Original Article

Assessment of Anthropometric Profile and Nutrient Adequacy among Middle-Aged Adults with Long Duration Type 2 Diabetes in Mumbai: A Cross-Sectional Study

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Abstract

Background: Type 2 Diabetes Mellitus is a major public health concern in India, with increasing prevalence among middle-aged adults. Nutritional status plays a crucial role in glycemic control and prevention of complications, particularly in individuals with long-duration disease. However, limited hospital-based data are available regarding anthropometric profile and nutrient adequacy among such patients.

Methods: An observational cross-sectional study was conducted with a total of 75 people aged 55-65 years (with long duration type 2 diabetes) in Mumbai city. A personal survey (Face-to-face Interview) was taken and information about their anthropometry and dietary habits were recorded. A food frequency questionnaire, 24-hour recall and dietary diversity were used to assess their nutrient intakes.

Result: According to their BMI, a greater number of people were obese (84%). According to waist circumference all females and 90% males had abdominal obesity. In the nutrient analysis, consumption of energy was low compared to EAR (1321.05 ± 241.91kcal & 1061.09 ± 249.40 kcal) and consumption of fat (54.9g ± 9.314 & 41.7g ± 10.094) and carbohydrate (144.16g ± 23.852 & 134.79g ± 32.610) was moderate in both males and females respectively. Protein consumption was slightly higher than EAR (45.5g ± 8.396 & 37.8g ±12.670) in both males and females respectively.

Conclusion: The study highlights a high prevalence of obesity and nutrient imbalance among middle-aged adults with long-duration Type 2 Diabetes Mellitus. Regular nutritional assessment and individualized dietary counselling should be integrated into routine diabetes care to improve long-term outcomes.

Keywords: Type 2 Diabetes Mellitus, Nutritional Status, Anthropometry, Nutrient Adequacy, Middle-Aged Adults, Hospital-Based Study.

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Introduction

Diabetes is being acknowledged as a major global health epidemic. According to the report of International Diabetes Federation (IDF) 2019, around 537 million adults aged 20-79 years in the world are living with diabetes. The global ubiquity of diabetes is expected to rise from 643 million (11.3%) to 783 million (12.2%) by 2045 [1].

The Framingham Heart Study data revealed that, men and women with diabetes who are 50 years and older live an average 7.5 and 8.2 years less than individuals without diabetes [2]. National non-communicable disease (NCD) monitoring survey done in rural and urban areas all over India in 2017-18, reported the prevalence of diabetes mellitus as 9.3% and impaired fasting blood glucose as 24.5%, highest among the urban middle age group (50-69 yrs). Of those with diabetes nearly half were aware 45.8%, one third on treatment 36.1%, and only 15.7% had their blood glucose level under control [3].

Since recent decades, the Type 2 Diabetes Mellitus epidemic has wreaked devastation. A chronic metabolic disorder, Diabetes Mellitus derived from Greek word 'Diabetes' means to pass through and the Latin word 'Mellitus' means sweet, which indicates high sugar level in the urine (glycosuria) of patients with diabetes [4]. Commonly diabetes is classified as type I and type II. T1DM occurs through the destruction of pancreatic beta-cells which presents in youngsters who remain entirely insulin deficient and as a consequence, require exogenous insulin. Patients with T1DM are exposed to diabetic ketoacidosis (DKA), diabetic coma and/or even death. T2DM happens due to gradual loss of insulin secretion and insulin resistance [5].

The progression of Diabetes Mellitus (T2DM) is rooted by combination of two factors: defective insulin secretion by pancreatic beta cells and the inability of insulin-sensitive tissues to respond to insulin. Therefore, defects in any of the mechanisms involved can lead to a metabolic imbalance that leads to the pathogenesis of diabetes [6].Several studies have found various risk factors associated with type 2 diabetes like, obesity, age, gender, marital status and education. Among these, obesity was the major risk factor [5].

The impact of different diets on glycemic control and weight loss is emerging nowadays. All types of diets like low-carbohydrate, low-fat, and Mediterranean diets and those replacing saturated and trans- fats with unsaturated fats significantly affect weight loss [7].

Indian diets, across states and income groups, have been found to be unhealthy. The consumption of cereals is more as compared to other food groups. Except for the richest 5% of the population, every group compared had an average daily calorie intake that is lower than the advised 2503kcal/capita/day. In India, only 6-8% of calories come from protein sources contrary to 29% in the EAT-Lancet reference diet [8]. Education and income both affect one's ability to make healthy diabetic decisions [9].

Need for the study

Despite the growing burden of Type 2 Diabetes Mellitus in India, hospital-based data on anthropometric status and nutrient adequacy among middle-aged adults with long-duration disease remain scarce. Most existing studies focus on newly diagnosed patients or community populations, leaving a critical gap in understanding dietary practices and nutritional inadequacies in individuals with established, long-standing disease. Studies have shown that long-term dietary adherence in patients with T2DM is poor, with high levels of dietary fatigue reported even among those who are aware of recommended dietary guidelines [23,24].

The present study was therefore undertaken with the objective to address this gap by assessing the anthropometric profile, dietary intake, morbidity profile and nutrient adequacy among middle-aged adults aged 55–65 years with Type 2 Diabetes Mellitus of more than five years' duration, attending a tertiary care hospital in Mumbai.

Materials & Methods

Study Design

A hospital-based cross-sectional study was conducted among patients with Type 2 Diabetes Mellitus attending the outpatient department of a tertiary care hospital in Mumbai.

Study Population

The study included 75 middle-aged adults diagnosed with Type 2 Diabetes Mellitus with a disease duration of more than five years.

Inclusion & Exclusion Criteria

Participants were included in the study if they were diagnosed cases of Type 2 Diabetes Mellitus, belonged to the age group of 55–65 years, and had a duration of diabetes of more than five years. Additionally, participants were required to be willing to provide informed consent and able to communicate in either English or Hindi. Participants were excluded from the study if they had Type 1 Diabetes Mellitus or gestational diabetes, were critically ill, or had severe complications that could significantly affect their dietary intake. Patients with severe complications affecting dietary intake, such as advanced diabetic nephropathy, gastroparesis, severe neuropathy, advanced retinopathy, diabetic foot ulcers requiring hospitalization, or severe cardiovascular disease, were excluded from the study.

Sample Size

For this study, 75 cases of Type 2 Diabetes Mellitus were recruited. They had received a confirmed medical diagnosis more than 5 years before.

Sampling Technique

Participants were selected using a non-probability convenience sampling method from patients attending the outpatient diabetes clinic. While this approach facilitates data collection in a hospital setting, it may limit the generalizability of findings to the broader population of individuals with Type 2 Diabetes Mellitus. To minimize selection bias, all eligible patients attending the clinic during the data collection period who met the inclusion criteria were approached consecutively.

Data Collection

Data were collected using an interview schedule. Participants were first provided with a Participant Information Sheet to explain the purpose of the study, ensure confidentiality, and obtain informed consent. Anthropometric measurements including height, weight, and waist circumference were recorded, and Body Mass Index (BMI) was calculated. Dietary data were collected using the 24-hour dietary recall method and a Food Frequency Questionnaire (FFQ) as described in the FAO dietary assessment guidelines (2018). The FFQ was used to assess the pattern of commonly consumed foods, while the 24-hour recall recorded the participant's daily food intake using standard household measures. Nutrient intake was calculated using the Indian Food Composition Tables (IFCT, 2017) and compared with percentage Estimated Average Requirement (%EAR 2020). Dietary diversity was assessed using the Individual Dietary Diversity Score (IDDS) based on FAO guidelines (2013), which measures the number of food groups consumed within 24 hours. The collected data were entered into MS Excel and analyzed using SPSS version 25. Descriptive statistics such as frequencies, percentages, means, and standard deviations were calculated, and a t-test was used to evaluate differences in nutrient intake between males and females. Ethical approval for the study was obtained from the ISBEC (Inter System Biomedica Ethics Committee), Mumbai, and written informed consent was obtained from all participants before data collection.

Result

This was an observational cross-sectional study to assess nutritional status of type 2 diabetic patients (with long-duration Diabetes) aged 55-65 years in Mumbai city. The study population consisted of 75 people with Type 2 diabetes of which 30 were males and 45 females.

Mean age of all the participants (n=75) was 59 ± 3.58 years. All the males were married while 20% of the females were widows. Most of the females were homemakers (84.4%) whereas 83.4% males were working. Two-thirds lived in joint families and three-fourths had an annual family income less than Rs.10 lakhs. All participants showed higher levels of blood glucose. Male participants (n=30) had a mean fasting blood sugar of 205.47 ± 34.67 mg/dL, postprandial blood sugar of 284.62 ± 43.39 mg/dL and HbA1c of 7.46 ± 0.44%. Female participants (n=45) showed a mean fasting blood sugar of 202.04 ± 42.22 mg/dL, postprandial blood sugar of 293.02 ± 52.48 mg/dL and HbA1c of 8.00 ± 1.86. No participant fell into the normal category of Fasting, Post-prandial and HbA1c.

Anthropometric data

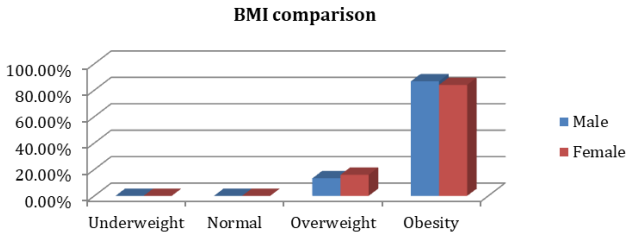

Fig. no. 1.1 BMI comparison between male and female

It was seen that greater number of participants fell into obesity category of BMI (84.0%). Similar proportion of male and female was seen in obesity category (86.7% & 82.2% respectively).

The mean BMI of all the participants was 27.9 ± 4.1.

In the current study waist circumference was 100.75cm ± 11.4 for males & 96.7 cm ± 11.0 for females which is higher compared to Asian cut-offs [17]. When compared to cut-off values i.e. ≥80cm in females and ≥90cm in males, all the females (100%) and 90% males were above the cut-off value indicating abdominal obesity.

So, the finding show that the participants had both general and abdominal obesity. This may further put them at risk of complications.

Distribution of subjects according to Self-reported symptoms

The distribution of subjects according to self-reported symptoms showed that the majority of participants experienced weakness and fatigue, with a higher prevalence among females (53.3%) compared to males (33.3%). This was followed by joint pain, which was reported by 46.7% of females and 20% of males. Additionally, frequent urination was a commonly reported symptom among both males (70%) and females (82.2%). Increased hunger and thirst were also reported, with 51.1% of males and 23.3% of females experiencing these symptoms.

Nutrient analysis

Nutrient intake was assessed using a 24-hour dietary recall and analyzed with IFCT (2017). Mean intake of energy was 1321 ± 241.9 kcal and 1061 ± 249.4 kcal, protein was 45.5 ± 8.3 g and 37.8 ± 12.6 g, fat was 54.9 ± 9.3 g and 41.7 ± 10.0 g and carbohydrate was 144.16 ± 23.8 and 134.79 ± 32.6 for males and females respectively. When expressed as percentage of Estimated Average Requirements (EAR) based on ICMR-NIN guidelines (2020), energy intakes were below the EAR (males 62.59 ± 11.46 % and females 63.89 ± 15.04 %) while protein intake met the EAR (106.02 ± 19.51 % males and 104.25 ± 34.9 % females). This was a moderate carbohydrate and protein diet with high fat intake.

Dietary Diversity Score

In the present study, IDDS (Individual dietary diversity score) were calculated from the 24- hour recall obtained for each participant.

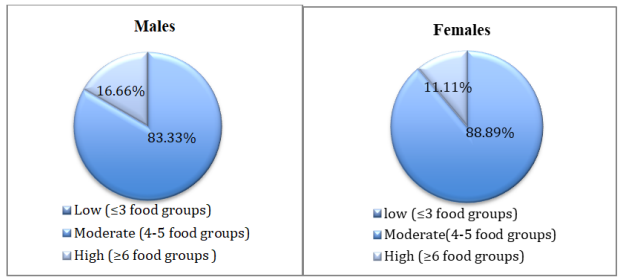

Fig. 4.1 Individual Food group consumption:

Starchy staples and milk & milk products were most consumed food groups, followed by legumes, nuts & seeds and other fruits & vegetables. Around 24% of participants had meat & fish. No one had organ meat. Eggs food group were consumed by 44% of participants. The consumption of dark green leafy vegetables was too low (2.67%).

The study included a total of 75 participants, comprising 30 males and 45 females. Overall, the combined mean score for all participants was 4.76 ± 0.67.

Dietary pattern

Data from food frequency questionnaire which reflects the pattern over last 12 months showed that cereal consumption was universal among participants, with 100% of both males and females consuming wheat flour as the staple cereal. Lentil dal was the most commonly consumed legume, other favourite being Bengal gram and green gram. Commonly consumed vegetables included bathua, spinach, cauliflower, tomato, and onion, with the

latter two consumed daily by all participants. Fruit intake was relatively low, with apple being the favourite while dates, papaya, banana, and lemon were eaten occasionally. Roots and tubers such as carrot, radish, potato, and beetroot were also commonly consumed. Almonds were consumed by 80% of participants, and packaged cow milk by all. Curd intake was slightly higher among females than males, while paneer consumption was occasional. About 57.3% of participants consumed eggs twice a week, and among non-vegetarians, mutton was the most eaten by females, while chicken and fish were consumed less frequently. Tea consumption was universal, whereas coffee was only occasional. Processed foods consumption revealed that around three-fourths of the participants consumed Namkeen as a snack option, while bakery products like biscuits were the next favourite (38.7%). Sweets and aerated drink were consumed occasionally not regularly. The higher consumption of processed foods like farsans was seen which is in line with result of SUN cohort study by Lavero-valero et al. [26].

Discussion

The present study assessed the anthropometric profile, dietary intake, and nutrient adequacy among middle-aged adults with long-duration Type 2 Diabetes Mellitus attending a tertiary care hospital in Mumbai. All the participants who were visiting the hospital had been on medication since the 5 years of diagnosis but still had high blood glucose levels. The findings indicate a high prevalence of overweight and obesity both general and abdominal, consistent with previous Indian studies, highlighting that long-standing diabetes is often accompanied by suboptimal weight management despite ongoing disease awareness. Moreover, intervention-based studies demonstrate that meaningful weight reduction is typically achieved only through structured and intensive lifestyle modifications, while routine care alone yields limited impact [14].

The mean BMI of all the participants was 27.9 ± 4.1. This study is in line with a study where overweight/obese people were more prone to being diagnosed with type 2 diabetes [15].

The diet though low in calories was high in fat. Several confounding factors may have influenced the dietary patterns observed in this study. The long duration of diabetes (>5 years) in participants may have contributed to dietary fatigue, whereby individuals with longstanding disease gradually relapse to pre-diagnosis eating habits [23]. Less of vegetables and fruits were being consumed. Socioeconomic factors, including a household income below Rs. 10 lakhs in three-fourths of participants, may have constrained access to diverse, nutrient-dense foods. Additionally, the predominantly urban Mumbai setting, with its high availability of processed and convenience foods such as namkeen and bakery products, likely shaped food choices. Though diet diversity was moderate showing the consumption of 4-5 food groups, but the amounts were less as seen in the low-calorie intake.

Medications such as metformin and insulin, which can affect appetite and gastrointestinal tolerance, may have further influenced dietary intake, though medication data were not systematically captured in this study, which represents a limitation [24].

This is a classic example of people with diabetes who are obese but consuming a low-calorie diet. Such a diet further lowers their body's metabolic rate. This could be accompanied by poor sleep, low physical activity and stress which causes the body to store more fat. These lifestyle measures could be the confounding factors which were not part of the present study.

These findings are consistent with previous studies showing that dietary practices in individuals with long-standing type 2 diabetes may remain suboptimal despite awareness of dietary recommendations. The other lifestyle factors may also play a major role [27]. A cross-sectional study among Indian patients with Type 2 Diabetes found that high dietary adherence was observed in only 4.2% of participants, despite good medication adherence of over 90%, underscoring the gap between disease knowledge and dietary behaviour[24]. Additionally, long-term adherence to dietary guidelines tends to decline, highlighting the need for continuous, individualized, and culturally appropriate nutritional interventions [20,21].

Overall, the findings suggest that dietary habits among this population are influenced by personal food preferences and the availability of foods, and

that despite awareness of diabetes management, dietary intake may not meet the recommended nutrient requirements. These results highlight the importance of regular nutritional assessment, individualized dietary counselling, and targeted dietary interventions to improve nutrition and support better diabetes management.

Conclusion

The study demonstrates a high prevalence of overweight and nutrient inadequacy among middle-aged adults with long-duration Type 2 Diabetes Mellitus. While staple foods and only the common vegetables are regularly consumed, intake of green vegetables, fruits and nutrient-dense foods is limited. Integration of regular anthropometric and dietary assessments, tailored nutrition education, and focused counselling into routine diabetes management is essential to improve long-term outcomes. These findings call for the integration of structured nutritional assessments and individualized dietary counselling into routine outpatient diabetes care protocols. Clinicians and registered dietitians working in tertiary care settings should prioritize culturally sensitive dietary interventions, especially for patients with long-standing disease who are at heightened risk of dietary fatigue and nutritional inadequacy.

STRENGTHS

Hospital-based data provided real-world insights from patients with long-duration diabetes. The use of both the Food Frequency Questionnaire (FFQ) and the 24-hour dietary recall enabled assessment of habitual dietary intake as well as nutrient adequacy.

LIMITATIONS

The study had a moderate sample size (n = 75) and purposive sampling, which may limit the generalizability of the findings. As the study was hospital-based, the results may not fully represent community-dwelling individuals with Type 2 Diabetes. Additionally, nutrient intake estimation may have been influenced by recall bias associated with the use of FFQ and 24-hour dietary recall methods.

Recommendations for Future Research

Future research should include a larger sample size across multiple hospitals and regions of India to better capture the diversity in dietary patterns. Conducting community-based studies would also provide a broader understanding of dietary habits and nutritional status among middle-aged adults with long-duration Type 2 Diabetes beyond hospital settings. Additionally, future studies could explore different dietary patterns, such as traditional and Westernized diets, and examine their association with glycemic control and anthropometric measures. The use of mobile applications or digital food tracking tools may also help improve the accuracy of dietary data and support continuous monitoring of nutrient intake in long-term diabetes management programs. Future studies should also consider incorporating alternative anthropometric indices such as the Body Roundness Index (BRI), which has demonstrated a significant association with Type 2 Diabetes risk and may offer stronger predictive value for visceral adiposity and glycemic risk compared to BMI alone [25]. The inclusion of such indices alongside waist circumference and waist-to-height ratio would provide a more comprehensive assessment of body composition in individuals with Type 2 Diabetes Mellitus.

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Declarations

Conflict of Interest: None declared

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Ethical Clearance: The study was approved by Inter-System Biomedical Ethics Committee (ISBEC) dated 18 Nov 2022 . Approval No. ISBEC/NR-34/ KM-KM/2022..

Informed Consent: Written informed consent was obtained from all participants

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