

Relationship between Body Mass Index and Waist Circumference among Diabetes Mellitus Patients in diabetic Clinic in Benghazi

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Abstract— Background: Diabetes mellitus is a prevalent health concern, necessitating a closer examination of factors like body mass index (BMI) and waist circumference in patients attending diabetic clinics, **Objective:** This study explored the BMI-waist circumference relationship among 150 diabetes mellitus patients in a Benghazi diabetic clinic, analyzing factors influencing this connection, **Methods:** A cross-sectional analysis was performed on patient data, including BMI, weight, waist circumference, age, gender, and height. Statistical methods like correlation coefficients and ANOVA were used for insights, **Results:** Findings indicated a positive BMI-weight correlation, emphasizing weight's role in BMI among diabetic patients. Waist circumference significantly impacted BMI, with age, gender, and height contributing to BMI variations, **Conclusions:** Personalized diabetes management is crucial, with weight interventions taking precedence. Recognizing the impact of central adiposity and tailoring interventions based on age, gender, and height is essential for patient care

Keywords- Body Mass Index, Waist Circumference and Diabetes Mellitus.

I. INTRODUCTION

Definition of Diabetes Mellitus Diabetes Mellitus (DM) is a chronic metabolic disorder characterized by elevated blood glucose levels resulting from defects in insulin secretion, insulin action, or both. It encompasses a group of disorders, with the main types being Type I Diabetes and Type II Diabetes (Yang, X. Y, 2016 P.328-333).

Type I Diabetes: is a complex autoimmune condition characterized by the body's immune system turning against its insulin-producing cells, leading to their destruction. This results in a lifelong dependence on insulin therapy, as the absence of insulin production poses a continuous challenge to blood glucose regulation. Managing Type I Diabetes involves a multifaceted approach, encompassing insulin administration, dietary adjustments, and close monitoring to ensure optimal health and well-being 1 (Yang, X. Y, 2016 P.328-333).

Diabetes Type II Diabetes manifests when the body develops resistance to insulin, a crucial hormone for regulating blood

sugar levels. This resistance disrupts the normal insulin function, leading to elevated blood glucose levels. Lifestyle factors, such as sedentary behavior and poor dietary choices, frequently contribute to the onset of Type II Diabetes. Addressing this condition involves lifestyle modifications, including diet and exercise, alongside medical management to enhance insulin sensitivity and overall health (Yang, X. Y, 2016 P.328-333).

Gestational: is another type of diabetes that can develop during pregnancy in women who don't already have diabetes. It develops in pregnancy when blood sugar levels get too high. GD usually appears during the middle of pregnancy, between 24 and 28 weeks. (Yang, X. Y, 2016 P.328-333).

Body Mass Index (BMI) and Waist Circumference: serve as crucial markers for evaluating body composition and overall health. BMI, a measure derived from weight and height, offers insights into general body fat levels. Simultaneously, waist circumference provides valuable information about the distribution of abdominal fat. Monitoring both these indicators is essential for a comprehensive assessment of an individual's health status, aiding in the identification of potential health risks associated with body weight and fat distribution 2 (Vazquez, 2007 P.115- 128).

Importance of BMI and Waist Circumference Ensuring a healthy Body Mass Index (BMI) and waist circumference is fundamental in safeguarding overall health and preventing various health issues, notably diabetes. These measurements act as critical indicators, reflecting the balance between weight and height as well as the distribution of abdominal fat. Proactively managing and maintaining optimal BMI and waist circumference levels contribute significantly to reducing the risk of developing health complications, particularly those associated with diabetes. Regular monitoring and adherence to healthy lifestyle practices play a pivotal role in achieving and sustaining these vital measurements within recommended ranges. (Vazquez, 2007 P.115-128).

Relationship between BMI and Diabetes Mellitus
Comprehending the intricate correlation between Body Mass Index (BMI) and diabetes holds paramount importance for diabetic clinics. This understanding serves as a linchpin in the effective management and personalized care of individuals with diabetes. By deciphering how BMI influences diabetes risk and progression, healthcare professionals can tailor interventions and strategies that address the specific needs of patients, thereby enhancing the overall quality of diabetes care provided in clinics. This knowledge forms a cornerstone in promoting proactive and targeted approaches to diabetes prevention and management within clinical settings (Wei, M., Gaskill, 1997 P.16-23).

Factors Influencing BMI and Waist Circumference
The complexity of Body Mass Index (BMI) and waist circumference variations stems from a myriad of factors, encompassing age, gender, and height. These multifaceted elements interplay in shaping an individual's body composition, influencing both BMI and waist circumference measurements. Age introduces unique considerations, impacting the physiological changes that affect these indicators. Gender disparities contribute to the diverse distribution of body fat, further influencing BMI outcomes. Additionally, height serves as a significant factor, adding another layer to the intricate web of influences on BMI and waist circumference. Understanding and navigating these factors are essential for a comprehensive assessment of an individual's health status (Wei, M., Gaskill, 1997 P.16-23).

Age and BMI
The relationship between age and Body Mass Index (BMI) is a multifaceted interplay that extends beyond numerical values. As individuals age, physiological changes, such as alterations in muscle mass and fat distribution, influence BMI outcomes. The intricate dynamics between aging and BMI underscore the importance of considering the life course when interpreting these health indicators. This awareness is pivotal for healthcare professionals seeking to tailor interventions based on a nuanced understanding of how age impacts body composition (Wei, M., Gaskill, 1997 P.16-23).

Gender Disparities in BMI
Exploring the nuances of BMI in relation to gender reveals a complex landscape shaped by physiological and societal factors. Gender differences in body composition, influenced by hormonal variations and societal norms, contribute to distinct patterns in BMI. Recognizing these disparities is essential for targeted health interventions, ensuring that strategies for managing and preventing conditions like diabetes are sensitive to the diverse needs of both men and women (Vazquez, 2007 P.115-128).
Height and its Role in BMI
Height is more than a physical attribute—it's a key factor influencing the Body Mass Index (BMI) landscape. Taller individuals may exhibit variations in

BMI due to the intricate relationship between height and body composition. This nuanced connection emphasizes the need for healthcare professionals to consider height as a contributing factor when assessing BMI. Understanding the role of height in BMI provides a more comprehensive perspective on an individual's health status (Vazquez, 2007 P.115-128).

Rising Significance of Diabetic Clinics
In the evolving landscape of healthcare, diabetic clinics emerge as crucial hubs for comprehensive diabetes management. Beyond their role in monitoring health metrics, these clinics become educational centers, empowering individuals with diabetes through tailored information. The rising significance of diabetic clinics extends beyond treatment; they are proactive spaces fostering a holistic approach to health, emphasizing prevention, management, and ongoing education for individuals navigating the complexities of diabetes (Vazquez, 2007 P.115-128).

This study addresses the existing gap in understanding the relationship between BMI, waist circumference, and diabetes mellitus in diabetic clinics

II. METHODS AND MATERIALS

A. *Research sitting and period:*

This study, conducted in Benghazi, investigates the link between BMI and Waist Circumference in diabetes patients from [2023/1/10] to [2023/1/11].

B. *Study design*

The study adopts a cross-sectional research design to investigate the relationship between Body Mass Index (BMI) and Waist Circumference (WC) among diabetes mellitus patients in Benghazi. Cross-sectional studies allow for the collection of data at a single point in time, enabling the exploration of associations between variables.

C. *Subjects*

The study involves a sample of 150 participants from Benghazi's diabetic clinics. The inclusion criteria encompass both male and female individuals diagnosed with diabetes mellitus, covering a broad age range from 18 to over 65 years.

D. *Procedure*

Data collection involved the use of survey data from participants in Benghazi diabetes clinic the dataset includes

information on demographic data (age and gender) BMI, weight, waist circumference, height, age, and gender.

E. Statistical analysis

The data was analyzed utilizing SPSS, with a particular emphasis on considering the standard deviation. Correlation Analysis • Pearson correlation coefficients were computed to explore relationships between BMI and various factors such as weight, waist circumference, and height. Regression Analysis • Linear regression analyses were performed to assess the impact of independent variables (weight, waist circumference, and height) on the dependent variable (BMI).

III. RESULTS AND DISCUSSION

A. Demographic Characteristics

A.1. Age Distribution:

Examining the age distribution of diabetes mellitus patients revealed a varied representation across different age groups. Notably, a significant proportion falls within the 46-55 and 56-65 age categories, constituting 34.0% and 37.3% of the participants, respectively

TABLE I. *Distribution of participants across different age groups*

Age groups (yrs.)	Frequency	Percentage
15-25	1	0.7
26-35	5	3.3
36-45	16	10.7
46-55	51	34.0
56-65	56	37.3
≥66	21	14.0

A.2. Gender Distribution

The gender distribution indicated a nearly equal representation, with 51.3% male and 48.7% female participants.

Gender	Frequency	Percentage
Male	77	51.3
Female	73	48.7

The cross tabulation of age groups and gender further delineates the distribution of participants, providing insights into the demographic composition within each category.

TABLE III: *Distribution of participants based on gender.*

Age /gender	Male	Female	Total
15-25	0	1	1
26-35	1	4	5
36-45	7	9	16
46-55	30	21	51
56-65	25	31	56
≥66	14	7	21

The correlation analysis between BMI and weight revealed a strong positive relationship ($r = 0.710$, $p < 0.001$). This implies that as weight increases, BMI tends to increase proportionally among diabetes mellitus patients in the diabetic clinic in Benghazi. Influence of Waist Circumference on BMI Our investigation into the relationship between BMI and waist circumference indicated a significant positive correlation ($r = 0.595$, $p < 0.001$). This suggests that an increase in waist circumference is associated with a higher BMI in this patient population. BMI Variation across Different Heights The analysis of BMI across different heights demonstrated a negative correlation ($r = -0.401$, $p < 0.001$). Taller individuals tended to have lower BMI values. This finding suggests a potential influence of height on the BMI of diabetes mellitus patients in Benghazi. Age as a Determinant of BMI The examination of BMI across various age groups uncovered notable variations. While patients aged 46-55 exhibited the highest BMI, those in the 18-25 age group had the lowest BMI. This suggests age as a potential determinant of BMI among diabetes mellitus patients in the clinic.

TABLE II. *Distribution of participants based on gender*

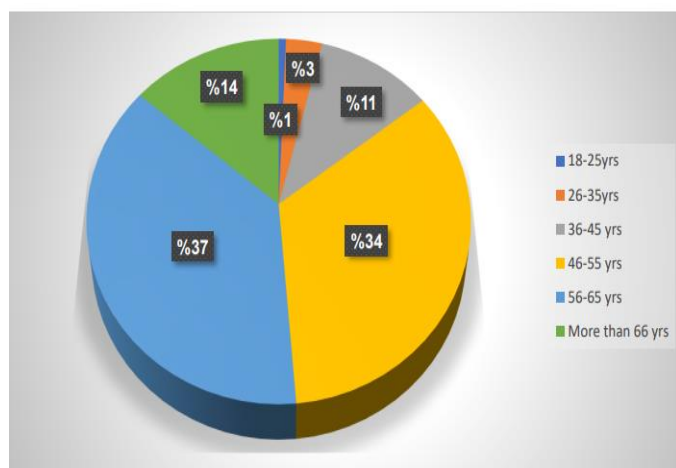


Figure I: Age as a Determinant of BMI

Gender Disparities in BMI Our analysis of BMI in relation to gender revealed that males had a higher mean BMI compared to females. The interplay between gender and BMI underscores the importance of considering gender-specific factors in understanding the relationship between BMI and waist circumference.

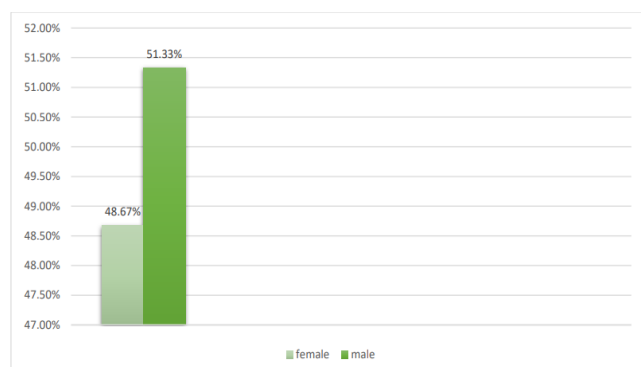


Figure II: Gender Disparities in BMI

The cross-tabulation of age and gender highlighted intriguing patterns. For instance, the age group 56-65 had the highest number of both male and female participants, contributing significantly to the overall BMI variations observed. This interaction emphasizes the need for a nuanced examination of age and gender dynamics in understanding BMI among diabetes mellitus patients.

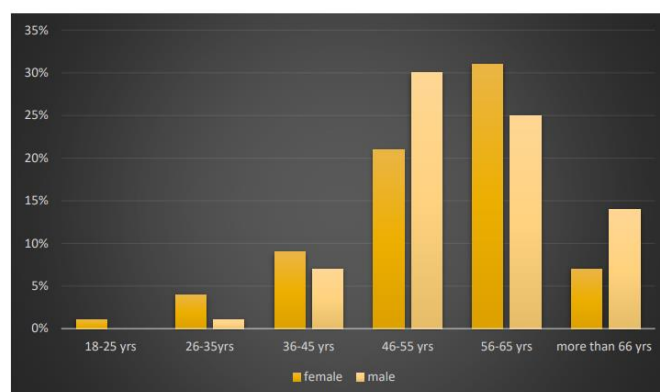


Figure III: Age and Gender Interaction

The BMI and Weight exhibit a strong positive correlation ($r = 0.710$, $p < 0.001$), indicating a significant linear relationship. The linear regression model, predicting BMI with Weight, is highly significant ($F(1, 148) = 150.261$, $p < 0.001$), explaining 50.4% of BMI variance. Weight proves to be a significant predictor of BMI among diabetes mellitus patients.

Table IV: Body Mass Index (BMI) and Weight

Variable	Mean	Std. deviation	N
BMI	30.8037	6.05664	150
Weight	84.63	15.567	150

Waist Circumference and BMI Relationship: Investigating the relationship between Waist Circumference and BMI demonstrated a moderate positive correlation ($r = 0.595$, $p < 0.001$). The linear regression model, using Waist Circumference as the predictor for BMI, was statistically significant ($F(1, 148) = 80.981$, $p < 0.001$), explaining 35.4% of the variance in BMI. These findings suggest that Waist Circumference serves as a relevant indicator for predicting BMI among individuals with diabetes mellitus.

Table V: Correlation analysis between BMI and Weight.

Variable	Mean	Std. deviation	N
BMI	30.8037	6.05664	150
Waist Circumference	102.23	15.609	150

The strong correlation between BMI and Weight suggests a noteworthy relationship among diabetes mellitus patients. The robust predictive power of Weight on BMI underscores the significance of weight management in diabetes care. The association between BMI and Waist Circumference (WC) reveals additional insights. The positive correlation implies that as BMI increases, WC tends to rise. This aligns with existing literature emphasizing the interconnectedness of general and central obesity in diabetes. Furthermore, the impact of Height on BMI suggests a negative correlation, emphasizing the relevance of considering height in understanding BMI variations. This highlights the need for a holistic approach to health assessments, incorporating multiple factors. The age distribution indicates that older participants (56-65 and 66 and over) form a substantial portion. Understanding age-related variations in BMI becomes crucial for tailored interventions, especially given the rising prevalence of diabetes in older populations. The gender distribution reflects a balanced representation, enabling a comprehensive analysis of BMI and its correlates across genders. The interplay of sociodemographic factors with BMI prompts a reflection on the broader societal influences on health outcomes. The findings contribute to the broader dialogue on health determinants, emphasizing the need for multifaceted interventions. In conclusion, this discussion underscores the interconnected nature of BMI with Weight, WC, Height, and sociodemographic factors among diabetes mellitus patients. These insights hold relevance for tailored interventions and public health strategies targeting diabetes management in diverse populations.

IV. CONCLUSION

In wrapping up our study, we've uncovered significant links between Body Mass Index (BMI), Weight, Waist Circumference (WC), and Height among diabetes mellitus patients in Benghazi. The strong associations highlight the importance of weight management in diabetes care. Our findings emphasize the interconnectedness of BMI with various factors, including sociodemographic elements. Older age groups are notably represented, urging attention to age related variations in BMI. This study contributes to the broader understanding of diabetes management, calling for holistic interventions that consider diverse factors. Balanced gender representation ensures comprehensive insights. In essence, our exploration provides valuable insights for tailored interventions and public health strategies, aiming to enhance diabetes care in the diverse population accessing clinics in Benghazi

REFERENCES

- [1] Neelamagam, K., & Wihandani, D. M. (2018). Correlation between body mass index and waist circumference among diabetes mellitus patients in Denpasar, Bali. *Intisari Sains Medis*, 9(3).
- [2] Kamath, A., Shivaprakash, G., & Adhikari, P. (2011). Body mass index and waist circumference in type 2 diabetes mellitus patients attending a diabetes clinic. *International Journal of Biological & Medical Research*, 2(3), 636-638.
- [3] Feller, S., Boeing, H., & Pischon, T. (2010). Body mass index, waist circumference, and the risk of type 2 diabetes mellitus: implications for routine clinical practice. *Deutsches Ärzteblatt international*, 107(26), 470.
- [4] Diabetes globally (2018) The DANII Foundation. Available at: <http://danii.org.au/diabetes-globally/> (Accessed: 13 December 2023).
- [5] Neylan (2014) PPT - integrated management of acute malnutrition Powerpoint presentation - ID:3393713, SlideServe. Available at: <https://www.slideserve.com/neylan/integrated-management-of-acute-malnutrition> (Accessed: 13 December 2023).
- [6] Sushil, M. I., Muneshwar, J. N., & Khan, S. T. (2015). To study body mass index, waist circumference, waist hip ratio, body adiposity index and lipid profile level in patients with type-2 diabetes mellitus. *OSR Journal of Dental and Medical Sciences*, 14(5), 98101.
- [7] Haghighatdoost, F., Amini, M., Feizi, A., & Iraj, B. (2017). Are body mass index and waist circumference significant predictors of diabetes and prediabetes risk: Results from a population based cohort study. *World journal of diabetes*, 8(7), 365.
- [8] Wei, J., Liu, X., Xue, H., Wang, Y., & Shi, Z. (2019). Comparisons of visceral adiposity index, body shape index, body mass index and waist circumference and their associations with diabetes mellitus in adults. *Nutrients*, 11(7), 1580.32
- [9] Bombelli, M., Facchetti, R., Sega, R., Carugo, S., Fodri, D., Brambilla, G., ... & Mancia, G. (2011). Impact of body mass index and waist circumference on the long-term risk of diabetes mellitus, hypertension, and cardiac organ damage. *Hypertension*, 58(6), 1029-1035.
- [10] Gierach, M., Gierach, J., Ewertowska, M., Arndt, A., & Junik, R. (2014). Correlation between body mass index and waist circumference in patients with metabolic syndrome. *International Scholarly Research Notices*, 2014.
- [11] Zhou, B. F. (2002). Predictive values of body mass index and waist circumference for risk factors of certain related diseases in Chinese adults--study on optimal cut-off points of body mass index and waist

- circumference in Chinese adults. *Biomedical and environmental sciences: BES*, 15(1), 83-96.
- [12] Haghighatdoost, F., Amini, M., Feizi, A., & Iraj, B. (2017). Are body mass index and waist circumference significant predictors of diabetes and prediabetes risk: Results from a population based cohort study. *World journal of diabetes*, 8(7), 365.
- [13] Wei, M., Gaskill, S. P., Haffner, S. M., & Stern, M. P. (1997). Waist circumference as the best predictor of noninsulin dependent diabetes mellitus (NIDDM) compared to body mass index, waist/hip ratio and other anthropometric measurements in Mexican Americans—a 7 - year prospective study. *Obesity research*, 5(1), 16-23.
- [14] Abe, M., Fujii, H., Funakoshi, S., Satoh, A., Kawazoe, M., Maeda, T., ... & Arima, H. (2021). Comparison of body mass index and waist circumference in the prediction of diabetes: a retrospective longitudinal study. *Diabetes Therapy*, 12(10), 2663-2676.
- [15] Vazquez, G., Duval, S., Jacobs Jr, D. R., & Silventoinen, K. (2007). Comparison of body mass index, waist circumference, and waist/hip ratio in predicting incident diabetes: ameta-analysis. *Epidemiologic reviews*, 29(1), 115-128.
- [16] Humayun, A., & Shah, A. S. (2010). Comparison of body mass index and waist circumference in predicting incident diabetes. *Pakistan Journal of Physiology*, 6(1), 47-49.
- [17] Bei - Fan, Z., & Cooperative Meta - analysis Group of Working Group on Obesity in China. (2002). Predictive values of body mass index and waist circumference for risk factors of certain related diseases in Chinese adults: study on optimal cut - off points of body mass index and waist circumference in Chinese adults.33
- [18] Lam, B. C. C., Koh, G. C. H., Chen, C., Wong, M. T. K., & Fallows, S. J. (2015). Comparison of body mass index (BMI), body adiposity index (BAI), waist circumference (WC), waist-to-hip ratio (WHR) and waist-to-height ratio (WHtR) as predictors of cardiovascular disease risk factors in an adult population in Singapore. *PloS one*, 10(4), e0122985.
- [19] Yang, X. Y., Zhang, M., Luo, X. P., Wang, J. J., Yin, L., Pang, C., ... & Zhao, J. Z. (2016). Body mass index, waist circumference and waist-to-height ratio associated with the incidence of type 2 diabetes mellitus: a cohort study. *Zhonghua yu fang yi xue za zhi [Chinese journal of preventive medicine]*, 50(4), 328-333.
- [20] Alvim, R. D. O., Mourao-Junior, C. A., de Oliveira, C. M., Krieger, J. E., Mill, J. G., & Pereira, A. C. (2014). Body mass index, waist circumference, body adiposity index, and risk for type 2 diabetes in two populations in Brazil: general and Amerindian. *PLoS one*, 9(6), e100223.