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Original Research

Examination of the Effects of Weight's Insulin Resistance on the People in Derna, Libya

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ABSTRACT:

This study aimed to identify the best single marker of insulin resistance using the gold standard method, focusing on its relationship with body weight. Conducted over three months (March to May, 2024). It included 159 participants (68.6% females, 31.4% males) who responded to paper and electronic questionnaires distributed among healthcare professionals and the public. The findings revealed that BMI was the strongest predictor of insulin resistance in adipose tissue, particularly in females, where 23% of obese women (BMI ≥29 kg/m²) exhibited insulin resistance. Among males, 62% of those with a BMI ≥30 kg/m² were affected. Waist circumference (WC) was also significantly linked to insulin resistance, with an 84% association in females (WC ≥96.55 cm) and a 50% association in males (WC ≥108 cm). These results highlight a high prevalence of insulin resistance in the city, with women being more affected than men. This study underscores the importance of BMI and WC as markers of insulin resistance, providing valuable insights into local health trends.

KEYWORDS: Insulin, Resistance, Body , Miss , Index , Waist , Circumference.

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INTRODUCTION

Insulin is crucial for glucose homeostasis and plays both anabolic and anticatabolic roles in various tissues. Insulin resistance (IR) occurs when tissues fail to respond adequately to insulin. IR can manifest early in the development of type 2 diabetes mellitus, making it an important target for therapeutic intervention (Castorani et al. 2020).

Insulin resistance is a condition in which the body's tissues become less responsive to insulin, prompting a compensatory increase in insulin production to maintain normal glucose metabolism. This reduced effectiveness of insulin leads to higher insulin production, resulting in hyperinsulinemia, which can cause harmful effects (Ahmed et al. 2021).

IR can affect specific tissues or be more generalized. When the term "insulin resistance" is used without specifying a tissue, it generally refers to a reduced sensitivity to insulin in regulating glucose and free fatty acid (FFA) metabolism (Li et al. 2022).

The link between IR and obesity is well-established, as adipose tissue actively releases molecules that interfere with insulin signaling. Chronic low-grade inflammation and oxidative stress are commonly present in insulin-resistant tissues, leading to a reduction in insulin-stimulated glucose uptake (James et al. 2021).

Additionally, the rise in obesity has coincided with an increase in type 2 diabetes (T2D) and metabolic syndrome. However, it is now recognized that there are also cases of "normal-weight metabolic obesity," where individuals are insulin resistant without being obese (Rachdaoui 2020).

Insulin influences the breakdown and storage of fat in fat cells by inhibiting lipolysis, which is the breakdown of fat into free fatty acids and glycerol. This has significant implications for both general health and athletes. While it is often believed that completely inhibiting lipolysis is undesirable—particularly for those aiming to reduce body fat—insulin's role in this process is crucial (Edwards and Mohiuddin 2020).

This study aims to identify the most effective marker of insulin resistance using the gold standard method. It will assess the associations between insulin resistance and body weight, with the goal of improving the understanding of conditions like type 2 diabetes mellitus and enabling more accurate evaluations of insulin resistance and its related health outcomes.

MATERIALS AND METHODS

Study Design

A paper questionnaire was distributed to nutrition and internal medicine doctors, who assessed the case by recording height, weight, and waist circumference. The questionnaire included questions on the patient's diet, sleep duration, water intake, and consumption of legumes, starches, sweets, and fiber.

Additionally, an electronic questionnaire was completed by patients diagnosed with insulin resistance.

Study Procedure

The study was conducted from March to May 2024 at private laboratories and clinics (Al-

Baraa Laboratory, Lavender Laboratory, Manarat Al-Mustaqbal Clinic, Derna Medical Center) in collaboration with the Department of Zoology at the University of Derna. A total of 159 cases participated, providing data on age, gender, height, waist circumference, and other research-related questions.

Statistical Analysis

Data were analyzed using Minitab software 17 and Microsoft Excel 2010. Statistical significance was determined using a two-sample t-test after confirming normal distribution, with a p-value < 0.05 considered significant

RESULTS AND DISCUSSION

The demographic characteristics of individuals with insulin resistance in March, April, and May of 2024 were the three consecutive months in which this study was conducted.

The total number of patients was 159. During the study months, she was diagnosed with symptoms related to insulin resistance. On the basis of gender, groups of males and females were created. The event was attended by 159 patients: 50 (31.4%) adult men and 109 (68.5%) adult women. They registered to participate in the study, as shown in Figure 1.

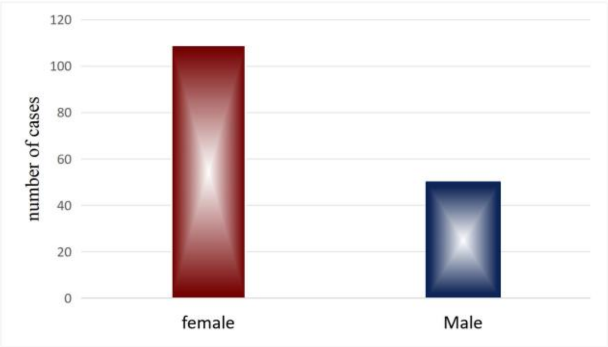

Figure: (1). Number of Cases Adult Females and Males.

Insulin Resistance, Body Mass Index, and Waist Measurement Changes

Insulin Resistance (IR)

As shown in Table 1, there are notable differences in the average insulin resistance between sexes. The mean insulin resistance value for adult females with abnormal insulin resistance was 3.78 ± 0.18, while for males, it was 3.44 ± 0.19. Statistically, these values differed significantly. In contrast, the mean insulin resistance value for adult females with normal insulin resistance was 1.38 ± 0.08, and for males, it was 1.56 ± 0.07, with a significant difference observed ($p < 0.05$).

Table:(1). Values of Insulin Resistance (IR) Normal and Abnormal for Adult Females and Males.

IR	Normal Mean± SEM	Abnormal Mean± SEM
Females	1.38 ± 0.08 a	3.78 ± 0.18 b
Males	1.56 ± 0.07 a	3.44 ± 0.19 b

Data are expressed as mean ± SEM of each gender. Within each column for male or female separately, means with different superscript (a, b or c) were significantly different at (p<0.05). Where means without superscripts mean that there is no significant difference (p>0.05).

The results aimed to assess the effect of insulin on weight for both sexes, as illustrated in Figures 2 and 3. The findings reveal that females predominated in the study, with a total of 109 females. Among them, 8 (7.33%) exhibited insulin sensitivity, 40 (36.6%) had insulin resistance, and 62 (56.88%) experienced serious insulin resistance.

As shown in Figure 3, among the males, 16 (32%) demonstrated insulin sensitivity, 11 (22%) had insulin resistance, and 23 (46%) were classified with serious insulin resistance.

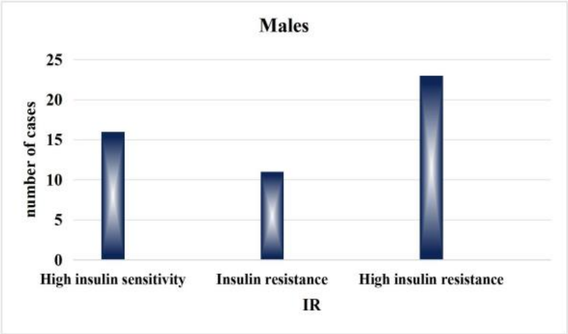

Figure: (2).Number of Adult Males Cases with Insulin resistance (IR).

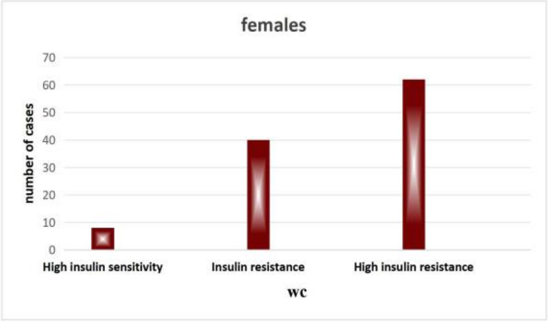

Figure: (3).Number of Adults Females Cases with insulin resistance (IR).

Body Mass Index (BMI)

Average BMI values were recorded for both females and overweight males in comparison to those with normal weight. Overall, the results showed considerable similarity between the sexes, as shown in Table 2.

The average BMI values for adult females and males were 27.4 ± 1.80 and 28.9 ± 1.75, respectively. This result was not statistically different from those of overweight individuals.

The average BMI for overweight females was 29.5 ± 0.59, and for overweight males, it was 30.85 ± 0.80.

Table:(2). Values of Body Mass Index (BMI) Normal and Abnormal for Adult Females and Males.

(BMI)kg/m2	Normal Mean± SEM	Abnormal Mean± SEM
Females	27.4 ±1. 80 a	29.5 ± 0.59 a
Males	28.9 ± 1.75 a	30.85 ±0.80 a

Data are expressed as mean ± SEM of each gender. Within each column for male or female separately, means with different superscript (a, b or c) were significantly different at ($p<0.05$). Where means without superscripts mean that there is no significant difference ($p>0.05$).

Figures 4 and 5 graphically show the proportion of adults of both sexes who suffer from excess body mass.

The number of females who were of normal weight was 38 (335%); those who were overweight were 15 (113.76%); those who were obese were 41 (36.61%); and those who were suffering from serious obesity were 13.76%.

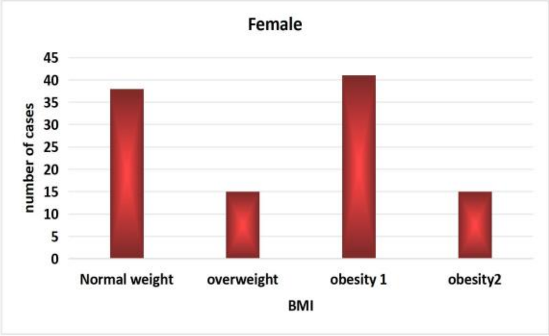

Figure:(4): BMI of Adult Females Cases.

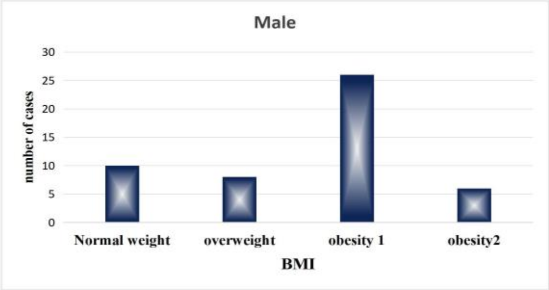

Figure: (5): BMI of Adult Male Cases.

The number of males who had a normal weight was 10 (20%), those who were overweight were 8 (16%), about 26 (52%) were obese, and 6 (12%) were seriously obese.

Waist Measurement

In the average waist measurement values, it was statistically shown that there was a significant difference between females and males whose waist measurements were normal and recorded (0.89 + 72.62) (80.78 + 4.52) respectively, compared to females and males whose waist measurements were large, where they recorded (96.55+ 0.877) (108.30 + 1.26) respectively, as shown in the table 3

Table:(3). Values of Waist Measurement(WC) Normal and Abnormal for Adult Females and Males.

WC	Normal Mean± SEM	Abnormal Mean± SEM
Females	0.89±72.62 a	96.55±O.877 b
Males	80.78± 4.52 b	108.30± 1.26 a

Data are expressed as mean ± SEM of each gender. Within each column for male or female separately, means with different superscript (a, b or c) were significantly different at ($p<0.05$). Where means without superscripts mean that there is no significant difference ($p>0.05$).

Figure 6 shows the number of females who suffer from an acceptable waist measurement of about 8 (7.33%); those who suffer from a serious waist measurement were 13 (12%); and those who suffer from a high risk waist measurement are about 88 (80.7%)).

The number of males with an acceptable waist size is about 19 (38%); As for those suffering from a dangerous waist measurement, their number was 12 (24%); Those who suffer from a high risk waist measurement number are about 19 (38%), as shown in Figure 7

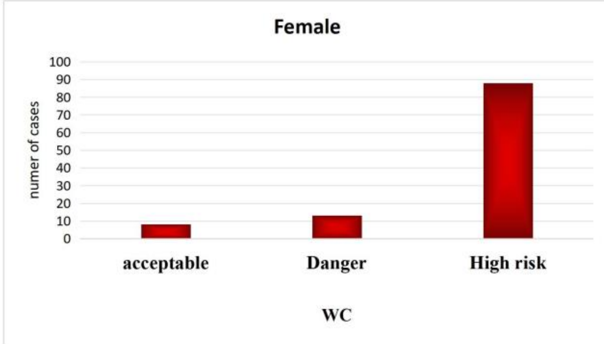

Figure: (6): Body Waist Measurement for Adult Females.

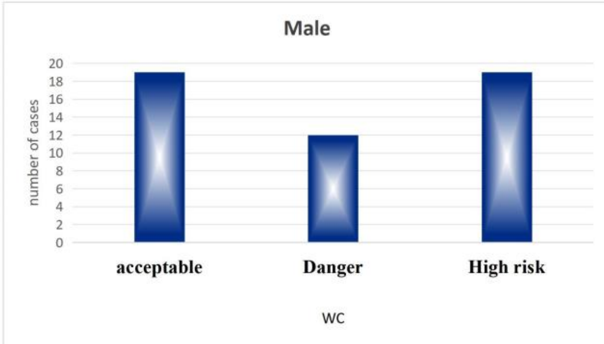

Figure: (7): : Body Waist (WC) Measurement for Adult Males**.**

Relationship between Insulin Resistance and Body Mass Index (BMI)

Figure 8 shows 8 (7.33%) of them suffered from insulin sensitivity, 7 (6.4%) of them had a large index mass, and 40 (36.6%) suffered from insulin resistance, of whom 39 (35.7%) had a large index mass and 62 (56.88%) had serious insulin resistance, 60 (55%) of whom had a large index mass.

Figure 9 shows that the males who were insulin sensitive were 16 (32%), of which 15 (30%) were males, and those who had insulin resistance were about 11 (22%), all of whom had an increased body mass index, and those who suffered from serious insulin resistance were 23. (46%). They also all suffered from a significant increase in the body mass index.

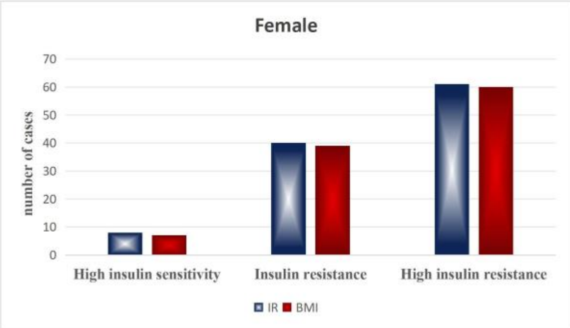

Figure: (8): A Relationship between Insulin Resistance and Body Mass Index (BMI) For Adult Females.

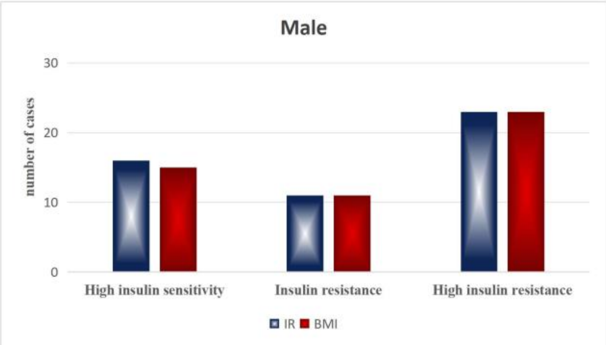

Figure: (9): A Relationship between Insulin Resistance and Body Mass Index (BMI) For Adult Males.

Relationship between Insulin Resistance and Waist Measurement (WC)

Figure 10 shows the percentage of females who suffer from a dangerous waist measurement. 8 (7.33%) of them suffered from insulin sensitivity, of which 2 (1.83%) had a large waist circumference, and 40 (36.6%) suffered from insulin resistance, of which 26 (23.8%) had a large waist circumference and 62 (56.88%) had serious insulin resistance. Of them, 35 had large waist circumferences.

The males who were insulin sensitive were 16 (32%), of whom 2 (4%) had a large waist circumference, and those who were insulin resistant were about 11 (22%), of whom 5 (10%) had a large waist. measurement; 23 (46%) of them had serious insulin resistance. 14 of them had large waist circumferences. As shown in Figure 11.

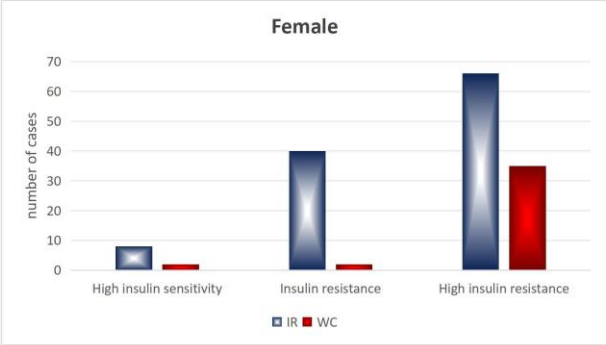

Figure: (10): A Relationship between Insulin Resistance and Waist Measurement (WC) For Adult Females.

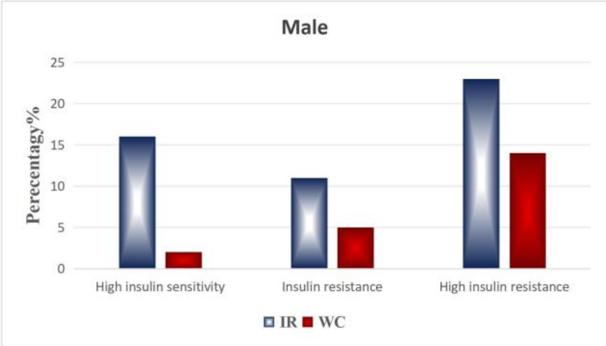

Figure: (11): A Relationship between Insulin Resistance and Waist Measurement (WC) For Adult Males.

This study aimed to examine the relationship between insulin resistance (IR), body mass index (BMI), and waist circumference (WC) in a cohort of adult males and females in Derna city.

The results confirm that insulin resistance is strongly associated with obesity, as measured by both BMI and WC, in both males and females, consistent with findings in the existing literature.

One of the key findings of this study is the significant relationship between increased BMI and insulin resistance. In females, those with a BMI ≥29 kg/m² were found to have a higher prevalence of insulin resistance, a trend which was also evident in males with a BMI ≥30 kg/m².

These results are consistent with previous studies that have highlighted BMI as a strong predictor of insulin resistance (Feng et al.

2020; Bhat et al. 2021). Increased adipose tissue, particularly visceral fat, has been identified as a critical factor in the development of insulin resistance, as it impairs insulin signaling and promotes the release of pro-inflammatory cytokines that further disrupt glucose homeostasis (James et al., 2021). Our findings align with these studies, which suggest that BMI remains an essential measure for assessing metabolic risk.

Waist circumference (WC), which is a measure of central obesity, was another important predictor of insulin resistance in this study. We found that individuals with a WC ≥96.55 cm in females and ≥108 cm in males had a significantly higher likelihood of insulin resistance. These results are in agreement with other studies that suggest abdominal obesity, characterized by excess visceral fat, plays a critical role in the development of insulin resistance and metabolic syndrome (Hübers et al. 2017). The accumulation of fat in the abdominal region is known to increase free fatty acid levels in the bloodstream, which can interfere with insulin action, particularly in insulin-sensitive tissues such as muscles and the liver (White et al. 2022).

In line with the literature, the study also demonstrated that the relationship between insulin resistance and obesity is not solely dependent on body fat percentage but is closely linked to the distribution of fat. As noted by Li et al. (2022), insulin resistance can be exacerbated when there is a higher proportion of fat stored in ectopic sites, such as the liver and muscles, rather than in subcutaneous adipose tissue.

This "ectopic fat" accumulation disrupts normal insulin signaling pathways, leading to impaired glucose uptake and storage. Our study's findings suggest that WC may be a more accurate reflection of visceral fat accumulation and, by extension, insulin resistance than BMI, especially in females.

Additionally, the gender differences observed in this study are consistent with prior research. Females, with a higher prevalence of insulin resistance and associated metabolic disturbances, appear to experience a more significant impact of obesity on insulin sensitivity than males (Rachdaoui 2020). This gender-based disparity may be related to differences in fat distribution and hormonal regulation. For example, females tend to accumulate more subcutaneous fat, while males often store more visceral fat, which is metabolically more active and contributes more significantly to insulin resistance (Ahmed et al. 2021).

Another crucial point to consider is the relationship between insulin resistance and muscle, liver, and adipose tissue, as explored in the literature. In insulin-resistant states, these tissues fail to effectively utilize glucose, leading to hyperglycemia and the development of type 2 diabetes (Koh et al. 2021; Batista et al. 2021). The study findings that demonstrate a higher prevalence of insulin resistance in individuals with abnormal BMI and WC values suggest that the pathophysiology of insulin resistance is multifactorial, involving complex interactions between adipose tissue, liver, and muscle (James et al. 2021). In our study, it was evident that the dysfunction in insulin signaling in these tissues, caused by excessive fat accumulation, played a central role in the observed metabolic disturbances.

In summary, this study corroborates the findings of previous research that emphasize the role of obesity, as measured by BMI and WC, in the development of insulin resistance. The results highlight the importance of using these anthropometric measures to identify individuals at risk for type 2 diabetes and other metabolic disorders. Notably, WC appeared to be a particularly strong indicator of insulin resistance, especially in females, reflecting the significance of abdominal fat in the metabolic dysfunction. Furthermore, the present study underscores the need for effective interventions targeting obesity and insulin resistance to mitigate the risk of developing type 2 diabetes and related conditions.

CONCLUSION

The findings from this study are consistent with the well-established notion that insulin resistance is a precursor to metabolic diseases, and it supports the growing body of evidence that early identification of insulin resistance, through simple and cost-effective measures like BMI and WC, is crucial for preventing the progression to more serious conditions such as type 2 diabetes.

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الملخص

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هدفت هذه الدراسة إلى تحديد أفضل علامة فردية لمقاومة الأنسولين باستخدام الطريقة القياسية الذهبية، مع التركيز على علاقتها بوزن الجسم. أُجريت الدراسة على مدى ثلاثة أشهر (مارس الى مايو، 2024). وشملت 159 مشاركًا (68.6% إناث، 31.4% ذكور) استجابوا لاستبيانات ورقية وإلكترونية تم توزيعها بين المهنيين الصحيين والجمهور. كشفت النتائج أن مؤشر كتلة الجسم كان أقوى مؤشر لمقاومة الأنسولين في الأنسجة الدهنية، لا سيما لدى الإناث، حيث أظهرت 23% من النساء البدينات (مؤشر كتلة الجسم ≥29 كجم/م²) مقاومة للأنسولين. بين الذكور، تأثر 62% من الذين لديهم مؤشر كتلة الجسم ≥30 كجم/م². كان محيط الخصر (WC) مرتبطًا بشكل كبير بمقاومة الأنسولين، حيث كانت نسبة الارتباط 84% لدى الإناث (WC ≥96.55 سم) و50% لدى الذكور (WC ≥108 سم). تُبرز هذه النتائج انتشارًا مرتفعًا لمقاومة الأنسولين في المدينة، حيث كانت النساء أكثر تأثرًا من الرجال. تؤكد هذه الدراسة على أهمية مؤشر كتلة الجسم ومحيط الخصر كعلامات لمقاومة الأنسولين، مما يوفر رؤى قيمة حول الاتجاهات الصحية المحلية

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الكلمات المفتاحية: الأنسولين، المقاومة، الجسم، مؤشر، محيط الخصر.