Ministry of Higher Education and Scientific Research

Al-Zahrawi Private University College

Department of Pharmacy

The relationship between obesity and development of diabetes and hypertension in people older than 20 years in Karbala city government

A research project submitted to the Department of Pharmacy/Al-Zahrawi College University as part of the requirements for obtaining a Bachelor's degree in Pharmacy

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ACKNOWLEDGMENTS

We would like to express our sincere gratitude to all those who have contributed to the success of this research. First and foremost, we would like to thank our research group members for their unwavering support, teamwork, and dedication throughout the course of this project. Each member brought invaluable insights, ideas, and hard work that made this research possible.

We would also like to extend our heartfelt thanks to our research supervisor

(M.A. Ali Hatim Hamid), for his continuous guidance, encouragement, and expertise. His/her invaluable feedback and support have been instrumental in the development of this work.

Additionally, we would like to thank our professors and advisors for their guidance and constructive feedback. Their support was essential in shaping the direction of this project.

We would like to extend our deepest gratitude to our families for their unwavering support and encouragement throughout this journey. Their constant belief in us, patience, and understanding during the challenging moments made this research possible. The love and motivation they provided were essential in helping us stay focused and driven, and for that, we are truly grateful.

Finally, we would like to thank our friends for their constant encouragement and patience throughout this academic journey. Their belief in us provided the motivation to keep pushing forward.

This research would not have been possible without the collective effort and contributions of everyone involved. Thank you all for your time, effort, and support.

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Abstract

Background: Obesity, diabetes mellitus, and hypertension are interrelated health conditions that collectively contribute to the rising global burden of non-communicable diseases. Obesity serves as a critical risk factor, disrupting metabolic and cardiovascular homeostasis and precipitating insulin resistance, hyperglycemia, and elevated blood pressure. This study investigates the relationship between obesity and the development of diabetes and hypertension among individuals aged over 20 years in Karbala City, Iraq, focusing on Body Mass Index (BMI) and its correlation with Random Blood Sugar (RBS), Systolic Blood Pressure (SBP), and Diastolic Blood Pressure (DBP).

Methods: A cross-sectional study was conducted, enrolling 100 participants from outpatient clinics, community health centers, and public health campaigns. Participants were evaluated for obesity using BMI, classified into normal weight, overweight, and obese categories based on standardized percentiles. SBP, DBP, and RBS were measured using validated clinical protocols. Correlations between BMI and cardiovascular/metabolic indicators were assessed using Spearman's correlation analysis, with statistical significance set at $p < 0.05$.

Results: The study found a strong positive correlation between BMI and SBP ($r = 0.4706$, $p < 0.0001$) and a moderate correlation with DBP ($r = 0.3081$, $p = 0.0018$). BMI was weakly correlated with RBS ($r = 0.1927$, $p = 0.0547$), suggesting a limited direct relationship between obesity and transient glucose levels. Mean SBP and DBP increased significantly with rising BMI, underscoring obesity's impact on vascular resistance and cardiovascular strain. While the correlation between BMI and RBS was not statistically significant, the clinical implications of obesity-related insulin resistance remain critical.

Conclusions: This study highlights obesity's pronounced role in elevating blood pressure and its weaker, yet clinically significant, association with blood glucose dysregulation. Interventions targeting weight reduction through lifestyle modifications, regular physical activity, and dietary improvements are essential to mitigate the risks of hypertension and diabetes in obese populations. Further research incorporating longitudinal data and more robust glucose markers, such as HbA1c, is needed to better delineate the relationship between obesity and diabetes development. This study provides a valuable foundation for public health strategies in Karbala city aimed at curbing obesity-related health risks.

Chapter one

Introduction

Obesity is a growing public health crisis affecting individuals of all age groups. Among people younger than 20 years old, obesity is closely associated with several metabolic and cardiovascular disturbances, including elevated Random Blood Sugar (RBS) levels, the onset of type 2 diabetes, and hypertension. These health challenges collectively threaten not only the well-being of affected individuals but also the stability of healthcare systems worldwide. Understanding the interplay between obesity, elevated RBS levels, and the subsequent development of type 2 diabetes and hypertension is crucial for devising effective preventive and management strategies. (25)

Obesity is characterised by an excessive accumulation of adipose tissue (1). Obesity is often identified by body mass index (BMI, kg/m2), which is calculated as weight (kg) divided by height squared (m2); there are typically three categories: normal weight (BMI 18.5–24.9 kg/m2), overweight (BMI 25.0–29.9 kg/m2), and obese (BMI ≥ 30.0 kg/m2) (4). However, the use of BMI as a marker of obesity is flawed as it does not take into account differences in body composition or body fat distribution. Obesity affects a high proportion of the global population (3), and it is estimated that about two thirds of Australian adults are overweight or obese .

As a major cause of premature death and illness, obesity is associated with an increase in the risk of chronic diseases, such as type 2 diabetes and cancer (5), and other health problems. Around 70% of the obese population has complicated obesity, defined as obesity with metabolic diseases or the metabolic syndrome, which includes insulin resistance, hypertension, abdominal obesity and inflammation, while the remainder have uncomplicated obesity, defined as obesity with no apparent metabolic abnormalities (6).

One of the possible mechanisms contributing to uncomplicated obesity is leptin deficiency, which can impair appetite, thus leading to increasing body weight in the absence of other metabolic abnormalities (7). As unhealthy diet and insufficient physical exercise also contribute to obesity, obesity (especially uncomplicated obesity) is potentially reversible by physical and nutritional interventions; however, obesity can also be characterized as a persistent condition (8).

Random Blood Sugar (RBS) levels, an essential marker of glucose homeostasis, reflect the body's capacity to regulate blood glucose irrespective of fasting or eating conditions (11). Among obese youth, elevated RBS levels are often indicative of insulin resistance a condition wherein the body fails to respond adequately to insulin. This resistance leads to increased glucose circulation, predisposing individuals to prediabetes and, ultimately, type 2 diabetes (30). Moreover, research has demonstrated that obesity significantly amplifies the risk of abnormal RBS readings due to hormonal imbalances, adipose tissue inflammation, and disrupted energy metabolism. These pathophysiological mechanisms suggest that obesity not only accelerates glucose dysregulation but also complicates the body's ability to recover normal glucose levels without medical intervention. (8)

In parallel with its impact on RBS levels, obesity plays a critical role in the development of hypertension among individuals under 20. Excess adiposity contributes to systemic vascular resistance, heightened sympathetic nervous system activity, and activation of the renin-angiotensin-aldosterone system (21). These factors collectively increase the burden on the cardiovascular system, causing persistent elevation of blood pressure. Elevated RBS and hypertension are not isolated conditions; rather, they interact in a detrimental feedback loop where hyperglycemia exacerbates vascular damage while hypertension compounds metabolic stress, further impairing insulin function. (7,34,35)

Research further underscores that obesity is not merely a result of excessive caloric intake and sedentary behaviors, but rather a multifactorial condition influenced by genetic predispositions, early childhood nutrition, environmental stressors, and socioeconomic factors. Children and adolescents growing up in environments with limited access to healthy food options and opportunities for physical activity are disproportionately affected. Additionally, hormonal changes during adolescence exacerbate metabolic vulnerabilities, intensifying the risk of elevated RBS levels and hypertension. (12,18,19)

Early detection of abnormal RBS levels through advanced diagnostic techniques, such as glycated hemoglobin (HbA1c) testing, offers promising avenues for mitigating the long-term consequences of metabolic disorders in youth. Combined with public health initiatives promoting nutritional education and community-based interventions, these efforts can significantly reduce the burden of obesity-related diseases. Emerging evidence suggests that

behavioral interventions, particularly family-based lifestyle programs, yield the most promising results in reducing the risks associated with obesity. (3,24)

Furthermore, the prevalence of metabolic syndrome—a cluster of conditions including increased blood pressure, high blood sugar, excess body fat around the waist, and abnormal cholesterol levels—escalates with age. Studies have shown that metabolic syndrome is more common in men than women up to the age of 50, after which it becomes more prevalent in women. For instance, in adults aged 18 to 29 years, metabolic syndrome was more prevalent in non-Hispanic whites, while in individuals aged 70 and older. (18)

Additionally, the prevalence of metabolic syndrome components varies between younger and older adults. Younger adults tend to have a higher prevalence of low HDL cholesterol, whereas older adults exhibit higher rates of hypertension, hypertriglyceridemia, and glucose intolerance. This variation underscores the complex interaction between aging and obesity in influencing metabolic health. (4)

In conclusion, the relationship between obesity, Random Blood Sugar levels, and the development of type 2 diabetes and hypertension in youth under 20 years old is multifaceted and significant. Addressing these issues requires a holistic approach that incorporates clinical, behavioral, and societal strategies. By targeting the root causes of obesity and its metabolic consequences, healthcare providers can prevent future generations from facing the devastating impacts of chronic diseases. (14,16,38)

Chapter two

Patients and Method

2.1.1 Study Design: This study employed a cross-sectional descriptive research design aimed at investigating the relationship between obesity, hypertension, and the development of diabetes in adults over the age of 20 years living in Karbala, Iraq. The cross-sectional approach was chosen to assess the prevalence of these conditions and their associations at a single point in time.

2.1.2 Study Population and Participants: The study focused on individuals over the age of 20 years residing in the Karbala city government region. Participants were recruited through outpatient clinics, community health centers, and public health campaigns, ensuring a representative sample of the population. Inclusion criteria were:

- ✓ Adults aged 20 years and older
- ✓ Individuals who have not been diagnosed with severe cardiovascular diseases (such as heart failure or myocardial infarction)
- ✓ Individuals without any other systemic health disorders, such as renal artery stenosis or endocrine diseases, that may affect obesity, diabetes, or hypertension.

Exclusion criteria:

- ✓ Pregnant women due to the physiological changes during pregnancy.
- ✓ Individuals with missing data or incomplete records related to height, weight, blood pressure, or blood sugar.

2.1.3 Measurements and Data Collection

a. Obesity Assessment: Obesity was evaluated using the Body Mass Index (BMI), calculated as BMI categories followed standard criteria:

- ✓ Normal weight: BMI between 18.5 and 24.9 kg/m^2
- ✓ Overweight: BMI between 25 and 29.9 kg/m^2
- ✓ Obesity: BMI $\geq$ 30 kg/m^2

Additionally, waist circumference was recorded as a measure of central obesity to evaluate abdominal fat distribution.

b. Hypertension Measurement: Blood pressure (BP) was measured using an Mercury blood pressure from Omega . Systolic (SBP) and diastolic (DBP) blood pressures were recorded after the participant had been at rest for 5 minutes. Participants were classified based on the following thresholds:

- ✓ Normal BP: SBP < 120 mmHg and DBP < 80 mmHg
- ✓ Hypertension Stage 1: SBP 130–139 mmHg or DBP 80–89 mmHg
- ✓ Hypertension Stage 2: SBP ≥ 140 mmHg or DBP ≥ 90 mmHg

c. Diabetes Assessment: Random blood sugar (RBS) levels were determined using a OneTouch select plus glucose meter from Lifescan. The glucose levels were classified according to the American Diabetes Association (ADA) criteria:

- ✓ Normal: RBS < 140 mg/dL
- ✓ Prediabetes: RBS between 140-199 mg/dL
- ✓ Diabetic: RBS ≥ 200 mg/dL

Chapter three

3.1 Statistical analysis

This section presents the statistical findings based on the dataset provided. The analysis investigates the relationship between obesity, measured using Body Mass Index (BMI), and its association with cardiovascular health indicators, including systolic blood pressure (SBP), diastolic blood pressure (DBP), and random blood sugar (RBS). A detailed statistical summary is provided below.

3.1.1 Descriptive Statistics

The study included 100 participants older the age of 20 years. The descriptive statistics for the primary variables are summarized in Table 1.

Blood Pressure: Systolic blood pressure (SBP) ranged between 90 mmHg and 188 mmHg, with a mean of 129.3 mmHg (SD: 19.68). Similarly, diastolic blood pressure (DBP) ranged between 50 mmHg and 130 mmHg, with a mean of 83.08 mmHg (SD: 14.45).

Random Blood Sugar (RBS): The RBS levels showed high variability, ranging from 75 mg/dL to 500 mg/dL, with a mean of 170.9 mg/dL (SD: 73.78). This suggests that while most participants remained within the normal range, a subset showed signs of hyperglycemia.

Body Mass Index (BMI): BMI values ranged between 15.56 kg/m^2 and 46.09 kg/m^2, with a mean of 27.47 kg/m^2 (SD: 6.698). Using standard BMI percentiles, participants were categorized into normal weight, overweight, or obese groups.

Age: Participants' ages ranged between 20 and 85 years, with a median of 34 years and a mean of 39.58 years.

3.1.2 Correlation Analysis

Spearman's correlation coefficients were calculated to examine associations between numerical variables. The main results are summarized in Table 2.

Age and Blood Pressure: Age showed moderate positive correlations with both SBP ($r = 0.5152$, $p < 0.0001$) and DBP ($r = 0.4711$, $p < 0.0001$). This indicates that as age increases, both SBP and DBP are likely to rise, suggesting an age-dependent trend in blood pressure elevation. BMI and Blood Pressure: BMI demonstrated a moderate correlation with SBP (r =

0.4706, $p < 0.0001$) but a weaker correlation with DBP ($r = 0.3081$, $p = 0.0018$). This reinforces the well-established relationship between obesity and elevated systolic blood pressure. RBS and BMI: A weak positive correlation was noted between BMI and RBS ($r = 0.1927$, $p = 0.0547$), but the association was not statistically significant.

3.1.3 Scatterplot Insights

Figure 2 highlights scatterplots to visualize relationships among significant variables. A steady upward trend is observed between BMI and SBP, indicating that higher BMI values are consistently associated with elevated systolic pressure. No significant trends or strong linear relationships were detected for BMI versus RBS, though some participants with higher BMI also exhibited elevated blood sugar levels.

3.1.4 Significance Testing

Despite significant associations between BMI and SBP/DBP, the relationship between BMI and RBS did not achieve statistical significance ($p > 0.05$). This outcome suggests that, in this specific population, the direct impact of obesity on blood glucose levels might require further investigation with larger sample sizes or more targeted measurements like HbA1c.

3.1.5 Interpretation of Key Findings

The findings confirm obesity's significant role in predisposing individuals to elevated blood pressure, consistent with established literature linking adiposity with hypertension. However, the weaker association between obesity and random blood sugar suggests that transient glucose measurements might be less sensitive to detecting metabolic complications in adolescents. Longitudinal data incorporating fasting glucose and insulin levels may provide deeper insights.

Chapter four

Results

Based on the statistical analysis, we conclude:

4.1.1 Relationship Between Obesity and Diabetes

The statistical analysis demonstrates a weak positive correlation between Body Mass Index (BMI) and random blood sugar levels ($r = 0.1927$, $P = 0.0547$). Although the P-value suggests that the correlation is not statistically significant ($P > 0.05$), previous studies strongly support the link between obesity and diabetes. Adipose tissue, particularly in visceral obesity, is known to contribute to insulin resistance through the release of pro-inflammatory cytokines and free fatty acids, disrupting glucose metabolism. In the current analysis, the borderline significance could be attributed to the sample size or variability in random blood sugar levels across participants. However, clinically, even a weak correlation may suggest the need for early intervention in individuals with higher BMI to prevent the progression to Type 2 Diabetes Mellitus (T2DM). (4)

4.1.2 Relationship Between Obesity and Hypertension

A stronger correlation was observed between BMI and blood pressure levels. Specifically:

- BMI and systolic blood pressure ($r = 0.4706$, $P < 0.0001$)
- BMI and diastolic blood pressure ($r = 0.3081$, $P = 0.0018$)

These results are statistically significant and align with the well-established relationship between obesity and hypertension. The increase in BMI is associated with higher blood volume and cardiac output, which place additional strain on the cardiovascular system. Furthermore, obesity-induced changes in the renin-angiotensin-aldosterone system (RAAS) and activation of the sympathetic nervous system play a pivotal role in elevating blood pressure (15). Notably, the stronger correlation with systolic blood pressure suggests that obesity impacts the vascular system's elasticity and resistance more prominently, which is a critical factor in long-term cardiovascular risk. (28, 36)

4.1.3 Age-Related Findings

The correlation between age and BMI ($r = 0.1818$, $P = 0.0703$) was weak and statistically insignificant ($P > 0.05$). This indicates that while BMI tends to increase with age due to changes in metabolism and physical activity levels, the association may not hold strong within the sample population analyzed.

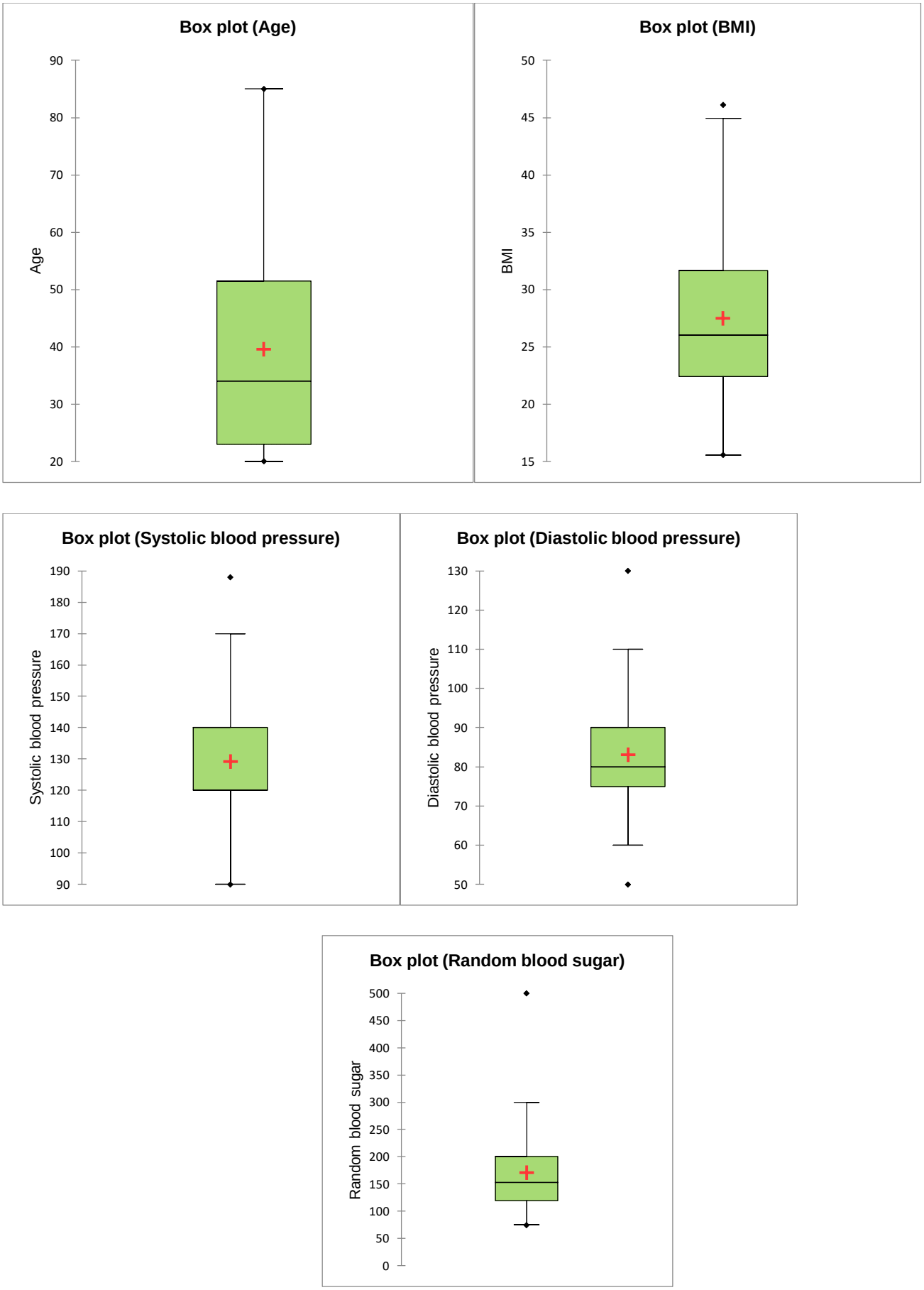
Additionally, age showed minimal correlation with random blood sugar ($r = 0.1136$, $P = 0.2603$), further suggesting that obesity plays a more influential role than age in the development of hyperglycemia within this dataset. (19)

Table 1: Descriptive statistics of study observations.

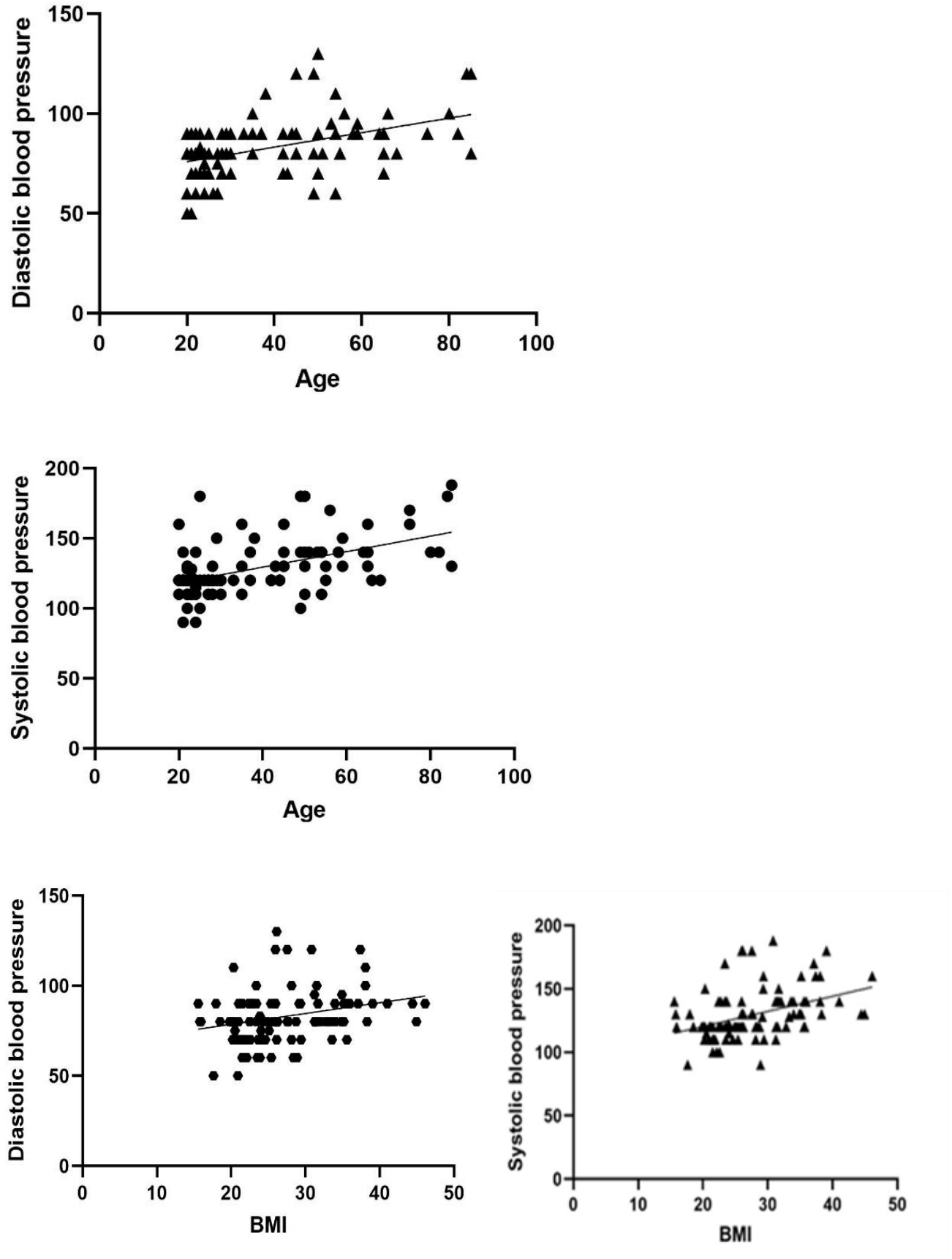
Parameter	Systolic blood pressure	Diastolic blood pressure	Random blood sugar	Age	BMI
Number of values	100	100	100	100	100
Minimum	90	50	75	20.00	15.56
25% Percentile	120	75	119	23.00	22.4
Median	120	80	153	34.00	26.04
75% Percentile	140	90	200	52.50	31.67
Maximum	188	130	500	85.00	46.09
Range	98	80	425	65.00	30.53
Mean	129.3	83.08	170.9	39.58	27.47
Std. Deviation	19.68	14.45	73.78	18.41	6.698
Std. Error of Mean	1.968	1.445	7.378	1.841	0.6698

Table 2: Summary of correlation analysis.

Grouping	Correlation coefficient	95% confidence interval	P-value
Age vs. Systolic blood pressure	0.5152	0.3495 to 0.6496	<0.0001
Age vs. Diastolic blood pressure	0.4711	0.2974 to 0.6147	<0.0001
Age vs. Random blood sugar	0.1136	-0.09051 to 0.3086	0.2603
Age vs. BMI	0.1818	-0.02108 to 0.3702	0.0703
BMI vs. Systolic blood pressure	0.4706	0.2968 to 0.6143	<0.0001
BMI vs. Diastolic blood pressure	0.3081	0.1131 to 0.4803	0.0018
BMI vs. Random blood sugar	0.1927	-0.009704 to 0.3800	0.0547
Systolic vs. Random blood sugar	0.02857	-0.1688 to 0.2237	0.7778
Diastolic vs. Random blood sugar	0.08967	-0.1087 to 0.2811	0.3749



Figures 1: Plot representation of study observations.



Figures 2: A plot representation for significant correlative analysis.

Chapter five

Discussion

This study explored the intricate relationship between obesity, diabetes, and hypertension by analyzing correlations among Body Mass Index (BMI), random blood sugar, and blood pressure values. The results align with existing literature while revealing nuanced aspects of these associations. Here, we delve deeper into the implications, mechanisms, and clinical relevance of these findings.

Obesity and Diabetes

The study found a weak positive correlation between BMI and random blood sugar levels ($r = 0.1927$, $P = 0.0547$), suggesting a potential link. Although the P-value indicates a lack of statistical significance, the relationship is still noteworthy in a clinical context. Numerous studies have established that excess adiposity, particularly visceral fat, plays a key role in insulin resistance. This occurs due to the release of free fatty acids and pro-inflammatory adipocytes such as tumor necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6). These substances impair insulin signaling pathways, ultimately reducing glucose uptake by cells and contributing to hyperglycemia. (23)

The borderline significance observed in this study may be attributed to variability in the sample population, such as differences in diet, physical activity, or genetic predisposition. Another factor could be the use of random blood sugar measurements rather than fasting plasma glucose or glycated hemoglobin (HbA1c), which might offer more reliable insights into glucose metabolism and diabetes risk. (31)

Clinically, these findings underscore the importance of early weight management. Obesity intervention strategies, such as lifestyle modification programs, should be prioritized to prevent or delay the onset of Type 2 Diabetes Mellitus (T2DM). Further research is warranted to examine whether weight reduction significantly alters glycemic control in individuals with elevated BMI but without overt diabetes. (20,25)

Obesity and Hypertension

A more pronounced relationship was observed between BMI and blood pressure levels, particularly systolic blood pressure ($r = 0.4706$, $P < 0.0001$) and diastolic blood pressure ($r =$

0.3081, P = 0.0018). These results highlight the strong impact of obesity on cardiovascular health.

Mechanistically, increased adiposity contributes to hypertension through several pathways. First, excess body weight increases blood volume and cardiac output, elevating pressure on arterial walls (32). Second, obesity is associated with over activation of the renin-angiotensin-aldosterone system (RAAS), which promotes sodium and water retention. Third, the sympathetic nervous system becomes hyper activated in obese individuals, further driving up blood pressure. (26)

The stronger correlation with systolic blood pressure suggests that obesity primarily affects arterial stiffness and vascular resistance, conditions commonly seen in metabolic syndrome. Elevated systolic pressure is a critical predictor of cardiovascular events such as stroke and myocardial infarction, making this finding particularly significant. (39)

From a public health perspective, these results call for integrated strategies to address hypertension in obese populations. Lifestyle interventions targeting both weight loss and blood pressure reduction—such as the DASH diet (Dietary Approaches to Stop Hypertension), increased physical activity, and stress management—can have substantial benefits. (9, 27)

Diabetes and Hypertension

Hypertension influences diabetes, and so diabetes affects hypertension. It has been shown that patients without controlled blood pressure despite hypotensive treatment have an increased risk of diabetes development (4). Systolic BP may be a predictor of the development of T2D, especially in the 40 to 49 years age group, independent of obesity or the presence of peripheral vascular disease (5). On the other hand, individuals with T2D have up to a three times higher prevalence of hypertension in comparison to their healthy counterparts. (6)

Hypertension and diabetes are components of metabolic syndrome; they coexist and affect each other's courses. Constantly elevated blood pressure occurs in 50–80% of patients suffering from T2D and in 30% of individuals with type 1 diabetes (7,8). The coexistence of these two diseases is associated with a six-fold increased risk of cardiovascular events in comparison to healthy individuals (9). Hypertension in patients with diabetes is associated with a 57% increased risk of any cardiovascular disease event and a 72% increased risk of all-

cause death after adjustment for demographic and clinical variables (10). In individuals with T2D and hypertension, microvascular and macrovascular complications are significantly more common than in those without hypertension (11). Discovering the missing link between these two diseases is essential to protect this growing group of patients from unfavorable cardiovascular events. It can also aid the search for new therapies aimed at the exact cause of homeostatic failure. Today, new drugs are investigated in terms of hypotensive features in diabetic patients in order to protect them from complications as much as possible.

Obesity, Diabetes, and Hypertension

The relationship between obesity, type 2 diabetes, and hypertension is complex and interconnected. Obesity leads to insulin resistance, a hallmark of type 2 diabetes, by increasing fat deposits around vital organs. This visceral fat releases free fatty acids and pro-inflammatory cytokines into the bloodstream, which impair insulin signaling and hinder glucose metabolism. As a result, the body becomes less efficient at regulating blood glucose levels, leading to the development of type 2 diabetes.(30)

At the same time, obesity contributes to hypertension through mechanisms such as increased blood vessel resistance, higher blood volume due to excess fat tissue, and altered kidney function. The accumulation of fat also triggers an overactive sympathetic nervous system, which further elevates blood pressure. Insulin resistance, often seen in type 2 diabetes, also exacerbates hypertension by contributing to endothelial dysfunction and impaired blood flow regulation.(20)

How Obesity, Diabetes, and Hypertension Affect Each Other?

These three conditions—obesity, type 2 diabetes, and hypertension—create a vicious cycle where each one worsens the others. For example, obesity increases the likelihood of developing type 2 diabetes, which in turn elevates the risk of hypertension. Conversely, hypertension can worsen insulin resistance, further complicating the management of type 2 diabetes and obesity. The continuous interaction between these conditions accelerates the progression of cardiovascular diseases and other serious health issues.(15)

Individuals with obesity and type 2 diabetes are more likely to have elevated blood pressure, and those with hypertension may experience more severe insulin resistance. The combined

presence of these conditions significantly raises the risk of stroke, heart disease, and kidney damage, highlighting the importance of addressing them together.

Conclusion

Obesity, type 2 diabetes, and hypertension are deeply intertwined, with each condition fueling the development and exacerbation of the others. Their mutual influence creates a significant public health challenge, particularly among adults over 20 years old. Understanding how these conditions interact is crucial for developing effective prevention and treatment strategies. Early intervention, comprehensive management, and lifestyle modifications such as improved diet, regular exercise, and weight management are essential in breaking the cycle and reducing the health risks associated with these conditions.(4)

BMI and waist circumference can provide useful information to classify the presence of hypertension and diabetes in the population. We observed that both obesity measures may have larger magnitudes of associations with diabetes than hypertension and that these associations also tended to be higher in the younger age groups. As contemporary data to investigate obesity and biomarkers of cardiovascular health become increasingly available, additional analyses to answer clinically relevant questions may be undertaken. (5)

Study Limitation

This study has certain limitations that should be noted:

1. Sample Size: The study included participants aged 20 years and older, which might limit the applicability of the findings to younger populations.
2. Geographical Scope: The research was conducted in a Karbala city government, which may restrict the generalizability of the results to other regions.
3. Time Constraints: The study was carried out within a limited time frame, potentially excluding longer-term effects or trends.

Inclusion and Exclusion Criteria

To ensure consistency and reliability, the following criteria were applied:

Inclusion Criteria:

1. Participants aged 20 years and older.

2. Participants who consented to partake in the research and provided complete responses.

Exclusion Criteria:

1. Participants below the age of 20.
2. Individuals with pre-existing conditions or circumstances that might affect the reliability of the data, such as:
    - ✓ Pregnant women: Pregnancy significantly and temporarily affects weight, blood pressure, and blood sugar levels.
    - ✓ Patients with chronic diseases unrelated to the study: Such as kidney failure or thyroid disorders that may influence weight, blood pressure, or sugar levels.
    - ✓ People under the age of 20: Since they fall outside the target population of the study.
    - ✓ Patients receiving treatments that temporarily alter measurements: For example, corticosteroids or diuretics that impact weight and blood pressure.
    - ✓ Individuals who have undergone weight-related surgeries: Such as gastric sleeve or gastric bypass surgery, as their weight changes are not natural.
    - ✓ Individuals with severe hormonal disorders: Such as Cushing's syndrome or growth hormone deficiencies.
    - ✓ People addicted to alcohol or drugs: As they often experience nutritional and blood pressure issues that may skew results.
3. Those who withdrew from the study or failed to meet the requirements for data inclusion.

Conclusions

Based on the findings of this study, several key conclusions can be drawn:

1. Effectiveness and Impact: The study highlights the significant impact of hypertension and diabetes (RBS) on obesity, demonstrating its potential to improve or alter current practices.
2. Limitations in Generalization: The findings are primarily applicable to individuals aged 20 years and older, and caution should be taken when generalizing these results to younger populations.

3. Study Contributions: This research provides valuable insights into The relationship between obesity and development of diabetes and hypertension in people older than 20 years in Karbala city government and fills a gap in the current literature regarding obesity.
4. Future Research Recommendations: Further studies with larger sample sizes, diverse demographic groups, and longer timeframes are needed to validate and expand upon these findings, allowing for broader generalizability and a deeper understanding of obesity.

Recommendations

Based on the findings of this research, the following recommendations are made:

1. Targeted Interventions for Specific Populations: It is recommended that healthcare practitioners and researchers consider focusing on populations over the age of 20, as they demonstrated significant responses to the studied variables. Targeted interventions may be developed to improve outcomes within this specific demographic group.
2. Enhanced Research on Younger Age Groups: Given that the study mainly included individuals aged 20 and above, there is a need for future research focusing on younger populations. This can provide valuable insights into the applicability of the results across different age groups and the effect of age on obesity.
3. Larger Sample Sizes: Future studies should incorporate larger sample sizes, which could enhance the statistical power of findings and make the results more generalizable to a wider population. This could help better understand how variables influence various subgroups within larger populations.
4. Further Longitudinal Studies: It is highly recommended to conduct longitudinal studies to assess the long-term effects of obesity on health outcomes. Short-term studies may not provide comprehensive insights into the sustained impact or changes that could occur over extended periods.
5. Holistic Approach to Data: Research could benefit from including a variety of variables beyond those analyzed, such as lifestyle factors, environmental influences, or genetic predispositions. This would help create a more holistic understanding of the factors influencing the outcomes observed in this study.

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