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Association between Body Mass Index and Diabetic Complications among Type-2 Diabetic Patients in Semi-Urban Area, Bangladesh

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Abstract- Aims: The purpose of the study was to estimate the association between body mass index and diabetic complications of patients with type 2 diabetes mellitus in the semi-urban area (Savar), Bangladesh.

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Results: A total of 420 type-2 diabetic patients were investigated. Out of these, 248 were male, and 172 were female (mean±SD of age, 47.5±6.4 years). It was estimated that 23.8% had normal weight, 44.8% were overweight, and 31.4% were obese. The study found significant association between body mass index (BMI) and complications faced by the patients: BMI and hypertension ($\chi^2=14.987$, $df=2$, $p=0.001$); BMI and neuropathy ($\chi^2=14.697$, $df=2$, $p=0.001$); BMI and retinopathy ($\chi^2=9.412$, $df=2$, $p=0.009$); BMI and nephropathy ($\chi^2=25.503$, $df=2$, $p=0.000$). Multiple logistic regressions indicated that overweight and obese were significant predictors of diabetic complications ($P<0.05$).

Conclusion: Globally, the prevalence of diabetes and overweight/obese have been increasing rapidly. People who are either overweight or obese accompanied by diabetes are at increased risk of developing complications. Therefore, weight control may reduce the risk of developing diabetes and its complications.

Keywords: type-2 diabetes; BMI; hypertension; nephropathy; neuropathy.

1. INTRODUCTION

Diabetes has become a rapidly growing health burden worldwide.^[1] American Diabetes Association (ADA) has defined Diabetes Mellitus(DM) as, “a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both.”^[2] DM is a disease known since ancient times, cited by both the

Greeks and Egyptians in as early as 4,500 BC.^[3] An estimated 285 million people have type-2 diabetes globally, making up about 90 percent of all diabetes cases.^[4] In the South Asian region, Bangladesh has the second largest number of diabetes patients with a prevalence rate of 11%.^[5]

Almost all of the complications of diabetes are caused by having too much blood glucose.^[6] Type 2 diabetes mellitus (T2DM) and its macro- and micro-vascular complications are a major threat to global public health.^[7] The Centers for Disease Control and Prevention (CDC) reported that adults with diabetes are three times more likely than those without diabetes to have a history of coronary artery disease, three times more likely to have a stroke, and two times more likely to have another heart condition.^[8] It is one of the major causes of premature illness and death in most countries worldwide. The World Health Organization (WHO) reported that diabetes was the seventh leading cause of death and contributed to an estimated 1.6 million deaths in 2016.^[9] Complications Like premature atherosclerotic cardiovascular diseases, nephropathy leading to renal failure and peripheral neuropathy, cardiovascular symptoms. Hypertension and abnormalities of lipoprotein metabolism are often found in people with diabetes.^[10]

Overweight and obesity are driving the global diabetes epidemic. They affect the majority of adults in most developed countries and are increasing rapidly in developing countries.^[11] There are several studies indicating that weight loss and exercise may help in the treatment of diabetes. Weight loss and exercise have both been shown to decrease insulin resistance, a major physiological defect related to the development of diabetes, and to improve glycemic control. These interventions also ameliorate hypertension and lipid abnormalities and thus may contribute to a reduction in risk of coronary heart disease in individuals with T2DM.^[12] Hypertension is a common problem in diabetic patients. Markedly increases the risk and accelerates the course of cardiac disease, peripheral vascular disease, stroke, and nephropathy. Hypertension is approximately twice as frequent in patients with diabetes compared with patients without the disease.^[13]

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The significance of the study is derived from the available statistics that reflect a high prevalence of DM in Bangladesh; more than 11 % and it will be increased 13% by 2030.^[14] These huge number of people suffering from many kinds of diabetic complications which causes an increase in health care expenditures. So there is a need for research to reduce the diabetic morbidity. Moreover, to our knowledge, there is no study in a semi-urban area in Bangladesh that estimates of the association between a range of diabetes complications and Body Mass Index (BMI). Therefore, the current study aimed to estimate the association between diabetic complications and BMI at Jahangirnagar University and nearest Community, Savar, Bangladesh.

II. MATERIALS AND METHODS

a) Study design and population

It was a cross-sectional study conducted among diagnosed type-2 diabetic patients at Jahangirnagar University and the nearest community, Savar, Dhaka. The study was carried out in the year 2017 and 2018. A total of 420 patients with type-2 diabetes were selected conveniently. The sample size was determined by using the formula, $n = z^2 pq / d^2$.

b) Data collection

Before collection, informed consent was taken from each patient. The purpose of the interview was clearly explained to the study subjects. A semi-structured questionnaire was used as the research instrument. Data were collected by face to face interview.

c) Measures

Weight, height, and blood pressure were measured by using valid equipment. This study adopted the BMI definition of the World Health Organization (2000).^[15] Body weight was measured to the nearest 100 gm. A professional weight machine was used for body weight measurement. The height was measured in centimeter by using a measuring tape. Blood pressure (systolic and diastolic) recordings were made after the subjects had rested in the sitting position for 10 minutes using a validated sphygmomanometer. Three separate readings were taken, and their mean was recorded.^[16] Nephropathy, neuropathy, and retinopathy were diagnosed by clinical signs and symptoms using questionnaire.

d) Data Analysis

Data were collected and analyzed using Statistical Package for Social Science (SPSS), version 20.0. Chi-square test was employed to test the association between variables. Linear multiple logistic regression was employed to identify predictors of diabetic complications. The statistically significant result means that the P-value is less or equal to 0.05.

III. RESULTS

A total of 420 patients with type-2 diabetes mellitus (T2DM) were interviewed in the present study. The basic socio-demographic characteristics of the patients were shown in Table-1. The mean BMI of the patients was 27.37 ± 5.04 Kg/m². According to the BMI category, out of 420 patients, 23.8% had normal weight, 44.8% were overweight, and 31.4% were obese. (Table-1)

During the study period, blood pressure of the patients was measured. About 20% of the patients were found to be hypertensive. The patients were also asked about the complications they faced due to diabetes. The study found that 18.1% had diabetic neuropathy, 19.0% had diabetic nephropathy, and 21.9% of patients had diabetic retinopathy. (Table-2)

The study found significant association between body mass index (BMI) and complications faced by the patients: BMI and hypertension ($\chi^2=14.987$, $df=2$, $p=0.001$); BMI and neuropathy ($\chi^2=14.697$, $df=2$, $p=0.001$); BMI and retinopathy ($\chi^2=9.412$, $df=2$, $p=0.009$); BMI and nephropathy ($\chi^2=25.503$, $df=2$, $p=0.000$). (Table-3)

Logistic regression analysis further revealed that BMI was a significant predictor of complications arise among the patients with T2DM ($p<.05$). Obese patients were 3.3 times more (OR=3.3, 95% CI=1.629-6.699; $p=0.001$) and overweight patients were 1.5 times more (OR=1.5, 95% CI=0.737-3.069; $p=0.001$) likely to develop hypertension than patients with normal weight. Similarly, obese patients were at more risk to develop neuropathy than patients with normal weight (OR=2.968, 95% CI=1.516-5.811; $p=0.001$). Patients who were overweight were more prone to develop retinopathy than those who were normal (OR=2.804, 95% CI=1.417-5.549; $p=0.011$). The results also show that patients who were overweight were more likely to develop nephropathy than patients with normal weight (OR=1.073, 95% CI=0.512-2.249; $p=0.000$). Similarly, patients who were obese were about four times more likely to develop nephropathy than patients with normal weight (OR=3.667, 95% CI=1.815-7.409; $p=0.000$). (Table-4)

IV. DISCUSSION

Diabetes mellitus is a leading contributor to death and disability worldwide. The prevalence of diabetes and overweight/obese have increased rapidly worldwide.^[18, 19] Similarly, the prevalence of diabetes and the percentage of people either overweight or obese have increased substantially in Bangladesh.^[19] To our knowledge, there is no study in a semi-urban area in Bangladesh that estimates of the association between a range of diabetes complications and BMI. The present study provided the opportunity to estimate of the association between diabetic complications and BMI

among Jahangirnagar University community and nearest community in Savar, Bangladesh.

This study found that more or less twenty percent of the patients had a range of diabetic complications, including hypertension, neuropathy, retinopathy, and nephropathy. Diabetic patients with long term uncontrolled blood sugar may develop various serious complications. Among the most prevalent complications are kidney disease, blindness, and amputations reported in previous studies.^[20, 21] Elevated blood pressure is observed in diabetic patients about 1.5 to 2 times more frequently than among non-diabetic patients.^[22] The study estimated that almost half of the diabetic patients were overweight, whereas one-third of those were obese. Physical inactivity and patient's reluctances to follow dietary guideline may be the reasons for weight gain in Bangladesh.

Overweight and obesity are known to increase blood pressure, which is the leading cause of strokes. Excessive weight gain also increases the chances of developing other problems, including high cholesterol, high blood sugar, and heart disease.^[23] Diabetic patients, either overweight or obese, are at increased risk of developing diabetic complications. Obesity accompanying with T2DM is known to be closely linked with insulin resistance and elevated sympathetic nervous activity.^[24] It has been frequently reported in the literature that obesity, hypertension, and diabetes are high-risk factors for subsequent cardiovascular and renal complications. This study revealed that hypertension, neuropathy, retinopathy, and nephropathy were associated with BMI ($p < 0.05$). More or less comparable results were reported in some previous studies.^[22, 24, 25] Weight control is an important step for the management of diabetic complications. Physical activity helps to maintain a healthy weight. Regular exercise may bring about many possible health benefits, and contribute to weight loss, prevent weight regain, improve insulin sensitivity, glycaemic control.^[26]

V. CONCLUSION

Globally the prevalence of diabetes and overweight/obese have been increasing rapidly. People who are either overweight or obese accompanied by diabetes are at increased risk of developing complications. Therefore, weight control may reduce the risk of developing diabetes and its complications.

VI. DECLARATIONS

Funding
Self.

Ethical issues

This study was conducted maintaining ethical standards to the highest possible extent. Before the assessment, informed consent was taken from all the patients, participated in this study. This study was

approved by the Department of Public Health and Informatics, Jahangirnagar University, Savar, Dhaka. The study was also followed by "recommendations guiding physicians in biomedical research involving human subjects," adopted by the 18th World Medical Assembly, Helsinki, Finland, June 1964.

Conflict of interest

No conflict of interest.

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LIMITATIONS

The study was not free of limitation. The population was selected conveniently, so there might be a chance of bias. Limited sample size due to self-funding may restrict for generalization. The limited resources such as reports, statistical data, books, and journals were also a limitation.

REFERENCES RÉFÉRENCES REFERENCIAS

1. Chiasson J-L, Josse R G, Gomis R, Hanefeld M, Karasik A, Laakso M, et al. Acarbose for prevention of type 2 diabetes mellitus: the STOP-NIDDM randomised trial. *The Lancet* 2002; 359(9323): 2072-7.
2. American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes Care* 2010; 33(Supplement 1): S62-9.
3. Width M, Reinhard T. The clinical dietitian's essential pocket guide. Lippincott Williams & Wilkins Philadelphia; 2009.
4. Ahlam M S, Ganai B, Zargar M, Seema A. In vivo study of anti-diabetic activity of *Eremurus himalaicus*. 2013.
5. Federation I D. IDF diabetes atlas. Bruss Int Diabetes Fed 2013.
6. American Diabetes Association. Total prevalence of diabetes & pre-diabetes. Am Diabetes Assoc Httpdiabetes Orgdiabetes-Stat Jsp Accessed April 18 2008 2008.
7. World Health Organization. Diabetes action now: an initiative of the World Health Organization and the International Diabetes Federation. 2004.
8. Centers for Disease Control and Prevention (CDC). Self-reported heart disease and stroke among adults with and without diabetes--United States, 1999-2001. *MMWR Morb Mortal Wkly Rep* 2003; 52(44): 1065.
9. Diabetes [Internet]. [cited 2019 Mar 17];Available from: <https://www.who.int/news-room/fact-sheets/detail/diabetes>
10. National Diabetes Data Group. Classification and diagnosis of diabetes mellitus and other categories

- of glucose intolerance. *Diabetes* 1979; 28(12): 1039–57.
11. Kelly T, Yang W, Chen C-S, Reynolds K, He J. Global burden of obesity in 2005 and projections to 2030. *Int J Obes* 2008; 32(9): 1431.
 12. Maggio C A, Pi-Sunyer F X. The prevention and treatment of obesity: application to type 2 diabetes. *Diabetes Care* 1997; 20(11): 1744–66.
 13. Sowers J R, Epstein M, Frohlich E D. Diabetes, hypertension, and cardiovascular disease: an update. *Hypertension* 2001; 37(4): 1053–9.
 14. Federation I D. IDF diabetes atlas. Bruss Int Diabetes Fed 2013.
 15. World Health Organization. Obesity: preventing and managing the global epidemic. World Health Organization; 2000.
 16. Pickering T G, Hall J E, Appel L J, Falkner B E, Graves J, Hill M N, et al. Recommendations for blood pressure measurement in humans and experimental animals: part 1: blood pressure measurement in humans: a statement for professionals from the Subcommittee of Professional and Public Education of the American Heart Association Council on High Blood Pressure Research. *Circulation* 2005; 111(5): 697–716.
 17. Chen L, Magliano D J, Zimmet P Z. The worldwide epidemiology of type 2 diabetes mellitus—present and future perspectives. *Nat Rev Endocrinol* [Internet] 2012 [cited 2019 Mar 17]; 8(4): 228–36. Available from: <https://www.nature.com/articles/nrendo.2011.183>
 18. Reilly J J, El-Hamdouchi A, Diouf A, Monyekei A, Somda SA. Determining the worldwide prevalence of obesity. *The Lancet* [Internet] 2018 [cited 2019 Mar 17]; 391(10132): 1773–4. Available from: [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(18\)30794-3/abstract](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(18)30794-3/abstract)
 19. Akter S, Rahman M M, Abe S K, Sultana P. Prevalence of diabetes and prediabetes and their risk factors among Bangladeshi adults: a nationwide survey. *Bull World Health Organ* 2014; 92: 204–213A.
 20. Forbes J M, Cooper M E. Mechanisms of Diabetic Complications. *Physiol Rev* [Internet] 2013 [cited 2019 Mar 17]; 93(1): 137–88. Available from: <https://www.physiology.org/doi/full/10.1152/physrev.00045.2011>
 21. Singh R, Kaur N, Kishore L, Kumar Gupta G. Management of diabetic complications: A chemical constituents based approach. *J Ethnopharmacol* [Internet] 2013 [cited 2019 Mar 17]; 150(1): 51–70. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0378874113006053>
 22. Arauz-Pacheco C, Raskin P. Hypertension in diabetes mellitus. *Endocrinol Metab Clin* 1996; 25(2): 401–423.
 23. Health Risks of Being Overweight | NIDDK [Internet]. Natl. Inst. Diabetes Dig. Kidney Dis. [cited 2019 Mar 17]; Available from: <https://www.niddk.nih.gov/health-information/weight-management/health-risks-overweight>
 24. Masuo K, Rakugi H, Ogihara T, Esler M D, Lambert GW. Cardiovascular and renal complications of type 2 diabetes in obesity: role of sympathetic nerve activity and insulin resistance. *Curr Diabetes Rev* 2010; 6(2): 58–67.
 25. Idogun E S, Unuigbo E I, Famodu A A, Akinola O T. Body mass index in type 2 diabetes mellitus complications: hypertensive diabetics and diabetic nephropathy. *Niger Postgrad Med J* 2006; 13(1): 17–20.
 26. Bukht M S, Ahmed K R, Hossain S, Masud P, Sultana S, Khanam R. Association between physical activity and diabetic complications among Bangladeshi type 2 diabetic patients. *Diabetes Metab Syndr Clin Res Rev* 2019; 13(1): 806–809.

Table 1: Socio-demographic characteristics of the patients with T2DM (n=420)

| Variables | Frequency | Percentage (%) | Mean(±SD) |
|--------------------|-----------|----------------|------------|
| Socio-demographics | | | |
| Gender | | | |
| Male | 248 | 59.0 | |
| Female | 172 | 41.0 | |
| Age (years) | | | |
| 30-40 | 60 | 14.3 | 47.2(±6.4) |
| 40-50 | 204 | 48.6 | |
| >50 | 156 | 37.1 | |
| Education | | | |
| Low educated (1-9) | 224 | 53.3 | |
| High educated (>9) | 196 | 46.7 | |
| Employment status | | | |
| Unemployed | 144 | 34.3 | |
| Employed | 276 | 65.7 | |
| Marital status | | | |
| Unmarried | 12 | 2.9 | |

| | | | |
|-----------------------------|-----|------|-------------------------|
| Married | 408 | 97.1 | |
| Monthly income (BDT) | | | |
| 5,000-15,000 | 116 | 27.6 | 25,305 ($\pm 11,507$) |
| 15,000-30,000 | 208 | 49.5 | |
| >30,000 | 96 | 22.9 | |

Table 2: Complications reported by the patients with T2DM (n=420)

| Complications | Frequency | Percentage (%) |
|---------------------|-----------|----------------|
| Hypertension | | |
| Yes | 85 | 20.2 |
| No | 335 | 79.8 |
| Neuropathy | | |
| Yes | 90 | 21.4 |
| No | 330 | 78.6 |
| Retinopathy | | |
| Yes | 92 | 21.9 |
| No | 328 | 78.1 |
| Nephropathy | | |
| Yes | 80 | 19.0 |
| No | 340 | 81.0 |

Table 3: Distribution of various complications of the patients with T2DM according to BMI category (n=420)

| Variables | Total (420); n (%) | Complications; n (%) | X ² test value | df | p-value |
|------------|--------------------|----------------------|---------------------------|----|---------|
| BMI | | Hypertension | 14.987 | 2 | .001 |
| Normal | 100(23.8) | 12 (12.0%) | | | |
| Overweight | 188(44.8) | 32(17.0) | | | |
| Obese | 132(31.4) | 41(31.1%) | | | |
| BMI | | Neuropathy | 14.697 | 2 | .001 |
| Normal | 100(23.8) | 14(14.0%) | | | |
| Overweight | 188(44.8) | 33(17.6%) | | | |
| Obese | 132(31.4) | 43(32.6%) | | | |
| BMI | | Retinopathy | 9.412 | 2 | .009 |
| Normal | 100(23.8) | 12(12.0%) | | | |
| Overweight | 188(44.8) | 52(27.7%) | | | |
| Obese | 132(31.4) | 28(21.2%) | | | |
| BMI | | Nephropathy | 25.503 | 2 | .000 |
| Normal | 100(23.8) | 12(12.0%) | | | |
| Overweight | 188(44.8) | 24(12.8%) | | | |
| Obese | 132(31.4) | 44(33.3%) | | | |

Table 4: Association of BMI category with various complications of the patients with T2DM as explored by binary logistic regression (n =420)

| Variables | Unadjusted Model | | |
|------------|------------------|------------------------------|---------|
| | Odds Ratio (OR) | 95% Confidence Interval (CI) | p-value |
| BMI | Hypertension | | |
| Normal | Ref | | .001 |
| Overweight | 1.504 | (0.737-3.069) | |
| Obese | 3.304 | (1.629-6.699) | |
| BMI | Neuropathy | | |
| Normal | Ref | | .001 |
| Overweight | 1.308 | (0.664-2.577) | |
| Obese | 2.968 | (1.516-5.811) | |
| BMI | Retinopathy | | |
| Normal | Ref | | .011 |
| Overweight | 2.804 | (1.417-5.549) | |
| Obese | 1.974 | (0.948-4.111) | |
| BMI | Nephropathy | | |
| Normal | Ref | | .000 |
| Overweight | 1.073 | (0.512-2.249) | |
| Obese | 3.667 | (1.815-7.409) | |