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# A comparative study of Nutritional Status among the Eastern Indian Type 2 Diabetes and Diabetic Nephropathy patients Population of West Bengal

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KEYWORDS

Type 2 diabetes, Nephropathy, Short stature, Eastern Indian, Population

ABSTRACT

*To examine the association between nutritional status and type 2 diabetes disease phenotype in Eastern Indian patients' population of West Bengal, the present study covered 718 participants, out of which 168 were type 2 diabetic nephropathy patients on hemodialysis (T2DNH), 246 were type 2 diabetes patients without nephropathy (T2DM) which were compared with 304 unrelated healthy controls (CON). Participants were born in Bengalee families at Kolkata and the surrounding area. Data were analyzed by the use of ANOVA and Post Hoc tests to explore the inter and intra group differences. We found that the type 2 diabetic (T2DM) and diabetic nephropathy (T2DNH) patients were relatively shorter (P for trend < 0.01) while Controls were taller (P < 0.01) and heavier (P < 0.01) than patients groups. The T2DNH patients have higher readings of systolic and diastolic blood pressure compared to T2DM patients and Controls (P < 0.01). The basal metabolic rate also differed significantly between the study groups recording relatively higher mean value among Controls (P < 0.01). As expected glucose level was significantly higher in T2DM groups (P < 0.01). Comparatively higher percentages (14.29 %) of participants were found to be underweight among the type 2 diabetic nephropathy patients group. In sum, this study directly shows a positive association between short stature with type 2 diabetes and diabetic nephropathy diseased groups of Eastern Indian population of West Bengal.*

**Association of Short stature with Type 2 diabetes and Diabetic Nephropathy Patients of West Bengal**

## Introduction:

Type 2 Diabetes mellitus and related complications are rapidly emerging global health problem and expected to cross the pandemic level within a span of another two decades. It is an important public health problem in developed and developing countries like India. Worldwide its frequency is expected to rise from 171 million to 366 million within the next two decades and India will become the leading country with the highest number of diabetic patients (Wild et al. 2004). It is well documented that type 2 diabetes is significantly correlated with the presence of many risk factors such as blood pressure, BMI, WHR, coronary heart disease, gender difference, advancing of age, diet and obesity (Ramachandran et al. 2000; Kanaya et al. 2002 ; Park et al. 2004; Wild et al. 2004; Freemantle et al. 2008). Type 2 diabetes mellitus with high blood pressure leads to microvascular complications such as nephropathy, neuropathy and retinopathy. Among these complications nephropathy is the leading cause of chronic kidney disease in patients with diabetes mellitus (Michel et al. 2007). Diabetic nephropathy is a complex process which accounts for reduced life expectancy in various countries around the world and it involves the contribution of several etiologies both genetic as well as environmental in nature. The prevalence of diabetic nephropathy in Type 2 diabetes subjects is reported to be 5-9% from various Indian studies (John and Kangasabapathy, 1991) and nearly 30%

of chronic renal failures in India are due to diabetic nephropathy (Agarwal and Dash, 2000).

The rapid expansions of economy and urbanization in recent years in Indian subcontinent have changed lifestyle in many folds. These changes involving major deviation of diet pattern decreased physical activity and increased high level of mental stress etc. (Mohan et al. 1986; McKeigue et al. 1991; Davey et al. 2000; Abate et al. 2001; Ramachandran et al. 2003; Mohan et al. 2007; Mehta et al. 2009). Therefore, the occurrence of this disease is increasing in India due to the quick changing towards western lifestyle. Hence, in a country like India with the burden of type 2 diabetes and its complications, early screening and diagnosis have immense importance to achieve the goal of reduction of frequency to the disease.

Therefore, the aim of the present study was to investigate the distribution of anthropometric variables, nutritional status and its relationship with type 2 diabetic and nephropathy patients in Eastern Indian population.

## Materials And Method:

A cross-sectional case control study was undertaken. Patients were recruited from registered patients list of two participating medical institutions, namely Calcutta Medical College and Hospital (Kolkata, West Bengal) and B.P. Poddar Hospital and Research Centre (Kolkata, West Bengal). A standardized protocol was implemented to obtain data from each of the study participants. Ethical committee clearance was obtained from the medical institutions prior to the recruitment of subjects in this study. An informed consent was obtained from all the participants prior to their recruitment for the study.

### *Participants:*

A total of 718 participants were included in this study. Out of 718 only 414 Participants were type 2 diabetes patients with or without nephropathy, who had been taking anti-diabetic medication since more than 5 years and 304 participants were healthy controls with no family history of any metabolic diseases. The present study covers only ethnic Bengalee population. Participants are born in Bengalee family at Kolkata and the surrounding area. The study included 168 type 2 diabetic nephropathy patients on hemodialysis (T2DNH), 246 type 2 diabetes patients without nephropathy (T2DM) and 304 controls (CON). The identification of Type 2 diabetic and nephropathy patients was based on physician's recommendation or registered patient for dialysis. A detailed medical history of each patient was recorded. The unrelated controls were randomly selected and recruited from local community centers.

Measurements:

All the participant patients and controls were measured for anthropometric as well as physiological measurements like weight (kg), height (cm), systolic blood pressure (SBP) and diastolic blood pressure (DBP) were collected using standard technique. Clinical information regarding duration of diabetes, presence of any complication and history of other disorders were recorded. Anthropometric measurements namely height vertex (cm), and weight (kg) were measured using standard methodology (Weiner and Lourie 1981; Lohman et al. 1988). Height and weight were recorded to the nearest 0.1 cm and 0.5 kg, respectively. Body Mass Index (BMI) was calculated as weight in kilograms divided

by height in meters square (weight in kg /height m2). Conventional BMI cut off points were applied to classify the studied population into four categories following WHO expert group (WHO 1995, 2000, 2004). Blood pressure was measured from the right arm of the participants using a regularly calibrated automated Blood pressure monitor M4 (OMRON Corporation, Tokyo 105, Japan). Before measurement each individual was made comfortable and made to seat at least for 15 minutes on the chair before measurement. Hypertension was defined as systolic blood pressure (SBP) >140 mmHg and/or diastolic blood pressure (DBP) > 90 mmHg as per US Seventh Joint National Committee on Detection, Evaluation and Treatment of Hypertension (JNC VII) criteria (Chobanian et al. 2003). Capillary Glucose (mg/dl) was measure by Bayer's Breeze 2 blood glucose meter (Bayer Health Care LLC, Mishawaka, I M 46544, USA). All the instruments were calibrated and verified before use. The Basal Metabolic Rate (BMR) is estimated with most commonly used Mifflin - St Jeor equation (Mifflin and Jeor et al. 2005):

BMR (Kcal/day) for Male = 10 * weight (kg) + 6.25 * height (cm) - 5 * age (y) + 5

BMR (Kcal/day) for Female = 10 * weight (kg) + 6.25 * height (cm) - 5 * age (y) - 161

***Statistical analysis:***

The anthropometric, blood pressure and glucose data collected from patients and Controls were analyzed for descriptive statistics (Mean ± SD), ANOVA and Post Hoc tests to find differences in mean and F values for significance between different study groups. Statistical significance was assumed at the 1% and 5% level. All data were analyzed with SPSS (Statistical Package for social sciences, Version 16, SPSS).

## Results And Discussion:

***Results:***

The number and percentage of male and female individuals were included in the present study presented in Table 1 and exhibit that the control subjects consisted of 59.21 % males and 40.79 % females. Among the T2DNH and T2DM cases, 53.57 % and 52.03 % were males while 46.43 % and 47.97% females. All subjects were near age matched with a mean age of 54.41±5.29 years for Controls, 55.45±9.29 years for T2DM and 54.49±8.08 years for T2DNH.

The descriptive statistics of metric variable among the study groups respectively as per their diabetic status are presented in Table 2 and Table 3. The mean values of anthropometric measurements namely height, weight and estimated body mass index (BMI) and Basal metabolic rate (BMR); physiological parameters i.e. systolic blood pressure (SBP) and diastolic blood pressure (DBP) and glucose level among Controls, T2DM and T2DNH are presented in Table 2. Multiple comparisons for finding differences between specific study groups were made using Post Hoc test which is presented in Table 3.

The mean values of anthropometric measures viz. height, weight and BMR were significantly higher among the Control group when compared to T2DM and T2DNH groups. The diabetic (158.49; 62.25) and diabetic nephropathy patients (158.44; 56.06) were relatively shorter while Controls (163.03; 64.02) were taller and heavier than patients. The T2DNH patients have registered higher

readings of systolic (151.61±25.8) and diastolic (88.08±13.72) blood pressure compared to T2DM patients (137.28 / 85.27); and Controls (123.78 /82.24). The differences in mean values between the three study groups are statistically significant. Since the selected Controls subjects were healthy they always reported normal blood pressure levels only. The basal metabolic rate also differed significantly between the study groups recording relatively higher mean value among Controls (1455.7±142.12) followed by T2DM (1416.9±158.55) and lower values reported among T2DNH (1357.8±119.09) patients. As expected glucose level was significantly higher in T2DM (165.12±71.15) group than Control (113.66 ±20.24) and T2DNH (106.88±21.23) group. However T2DNH patients exhibit nearly normal levels of glucose due to dialysis and medication.

It has also been tried to see the distribution of Diabetic patients with respect to different categories of nutritional status as per BMI and the results have been shown in Figure 1. The figure shows that 14.29 % of Diabetic nephropathy patients were underweight. However 34.21% of Controls, 37.40 % T2DM and 23.81 % of diabetic nephropathy patients were found to be overweight.

## Discussion

Hypertension, diabetes as well as complication of diabetes are increasing health problems throughout the world and India is the one of the top countries as to the affected persons. Diabetic nephropathy is a pathophysiological complex process which accounts for reduced life expectancy in various countries around the world and it involves the contribution of several etiologies both genetic as well as environmental in nature. The present comparative study describes the differences in anthropometric variables with blood pressure level as well as blood glucose level among the Eastern Indian patients' population groups of West Bengal.

As mentioned in the preceding paragraphs, Controls were found to be taller significantly than T2DM and T2DNH patients. However, a difference in height between T2DM and T2DNH patients were marginal and was not significant. Further, Controls who were heavier than T2DNH differ significantly in their body weight. The difference in the weights between T2DM patients who are slightly heavier and T2DNH patients who are relatively thin is also significant. The Control subjects with relatively higher BMI differed significantly with T2DNH, while T2DM patients with a higher BMI than T2DNH also differ significantly. The results revealed that the individuals with diabetes and diabetic nephropathy were shorter and thinner than their age matched healthy Controls. Further, T2DM patients recorded slightly higher values for their height, weight and BMI than their counter part T2DNH patients. The positive relation between short stature with Type 2 diabetes is obscure in this study as well as our earlier study among the Mewari population (Purkait et al. 2015) but recent shreds of evidence suggest linkage of shorter height with less favorable metabolic profiles among young adults (Sato et al. 2014). However, there is recent evidence that shows leg length to be independently and inversely related to the increase in the ethnic specific prevalence of diabetes (Weitzman et al. 2010).

Regarding blood pressure, Controls with normal levels of SBP and DBP always differed from both T2DM and T2DNH patients who exhibited relatively higher blood pressure. However, T2DM patients with relatively lower blood pressure levels than T2DNH patients also differed significantly. The inter group differences in blood pressure levels were highly significant. Among the T2DNH group, the significantly higher mean of SBP level inferred that increase in SBP is likely to develop T2DNH, which supports the earlier findings (Fabris et al. 2005 and Vasudevan et al. 2011). Hypertension is

one of the main risk factor for the development of Diabetic Nephropathy (Ravid et al. 1998; Park et al. 1998) and probably the best known relevant factor related to its progression. The present study showed significant differences between T2DNH, T2DM and Control subjects and higher values of SBP, DBP among the T2DNH group.

Basal Metabolic Rate (BMR) of all study groups differed significantly with each other due to a relatively higher metabolic rate among Controls followed by T2DM and T2DNH. BMR is the amount of required essential energy while resting in a temperate environment during the postabsorptive state, or when the digestive system is inactive. In this state, energy will be used only to maintain vital organs, which include the heart, lungs, kidneys, the nervous system, intestines, liver, sex organs, muscles, and skin. The BMR increases with muscle mass and decreases with age.

Post Hoc test revealed that Control samples due to their lower levels of glucose, than diabetic patients, differ significantly with T2DM. Further, T2DM patients differed significantly with T2DNH patients in their glucose level. Hyperglycemia is a significant risk factor for the development of microalbuminuria, both in type 1 and in type 2 DM (Gall et al. 1997; Ravid et al. 1998). Whereas, some studies reported a deleterious effect of high glucose levels on GFR (Alaveras et al., 1997; Hovind et al. 2003).Theoretically, GFR could cause DN due to glomerular damage (Caramori et al. 1999; Silveiro et al. 1993; Brenner et al. 1996). Studies led to controversial findings regarding its role as a risk factor for the development of T2DN (Murussi et al., 2002; Caramori et al. 1999; Dahlquist et al. 2001). In conclusion, the present study exhibits a significant finding that patients groups are comparatively shorter than the control group whereas, the higher level of glucose value among the Type 2 diabetic group. As expected, diabetic nephropathy patients group has shown a higher value of blood pressure level. Due to the disease condition patients groups has the lower value of BMR than the control group because of the healthy metabolic condition.

The linkage between hypertension and body weight become clear after basic clinical and population-based research significantly clarified many aspects of the relationship between these two common and complex regulatory disturbances. Admiration of the clinical significance of hypertension related hyperglycemia has grown considerably over this same time period, to the point where obesity is recognized as a major cause of hypertension and the combination with diabetes and hypertension is recognized as a prominent cause of microvascular complication, such as nephropathy disease.

**Conflict Of Interest:** *The authors declare no conflict of interest for the present research outcome.*

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*Table 1: The study groups and sample size*

| STUDY GROUPS | | FEMALE | MALE | TOTAL |
|---|---|---|---|---|
| CONTROL | N (%) | 124 (40.79) | 180 (59.21) | 304 (100) |
| T2DM | N (%) | 118 (47.97) | 128 (52.03) | 246 (100) |
| T2DNH | N (%) | 78 (46.43) | 90 (53.57) | 168 (100) |
| TOTAL | N (%) | 320 (44.57) | 398 (55.43) | 718 (100) |

*Table 2: Descriptive statistics (ANOVA) of metric variables (Anthropometric characteristics, blood pressure and Glucose level) among the study groups*

| VARIABLES | CONTROL Mean± SD | T2DM Mean± SD | T2DNH Mean± SD | F | SIG. |
|---|---|---|---|---|---|
| Height (cm) | 163.03±9.78 | 158.49±9.26 | 158.44±8.53 | 21.046 | 0.00* |
| Weight (kg) | 64.02±12.08 | 62.25±13.04 | 56.06±9.26 | 25.137 | 0.00* |
| BMI ($kg/m^2$) | 24.05±3.83 | 24.69±4.31 | 22.35±3.48 | 18.190 | 0.00* |
| SBP (mmHg) | 123.78±21.31 | 137.28±20.02 | 151.61±25.8 | 88.498 | 0.00* |
| DBP (mmHg) | 82.24±10.27 | 85.27±10.4 | 88.08±13.72 | 15.289 | 0.00* |
| BMR Kcal/day) | 1455.7±142.12 | 1416.9±158.55 | 1357.8±119.09 | 25.409 | 0.00* |
| Glucose (mg/dl) | 113.66 ±20.24 | 165.12±71.15 | 106.88±21.23 | 117.37 | 0.00* |

* Significant at the 0.01 level

*Table 3: Multiple Comparisons of metric variables among study groups (Post Hoc Tests)*

| Variable | Comparison of Study groups | | Mean Difference | Sig. |
|---|---|---|---|---|
| Height (cm) | CONTROL | **T2DM** | **4.54** | **0.00*** |
| | | T2DNH | 4.59 | 0.00* |
| | T2DM | T2DNH | 0.05 | 1.00 |
| Weight (kg) | CONTROL | T2DM | 1.77 | 0.24 |
| | | T2DNH | 7.96 | 0.00* |
| | T2DM | T2DNH | 6.19 | 0.00* |
| BMI (kg/m$^2$) | CONTROL | T2DM | 0.64 | 0.17 |
| | | T2DNH | 1.69 | 0.00* |
| | T2DM | T2DNH | 2.33 | 0.00* |
| SBP (mmHg) | CONTROL | T2DM | 13.50 | 0.00* |
| | | T2DNH | 27.82 | 0.00* |
| | T2DM | T2DNH | 14.32 | 0.00* |
| DBP (mmHg) | CONTROL | T2DM | 3.03 | 0.01* |
| | | T2DNH | 5.84 | 0.00* |
| | T2DM | T2DNH | 2.81 | 0.04** |
| BMR (Kcal/day) | CONTROL | T2DM | 38.88 | 0.01* |
| | | T2DNH | 97.96 | 0.00* |
| | T2DM | T2DNH | 59.07 | 0.00* |
| Glucose (mg/dl) | CONTROL | T2DM | 51.45 | 0.00* |
| | | T2DNH | 6.78 | 0.35 |
| | T2DM | T2DNH | 58.24 | 0.00* |

* Significant at the 0.01 level; ** Significant at the 0.05 level

*Figure 1: Nutritional status among the studied groups of Eastern Indian patients Population*