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Research Article

Association of Dietary Factors with Obesity among Type 2 Diabetes Mellitus Patients Attending Diabetic Clinic at a Tertiary Care Hospital in North-East India

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Abstract

Introduction: Diabetes mellitus is not a single disease entity but rather a group of metabolic disorders sharing the common underlying feature of hyperglycemia. Obesity particularly abdominal obesity is strongly associated with insulin resistance. Clinical evidence indicates a stronger association of diabetes with central obesity than general obesity. The cultural diversity prevailing in Tripura is clearly reflected in the food habits of the tribal and non-tribal people. The anthropometric parameters have ethnic susceptibility, so the objective of this study is to determine the prevalence of obesity using the anthropometric parameters of waist circumference (WC), waist-to-stature ratio (WSR), waist-to-hip ratio (WHR), and body mass index (BMI) among type 2 diabetes mellitus (T2DM) patients and the associated risk factors of obesity.

Materials and Methods: A cross-sectional, observational study was conducted at the diabetic clinic of AGMC and GBP hospital. Diagnosed T2DM cases attending the clinic were recruited after simple random sampling. Data were collected by a predesigned questionnaire. Height, weight, WC, and hip circumference were measured. The data were subjected to statistical analysis using the Statistical Package for the Social Sciences-26 software for Windows. Pearson's Chi-square test was used to find the association between types of obesity and various factors of the study population. $P < 0.05$ was considered to be significant.

Results: A total of 270 patients with T2DM (age >20 years) were studied out of which 138 (51.1%) were male and 132 (48.9%) were female. The overall prevalence of obesity according to BMI, WC, WHR, and WSR was 41.90%, 57%, 87.80%, and 58.90%, respectively. In males, the prevalence of BMI, WC, WHR, and WSR obesity was 26.80%, 35.50%, 83.30%, and 44.20%, respectively. However, in females, the prevalence of BMI, WC, WHR, and WSR obesity was 57.60%, 79.50%, 92.4%, and 74.20%, respectively. BMI obesity was found to be statistically significant with fruit consumption frequency ($P = 0.029$), sweet consumption frequency ($P = 0.047$), milk and milk product consumption frequency ($P = 0.005$), kind of fat used for frying, grilling, and roasting ($P = 0.039$), and frequency of food consumption fried away from home ($P = 0.007$). WC obesity was found to be statistically significant with the frequency of fish consumption among non-vegetarian people ($P = 0.039$), junk food consumption frequency ($P = 0.007$), sweet consumption frequency ($P = 0.003$), kind of fat used for frying, roasting, grilling, etc. ($P = 0.001$), and frequency of consumption of food fried at home ($P = 0.024$). WSR obesity was found to be statistically significant with the type of diet ($P = 0.036$), sweet consumption frequency ($P = 0.020$), kind of fat used for frying, roasting, grilling, etc. ($P = 0.005$), and frequency of consumption of food fried at home ($P = 0.014$).

Conclusion: This study concluded that obesity is a highly prevalent co-morbidity in diabetic patients. The change in waist-to-hip ratio was a better predictor of the disease. First-line intervention for weight loss by a combination of a low-calorie diet, increased physical activity, and behavioral therapy should be stressed for the effective management of T2DM. Consumption of fruits and vegetables may protect against the development of T2DM, as they are rich in nutrients, fiber, and antioxidants which are considered protective barriers against the disease.

Key words: Body mass index, Dietary factors, Obesity, Type 2 diabetes mellitus, Waist circumference, Waist-to-hip ratio

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INTRODUCTION

Diabetes mellitus is not a single disease entity but rather a group of metabolic disorders sharing the common underlying feature of hyperglycemia. Hyperglycemia in diabetes results from defects in insulin secretion, insulin action, or most commonly, both. Chronic hyperglycemia

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and attendant metabolic dysregulation may be associated with secondary damage in multiple organ systems, especially the kidneys, eyes, nerves, and blood vessels. The prevalence of diabetes is increasing sharply in the developing world as people adopt more sedentary lifestyles, with India and China being the largest contributors to the world's diabetic load.[1,2]

Tripura, a small state in the northeastern part of India, according to a report published by ICMR-INDIAB in 2017, has the highest prevalence of diabetes (9.4%) among all the northeastern states followed by Mizoram (5.8%). The prevalence was higher in urban Tripura (15.5%) than in rural (7.2%). The prevalence of pre-diabetes was also high in Tripura (14.7%).[3,4]

In recent years, increasingly sedentary lifestyles and poor eating habits have contributed to the simultaneous escalation of diabetes and obesity worldwide, which some have termed as the diabesity epidemic. Sadly, obesity and diabetes have now percolated even to children exposed to "junk" food and lacking adequate exercise.[5]

Simple anthropometric measurements have been used as surrogate measurements of obesity and have more practical value in both clinical practice and for large-scale epidemiological studies. Body mass index (BMI) is a simple method which is used to calculate the prevalence of overweight and obesity in the population. Waist circumference (WC) is the best measure of both intra-abdominal fat mass and total fat. However, BMI can be misleading, such as in individuals with a high proportion of lean muscle mass. WC, a more accurate measure of the distribution of body fat, has been shown to be more strongly associated with morbidity and mortality. Recently, the waist-to-stature ratio (WSR) has been proposed as a better screening tool than WC and BMI for adult metabolic risk factors.[6]

The cultural diversity prevailing in Tripura is clearly reflected in the food habits of the tribal and non-tribal people. The anthropometric parameters have ethnic susceptibility, so the objective of this study is to determine the prevalence of obesity using the anthropometric parameters of WC, WSR, waist-to-hip ratio (WHR), and BMI among type 2 diabetes mellitus (T2DM) patients and the associated risk factors of obesity.

MATERIALS AND METHODS

Study Design
Cross-sectional study.

Type of Study
Observational study.

Study Setting
Diabetic clinic at AGMC and GBP hospital.

Study Population
Diagnosed T2DM cases attending a diabetic clinic in AGMC and GBP Hospital.

Inclusion Criteria
i. Age ≥20 years of both gender
ii. Diagnosed with T2DM and willing to participate
iii. Patients attending the diabetic clinic of AGMC and GBP hospital.

Cases were interviewed in the hospital and additional details about other investigations and complications were obtained from Outpatient Department patient records for cases.

Exclusion Criteria
i. Patients with type 1 diabetes mellitus
ii. Patients of T2DM having severe comorbidities such as stroke, chronic renal diseases, and chronic lung diseases at the time of recruitment into the study
iii. Pregnant and lactating women.

Sample Size Calculation
The sample size was calculated to be 270 using Cochran's formula considering $P = 53.42$.[7-9]

Sampling Technique
Simple random sampling.

Study Tools
1. A pre-designed and pre-tested questionnaire set
2. Non-stretchable measuring tape
3. Hesley digital weighing scale, Hesley Inc., Germany
4. Stadiometer.

Consent
Written informed consent was obtained from all the study subjects.

Operational Definitions
Diabetes
Any subject with FBS value of ≥7 mmol (≥126 mg/dL) or 2-h plasma glucose ≥11 mmol (≥200 mg/dL) or HbA1C ≥6.5% (48 mmol/mol) was considered to have diabetes (as per the World Health Organization [WHO] criteria for diagnosis of diabetes).[10]

WC
It was measured at the midpoint between the tip of the iliac crest and the lower margin of the last palpable rib, using a non-stretchable tape, at the end of normal expiration, with the subject standing erect and arms relaxed insides. Abdominal/central obesity was considered to be present when the WC was ≥80 cm in women and ≥90 cm in men.[11]

Hip circumference

It was measured by a measuring tape and recorded in centimeters, to the nearest 0.1 cm, at the level of maximum circumference of the ischial tuberosity of the participant.

Height

Height was measured by a stadiometer and recorded in centimeters to the nearest 0.1 cm.

WHR

It was calculated as WC divided by hip circumference.

BMI

Defined as weight in kilograms divided by the square of the height in meters. Individuals are classified as underweight (BMI <18.5), normal (BMI 18.5–24.99), and overweight (BMI ≥25) in the WHO criteria.[12]

In Asians, the cutoffs for overweight (≥23.0 kg/m^2) and obesity (≥25.0 kg/m^2) are lower than WHO criteria due to risk factors and morbidities.[13-16]

Criteria for Defining Obesity

- BMI ≥23.0 kg/m^2 – overweight and BMI ≥25.0 kg/m^2 – obese[17-27]
- WSR >0.5[6]
- WC ≥90 cm in males and ≥80 cm in females (central/abdominal obesity)[6]
- WHR ≥0.95 for men and ≥0.85 for women[4]

Data Management

The data were subjected to statistical analysis using the Statistical Package for the Social Sciences-26 software for Windows. Pearson's Chi-square test was used to find the association between types of obesity and various factors of the study population. $P < 0.05$ was found to be statistically significant at 95% confidence interval.

Ethical Consideration

The study was conducted after due approval from the Committee for Ethical Approval – AGMC and GBP Hospital.

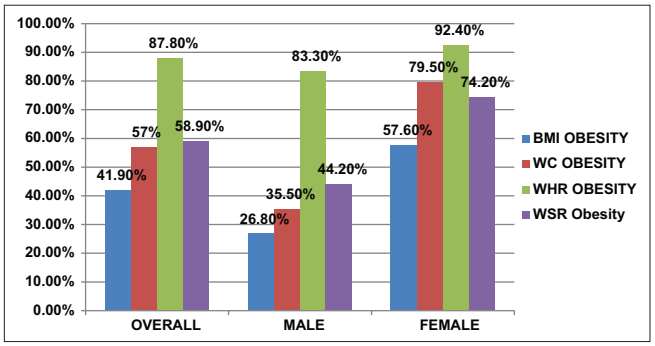
RESULTS

In this study, 270 patients with T2DM (age >20 years) were studied out of which 138 (51.1%) were male and 132 (48.9%) were female. The overall prevalence of obesity and obesity in male and female patients according to BMI, WC, WHR, and WSR is shown in Graph 1. The overall prevalence of obesity according to BMI, WC, WHR, and WSR was 41.90%, 57%, 87.80%, and 58.90%, respectively. In males, the prevalence of BMI, WC, WHR, and WSR obesity was 26.80%, 35.50%, 83.30%, and 44.20%, respectively. However, in females, the prevalence of BMI, WC, WHR, and WSR obesity was 57.60%, 79.50%, 92.4%, and 74.20%, respectively.

Table 1 shows the distribution of the study participants according to the types of obesity. Considering the BMI of the patients, 113 (41.9%) were in the obese category, 69 (25.6%) were in the overweight category, 78 (28.9%) were in the normal category whereas 10 (3.7%) were in the underweight category. Based on WC obesity, 154 (57%) patients were found to be obese and 116 (43%) were found to be non-obese. WHR obesity was found to be present in 237 (87.8%) of the subjects. WSR obesity was found to be in 159 (58.9%) of 270 patients.

The association of types of obesity with various dietary factors in the study population is shown in Table 2.

BMI obesity was found to be statistically significant with fruit consumption frequency ($P = 0.029$), sweet consumption frequency ($P = 0.047$), milk and milk product consumption frequency ($P = 0.005$), kind of fat used for



Graph 1: The overall prevalence of obesity and obesity in male and female patients according to body mass index, waist circumference, waist-to-hip ratio, and waist-to-stature ratio

Table 1: Distribution of the study participants according to the types of obesity

Types of obesity	n (%)
BMI	
Underweight (<18.5)	10 (3.7)
Normal (18.5–22.9)	78 (28.9)
Overweight (23.0–24.9)	69 (25.6)
Obese (≥25)	113 (41.9)
WC obesity	
Obese	154 (57.0)
Non-obese	116 (43.0)
WHR obesity	
Obese	237 (87.8)
Non-obese	33 (12.2)
WSR obesity	
Obese	159 (58.9)
Non-obese	111 (41.1)

BMI: Body mass index, WC: Waist circumference, WSR: Waist-to-stature ratio, WHR: Waist-to-hip ratio

Table 2: Association of types of obesity with various dietary factors

Risk factors	n	BMI obesity	WC obesity	WHR obesity	WSR obesity
Type of diet consumed most of the days of the week					
Vegetarian	30	18 (60.0)	21 (70.0)	25 (83.3)	23 (76.7)
Non-vegetarian	240	95 (39.6)	133 (55.4)	212 (88.3)	136 (56.7)
P-value		0.185	0.128	0.431	0.036
Frequency of fish consumption in a week among non-vegetarians					
Once a day	3	1 (33.3)	1 (33.3)	1 (33.3)	2 (66.7)
2–3 times/day	12	6 (50.0)	11 (91.7)	11 (91.7)	11 (91.7)
1–3 times a week	138	56 (40.6)	74 (53.6)	123 (89.1)	78 (56.5)
4–6 times a week	42	11 (26.2)	18 (42.9)	36 (85.7)	19 (45.2)
Less than once a week	41	19 (46.3)	27 (65.9)	37 (90.2)	24 (58.5)
Never/Less than once a month	4	2 (50.0)	2 (50.0)	4 (100.0)	2 (50.0)
P-value		0.165	0.039	0.076	0.132
Frequency of fruit consumption in a week					
Once a day	50	31 (62.0)	31 (62.0)	44 (88.0)	33 (66.0)
2–3 times/day	11	4 (36.4)	8 (72.7)	10 (90.9)	9 (81.8)
1–3 times a week	59	18 (30.5)	28 (47.5)	52 (88.1)	29 (49.2)
4–6 times a week	13	3 (23.1)	5 (38.5)	11 (84.6)	5 (38.5)
Less than once a week	110	47 (42.7)	70 (63.6)	98 (89.1)	70 (63.6)
Never or less than once a month	27	10 (37.0)	12 (44.4)	22 (81.5)	13 (48.1)
P-value		0.029	0.096	0.924	0.067
Frequency of junk food consumption in a week					
Once a day	3	0	0	2 (66.7)	1 (33.3)
2–3 times/day	4	3 (75.0)	3 (75.0)	4 (100.0)	3 (75.0)
1–3 times a week	18	5 (27.8)	6 (33.3)	15 (83.3)	10 (55.6)
4–6 times a week	4	0	0	4 (100.0)	0
Less than once a week	86	38 (44.2)	48 (55.8)	78 (90.7)	47 (54.7)
Never or less than once a month	155	67 (43.2)	97 (62.6)	134 (86.5)	98 (63.2)
P-value		0.115	0.007	0.604	0.113
Frequency of sweets (gulab jamun, rasagulla, etc.) consumption in a week					
Once a day	1	0	1 (100.0)	1 (100.0)	1 (100.0)
1–3 times/week	6	4 (66.7)	5 (83.3)	5 (83.3)	5 (83.3)
4–6 times/week	3	0	0	3 (100.0)	0
Less than once a week	66	26 (39.4)	27 (40.9)	55 (83.3)	31 (47.0)
Never or less than once a month	194	83 (42.8)	121 (62.4)	173 (89.2)	122 (62.9)
P-value		0.047	0.003	0.692	0.020
Frequency of consumption of milk and milk products					
Daily	61	29 (47.5)	35 (57.4)	53 (86.9)	31 (50.8)
1–3 times a week	30	13 (43.3)	17 (56.7)	27 (90.0)	21 (70.0)
4–6 times a week	12	0	4 (33.3)	11 (91.7)	5 (41.7)
Less than once a week	54	18 (33.3)	26 (48.1)	47 (87.0)	32 (59.3)
Never or less than once a month	113	53 (46.9)	72 (63.7)	99 (87.6)	70 (61.9)
P-value		0.005	0.161	0.984	0.279
Kind of fat is mostly used for frying, roasting, grilling, etc.					
Mustard oil	147	59 (40.1)	79 (53.7)	122 (83.0)	86 (58.5)
Vegetable oil	64	36 (56.3)	49 (76.6)	60 (93.8)	48 (75.0)
Rice bran oil	15	2 (13.3)	3 (20.0)	14 (93.3)	5 (33.3)
Mustard oil+vegetable oil	40	14 (35.0)	21 (52.5)	38 (95.0)	19 (47.5)
Butter+ghee+mustard oil+vegetable oil	4	2 (50.0)	2 (50.0)	3 (75.0)	1 (25.0)
P-value		0.039	0.001	0.083	0.005
Frequency of consumption of food that was fried at home					
Daily	240	102 (42.5)	142 (59.2)	214 (89.2)	146 (60.8)
1–3 times a week	4	2 (50.0)	2 (50.0)	3 (75.0)	3 (75.0)
4–6 times a week	23	9 (39.1)	7 (30.4)	17 (73.9)	7 (30.4)
Never or less than once a month	3	0	3 (100.0)	3 (100.0)	3 (100.0)
P-value		0.082	0.024	0.134	0.014
Frequency of consumption of food that was fried away from home					
Daily	10	3 (30.0)	6 (60.0)	9 (90.0)	7 (70.0)
1–3 times a week	52	28 (53.8)	30 (57.7)	42 (80.8)	28 (53.8)
4–6 times a week	6	1 (16.7)	1 (16.7)	5 (83.3)	1 (16.7)
Less than once a week	78	38 (48.7)	48 (61.5)	73 (93.6)	50 (64.1)
Never or less than once a month	124	43 (34.7)	69 (55.6)	108 (87.1)	73 (58.9)
P-value		0.007	0.311	0.283	0.174

BMI: Body mass index, WC: Waist circumference, WSR: Waist-to-stature ratio, WHR: Waist-to-hip ratio

frying, grilling, and roasting ($P = 0.039$), and frequency of food consumption fried away from home ($P = 0.007$).

WC obesity was found to be statistically significant with the frequency of fish consumption among non-vegetarian people ($P = 0.039$), junk food consumption frequency ($P = 0.007$), sweet consumption frequency ($P = 0.003$), and kind of fat used for frying, roasting, grilling, etc. ($P = 0.001$), and frequency of consumption of food fried at home ($P = 0.024$),

WHR obesity was not found to be statistically significant with any dietary factor.

WSR obesity was found to be statistically significant with the type of diet ($P = 0.036$), sweet consumption frequency ($P = 0.020$), kind of fat used for frying, roasting, grilling, etc. ($P = 0.005$), and frequency of consumption of food fried at home ($P = 0.014$).

DISCUSSION

This cross-sectional study was conducted in a tertiary care center in the northeastern region of India to assess the proportion of obesity among the patients attending the diabetic clinic of the center and to determine the factors associated with various types of obesity. About 270 of such diabetic patients were taken as samples for this study.

The distribution of the study participants was such that most of them were between the age group of 41 and 60 years which shows that T2DM was more prevalent among the age group of 41–60 years. This observation was similar to the WHO report which predicts that in India and other developing countries, the highest increase would occur in the age group of 41–60 years.[25]

The overall proportion of obesity based on BMI was 41.9% and the proportion of overweight patients in our study was 25.6%. The study conducted in Warangal reported 59.2% of overweight and obese subjects.[25] Another study conducted in Bangalore reported 73% obesity with a mean BMI of 26 kg/m^2 which is on par with our study.[26]

The proportion of central obesity assessed by WC, WHR, and WSR was 57%, 87.80%, and 58.90%, respectively, in our study. "Asian Indian phenotype" is characterized by less general obesity (measured by BMI) and more central obesity. Our study supports this hypothesis. A study done in a rural area of the Mangalore district of Karnataka showed a higher central obesity prevalence (90.63%) when compared to BMI.[27] The role of diet in the etiology of T2DM was proposed by Indians as mentioned earlier, who observed that the disease was almost confined to rich people who consumed oil, flour, and sugar in excessive amounts. The frequency of consumption of various food items was measured using an interviewer-administered food frequency questionnaire, which assessed the frequency of intake (number of portions consumed on a daily, weekly, monthly, and yearly/never basis) of some commonly consumed food items in India.[28] The kind of fat mostly used for frying, grilling, roasting, etc. was found to be statistically significant with BMI obesity ($P = 0.039$), WC obesity ($P = 0.001$), and WSR obesity ($P = 0.005$). Buscemi *et al.* stated that there are beneficial effects of using fish and olive oil and they are reported to be associated with improved glucose metabolism and decreased risk of T2DM, obesity, and cardiovascular disease. Satija *et al.* stated that conventionally, nutritional epidemiology has evaluated individual food/nutrient consumption as it relates to disease profiles. A new trend, with established reproducibility and validity, has been to assess composite dietary patterns. The rationale is that since foods are eaten together, their combined consumption might have a different impact on health than their isolated intake.[28] However, dietary patterns were not assessed in our study.

CONCLUSION

In the present study, it can be concluded that the overall proportion of BMI obesity, WC obesity, waist-to-hip ratio obesity, and waist-to-stature ratio obesity among T2DM patients was 41.90%, 57%, 87.80%, and 58.90% respectively. Furthermore, all three types of obesity were more prevalent among females. The proportion of WHR obesity is more in our study. "Asian Indian phenotype" is characterized by less general obesity and greater central body obesity. Our study supports the hypothesis. A combination of a low-calorie diet, increased physical activity, and behavioral therapy as the first-line intervention for weight loss should be stressed in the management of diabetes mellitus. Weight reduction using lifestyle modification with or without pharmacotherapy is important in reducing the risk of developing diabetes and improving metabolic control in obese patients with type 2 diabetes.

Limitations

The generalizability of the results is a limitation of the study because of the smaller sample size and disparities in various cutoffs used to define obesity in the available literature. A cohort study with a larger sample size is recommended to determine the optimal cutoff points for the various anthropometric measurements specific to the Indian population.

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REFERENCES

1. Park K. Park's Textbook of Preventive and Social Medicine. 24th ed. Jabalpur: Banarasidas Bhanot Publication; 2017.
2. IDF Diabetes Atlas. 9th ed. Belgium: International Diabetes Federation; 2019. Available from: https://www.diabetesatlas.org [Last accessed on 2024 May 21].
3. Anjana RM, Deepa M, Pradeepa R, Mahanta J, Narain K, Das HK, *et al*. Prevalence of diabetes and prediabetes in 15 states of India: Results from the ICMR-INDIAB population-based cross sectional-study. Lancet Diabetes Endocrinol 2017;5:585-96.
4. Lotfi MH, Saadati H, Afzali M. Association between anthropometric parameters (WC, BMI, WHR) and Type 2 diabetes in the adult Yazd population, Iran. J Diabetes Metab 2014;5:10.
5. Patro S, Adhya AK, Pal P, Mishra SN, Acharya SK. Study of dietary patterns and risk profile among the patients of diabetes mellitus in Bhubaneshwar? An original research article. Int J Drug Dev Res 2014;6:124-32.
6. Awasthi A, Rao CR, Hegde DS, Rao NK. Association between type 2 diabetes mellitus and anthropometric measurements-a case control study in South India. J Prev Med Hyg 2017;58:E56-62.
7. Yin X, Chen Y, Lu W, Jin T, Li L. Association of dietary patterns with the newly diagnosed diabetes mellitus and central obesity: A community based cross-sectional study. Nutr Diabetes 2020;10:16.
8. Food and Local Cuisines of Tripura. Tripuraonline. Available from: https://www.tripuraonline.in/about/profile/culture/food-and-local-cuisines-of-tripura [Last accessed on 2024 May 21].
9. Tripura Cuisines. Available from: https://easternroutes.com/northeast-india/tripura/traditional-food [Last accessed on 2024 May 21].
10. History of Diabetes. Available from: https://en.wikipedia.org/wiki/history_of_diabetes [Last accessed on 2024 May 21].
11. Ramachandran A, Snehalatha C, Vijay V, Wareham NJ, Colagiuri S. Derivation and validation of diabetes risk score for urban Asian Indians. Diabetes Res Clin Pract 2005;70:63-70.
12. Farzad H, Shafiee G, Azizi F. Anthropometric predictors of incident type 2 diabetes mellitus in Iranian women. Ann Saudi Med 2008;29:194-200.
13. Naja F, Hwalla N, Itani L, Salem M, Azar ST, Zeidan MN, *et al*. Dietary patterns and odds of Type 2 diabetes in Beirut, Lebanon: A case-control study. Nutr Metab (Lond) 2012;9:111.
14. Colles SL, Singh S, Kohli C, Mithal A. Dietary beliefs and eating patterns influence metabolic health in type 2 diabetes: A clinic-based study based in urban North India. Indian J Endocrinol Metab 2013;17:1066-72.
15. Bhalerao SD, Manjunath S, Vernekar SS, Ravishankar R, Goudar SS. Risk factors for type 2 diabetes mellitus in rural population of North Karnataka: A community-based cross sectional study. Int J Pharma Med Biol Sci 2014;3:1-14.
16. Kumar S, Datta A. Assessment of dietary habits and lifestyle of the medical students of Agartala Government Medical College. J Evol Med Dent Sci 2015;4:5609-16.
17. Suliga E, Kozieł D, Cieśla E, Głuszek S. Association between dietary patterns and metabolic syndrome in individuals with normal weight: A cross-sectional study. Nutr J 2015;14:55.
18. Agrawal N, Agrawal MK, Kumari T, Kumar S. Correlation between body mass index and blood glucose levels in Jharkhand population. Int J Contemp Med Res 2017;4:1633-6.
19. WHO. Definition and Diagnosis of Diabetes Mellitus and Intermediate Hyperglycemia: Report of a WHO/IDF Consultation. Geneva: World Health Organization; 2006.
20. WHO. Waist Circumference and Waist-Hip Ratio: Report of a WHO Expert Consultation. Geneva: World Health Organization; 2008.
21. WHO. Obesity: Preventing and Managing the Global Epidemic. Report of a WHO Consultation. WHO Technical Report Series 894. Geneva: World Health Organization; 2000.
22. Vasanthakumar J, Kambar S. Prevalence of obesity among type 2 diabetes mellitus patients in urban areas of Belagavi. Indian J Health Sci Biomed Res KLEU 2020;3:21-7.
23. Obesity. National Health Portal of India. Available from: https://www.nhp.gov.in [Last accessed on 2021 Jan 29].
24. Bashar AM, Modified BG. Prasad socioeconomic status scale: Updated for the Year 2022. Indian Pediatr 2022;31:123-5.
25. Sreelatha M, Kumar VS, Shekar GC, Shekar VC. Study of thyroid profile in patients with type 2 diabetes mellitus. J Chem Health Risks. Available from: https://jchr.org/index.php/JCHR/article/download/3012/2096/5615 [Last accessed on 2024 May 21].
26. Nagendra A, Chekri P, Swarupa K. A study on prevalence of abdominal obesity among diabetics. Indian J Nutr 2017;4:175.
27. Padmanabha UR, Nalam U, Badiger S, Nagarajaiah P. Prevalence and risk factors of type 2 diabetes mellitus in the rural population of Mangalore, South India. Natl J Community Med 2017;8:456-61.
28. Satija A, Hu FB, Bowen L, Bharathi AV, Vaz M, Prabhakaran D, *et al*. Dietary patterns in India and their association with obesity and central obesity. Public Health Nutr 2015;18:3031-41.

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