 – 24.

[31] Bourne, R.; Mukhi, S.; Zhu, N.; Keresteci,M. (2007): Role of obesity on the risk for total hip or knee arthroplasty, Clin. Orthop.Relat.Res., 465, 185 – 188.