ECRONICON OPEN ACCESS

EC ENDOCRINOLOGY AND METABOLIC RESEARCH

Research Article

Relationship Between Weight and Insulin Resistance in a Sample of An-Najah National University Students, A Cross Sectional Study

Fadwa Sharabati*, Sara Almansour, Mohammad Ghannam, Saif Atyani, Abdulsalam Khayyat, Souad Belkbir and Intisar Alalami

Faculty of Medicine and Health Science, at An-Najah National University, Nablus, Palestine

***Corresponding Author:** Fadwa Sharabati, Faculty of Medicine and Health Science, at An-Najah National University, Nablus, Palestine.

Received: December 16, 2021; **Published:** January 28, 2022

Abstract

Objectives: Type 2 diabetes has mainly resulted from decreased sensitivity to insulin. There are multiple risk factors that contribute to this insulin resistance including obesity. Controlling these risk factors may delay the progression of the disease. There are multiple methods for detection of insulin resistance in pre-diabetics, and one of them is HOMA. Our study aimed to detect the relationship between insulin resistance and BMI and waste circumference among An-Najah national university students.

Methods: This was a cross sectional study that involved 325 students of different academic levels from different faculties at An Najah National University-New Campus. A blood sample was drawn from each participant for FBS and insulin. And a questionnaire with open ended and closed ended questions was administered to them. Measurents of weight, height, waist circumference was taken. was used for analysis.

Results: Overall, 29.54% of the students had HOMA-IR score > 2.85 (with percent of 40.57% among the male population and 24.20% among females).

Conclusion: This study shows a high prevalence of insulin resistance among male students at An-Najah National University which makes them at higher risk for developing type 2 DM in the future. high incidence was also found in participants with high BMI and central obesity. so, education regarding lifestyle modification including improvement of their eating habits and exercise programs are needed.

Keywords: *Insulin Resistance; Sample; BMI; DM; Insulin*

Abbreviations

BMI: Body Mass Index; IRB: Institutional Review Board; DM: Diabetes Mellitus; NCD: Non-Communicable Disease

Introduction

Background

Type 2 diabetes has been a global issue. High incidence of the disease among children and young adults in the last decades brought serious concerns due to the known complications associated with the disease. These numbers are believed to be related to the increased obesity and the unhealthy lifestyle.

According to the health annual report of Palestine 2018, there were 5555 newly diagnosed cases of diabetes with incidence rate per 100 000 of 210.7.

The pooled prevalence of obesity and overweight is 6% and 15% % in children; 18% and 30% in adults; and 49% and 40% in people with NCDs [1].

Type 2 diabetes is a multi-factorial disease including both genetic and environmental factors. The pathophysiology of the disease is not fully understood but is highly suggested to be caused by insulin resistance, and the last is thought to be related to adipose tissue as it is mostly seen among obese and overweight individuals [2].

Overweight and obesity are major risk factors for developing many chronic diseases including type 2 diabetes, heart disease, gallstones and stroke [3]. There are multiple predictors for assessment of overweight including BMI and waste circumference.

According to the WHO underweight is defined as BMI < 18.5, normal weight as BMI 18.5 - 24.9, overweight BMI ≥ 25, pre-obese as BMI 25 - 29.9 and obese as BMI ≥ 30. Waist circumference is a measure of visceral fat and fat distribution, and it is considered a risk for type 2 diabetes if it is > 102 cm in men and > 88 in women [4].

There are multiple methods for detecting insulin resistance, HMOA-IR (homeostasis model assessment) is one of them, and it is an easy and reliable predictor in the absence of hyperglycemia and that is why it is preferred in pre-diabetic rather than already diagnosed diabetic patients. Cut –off value was considered according to the 75th percentile of the population as 2.85 [5].

Literature Review

Insulin controls a wide group of metabolic processes including regulation of intermediary metabolism, membrane transport of ions, protein synthesis, gene transcription, and cellular proliferation [6]. Insulin resistance can be described as the inability of insulin to achieve its biological functions [7]. It is defined clinically as inability of a specific quantity of insulin, whether it was endogenous or exogenous, to increase glucose uptake and utilization in an individual as much as in normal population [6].

Several mechanisms are proposed to explain insulin resistance and they include genetic abnormalities of proteins participating in the insulin action cascade, visceral adiposity, and fetal malnutrition [6]. Insulin resistance varies among individuals not only due to environmental influence such as physical inactivity leading to obesity and thus insulin resistance, but also due to genetic variations [7].

Insulin resistance provides basis for metabolic, endocrine and cardiovascular diseases depending on the genetic background of the individual and the site of the insulin action cascade at which the resistance occurs. It can precipitate the development of type 2 diabetes in individuals with genetically deficient beta cells reserve, polycystic ovarian syndrome in women with insulin hyper responsive ovaries, and hypertension and accelerated atherosclerosis in people with genetic factors affecting endothelium and vascular tissues [6].

Many methods are used to estimate insulin resistance, hyperinsulinemiceuglycimec clamp and intravenous glucose tolerance test being the most reliable. Other simple methods such as homeostasis model assessment (HOMA) and quantitative insulin sensitivity check index (QUICKI) are validated [5].

Direct quantitative evidence that development of insulin resistance is associated with progression from normal to impaired glucose tolerance is provided by studies using the euglycemic insulin clamp, minimal model, and insulin suppression methods. Most investigators demonstrated that even lean type 2 diabetics have resistance to the action of insulin [8].

Obesity is a major risk factor for Type 2 diabetes, hypertension, dyslipidemia, and cardiovascular disease [9]. Expansion of adipose depots results from adipose cells hyperplasia and hypertrophy in a depot-dependent fashion [10], and there's a wide individual variation in the size and expandability of different adipose tissue in humans [11] Expansion of some depots is associated with an increased risk of insulin resistance while expansion of others is associated with a decreased risk [12].

The odds of insulin resistance decreases by 48% for each standard deviation increase in subcutaneous adipose tissue mass, whereas the odds of resistance increases by 80% for each standard deviation increase in visceral adipose tissue mass [13]. This can explain that insulin resistance is not observed in all individuals with high BMI [11] and that some ethnic populations with relatively low BMI with high waist circumference have a very high incidence of insulin resistance and diabetes [14].

Body mass index, waist circumference, waist to hip ratio, and weight to height ratio are used to determine obesity in clinical practice [9]. Body mass index captures the degree of obesity but not fat distribution, so waist circumference is used to assess the levels of visceral fats [4].

Statement of the problem and rational of the study

Nowadays, there's a significant increase in sedentary lifestyle and physical inactivity among youth, leading to obesity and fat accumulation with a distribution that varies between genders and different ethnic groups. Visceral obesity increases the incidence of insulin resistance which can precipitate to development of type 2 diabetes. Studying the relationship between BMI, waist circumference, and insulin resistance among college students who are not diabetic will shed a light on how obesity, which is a modifiable risk factor, can lead to diabetes and how different fat distribution patterns might affect insulin resistance in different ways. This study will also pave the way for further comprehensive studies to determine insulin resistance levels in the Palestinian community and modify health policies to identify high insulin resistance and prevent its associated comorbidities.

Objectives of the study

Aim

To detect the relationship between insulin resistance and weight in An-najah national university students.

Specific objectives

- To measure the HMOA-IR, BMI and waste circumference.
- To identify the reference range of HOMA-IR in normal weight, overweight and obese students.
- To identify the relationship between insulin resistance and increased weight and waste circumference.

Materials and Methods

Study design

The study is cross-sectional. Subjects were selected randomly. Each one was handled the study's questionnaire and was guided to fill it with information about gender, age, past medical history, drugs, family history for type 2 diabetes, smoking, exercise, sleep and diet. Height, weight and waste circumference were then measured for each subject and a blood sample was taken by a well-trained staff for fasting glucose and fasting insulin which was measured in NNUH labs. Each patient was given a code number to ensure privacy and data protection.

BMI of each subject was calculated according to the equation

weight (kg)/(height (M))^^{2}.

HMOA-IR for each subject was calculated according to the equation: $(I_0 \times G_0)/22.5$ [5].

Study area and population of the study

Study was carried out at An Najah University new campus, and sample was selected randomly from the students there.

Sample size and sampling technique

The sample was selected randomly from the new campus students.

Sample size was calculated using a confidence level of 95% and 5% error according to the following equation as mentioned in http://www.raosoft.com/samplesize.html.

Inclusion and exclusion criteria

The sample was selected randomly from different university faculties students. Those who have diabetes, polycystic ovary disease or taking corticosteroids were excluded.

Data collection instrument

- The study's questionnaire (attached)
- Meter
- Weight scale
- Blood collection kits
- NNUH lab instruments to measure fasting insulin and fasting glucose levels.

Ethical approval

The study protocol was submitted to the research committee and Institutional Review Boards (IRB) at An-Najah National University and was approved before it was carried out. Subjects were approached and introduced to the study and its purpose and asked to participate in the study voluntarily after reading and signing the consent form (attached). Participant's privacy and data confidentiality was ensured and the blood samples were drawn by qualified staff.

Statistical analysis

Statistical analysis was performed using SPSS version21. A P value ≤.05 will be considered to be statistically significant. Data will be presented as mean ± SD or median (1st quartile, 3rd quartile), as appropriate, for continuous variables and as frequencies (proportions) for categorical variables. To assess the relationship between different groups, Univariate inferential statistics will be conducted using the appropriate significant test (Chi-squared, independent 2-sample t-test, Wilcoxon rank sum test, etc.).

Results

Socio-demographic information

A total of 325 students participated in this cross-sectional study with an average age of 20.99 years (SD = 1.85). The following table (Table 1) describe the socio-demographic characteristics of participants. However, the Higher percentage of females was a result of the higher percentage of female students at the university.

Socio-demographic Variables		N	%
Gender	Female	106	32.62%
	Male	219	67.38%
Residency	City	172	52.92%
	Village	150	46.15%
	Camp	3	0.92%

***Table 1:** Socio-demographic characteristics of participants (N = 325).*

Anthropometric parameters

Overall,6 (5.66%) of males had waist circumference > 102 cm, and 7(3.2%) of females had waist circumference > 88 cm; and these are the cutoff values for central obesity according WHO. Moreover, the mean for BMI was 23.35 (SD = 3.84), the BMI categories were as follows in (Table 2).

Anthropometric Parameters			N	%
Waist Circumference	Male	> 102	6	5.66%
		< 102	100	94.34%
	Female	> 88	7	3.2%
		> 88	112	96.8%
BMI	Underweight (< 18.5)		25	7.69%
	Normal weight (18.5 - 24.9)		205	63.08%
	Overweight (25 - 29.9)		74	22.77%
	Obese (> 30)		21	6.46%

***Table 2**: Anthropometric Parameters (N = 325).*

Prevalence of the behaviors that may affect insulin resistance

Regarding smoking, 57 (17.54%) of participants were smokers. Concerning physical activity, 105 (32.31%) of the participants were doing sports on regular basis (Table 3).

Whereas for diet habits, the Mean average of daily meals of all participants was 2.86 (SD = 0.93), mean of weekly consumed fast-food meals was 2.19 (SD = 1.96). Moreover, the participants had mean of 7.1 of sleeping hours (SD = 1.35).

Behaviors may affect Insulin Resistance		N	%
Smoking	Yes	57	17.54%
	No	268	82.46%
Physical Activity	Yes	105	32.31%
	No	220	67.69%
Daily Meals	1 - 3 Meals\day	263	80.9%
	4 - 6 Meals\day	62	19.1%
	> 6 Meals\day	0	0
Sleeping Hours	1 - 5 Hours\day	25	7.7%
	6 - 10 Hours\day	297	91.7%
	> 10 Hours\day	2	0.6%

***Table 3:** Behaviors may affect Insulin Resistance (N = 325).*

Fasting glucose and insulin and HOMA-IR

Lab results showed a mean average of fasting blood glucose of 89.01 (SD = 9.17), and a mean average of 11.9 (SD = 8.1) for fasting insulin. HOMA-IR has a mean average of 2.71 (SD = 2.46).

Furthermore, 96 (29.5%) of the total study population has HOMA-IR of > 2.85, whereas 229 (70.5%) of total population has HOMA-IR < 2.85. The HOMA-IR variations according to the gender, BMI, and waist circumference are described in detail at (Table 4) and (Figures 1-3).

HOMA-IR				N	%
Gender	Female		< 2.85	166	75.8%
	> 2.85		53	24.2%	
	Male		< 2.85	63	59.43%
	> 2.85		43	40.57%	
BMI	Underweight (< 18.5)		< 2.85	25	100%
	> 2.85		0	0	
	Normal weight (18.5-24.9)		< 2.85	154	75.12%
	> 2.85		51	24.88%	
	Overweight (25 - 29.9)		< 2.85	45	60.81%
	> 2.85		29	39.19%	
	Obese (> 30)		< 2.85	5	23.81%
	> 2.85		16	76.19%	
Waist Circumference	Female	< 88	< 2.85	162	76.42%
			> 2.85	50	23.58%
		> 88	< 2.85	4	57.14%
			> 2.85	3	42.68%
	Male	< 102	< 2.85	63	63%
			> 2.85	37	37%
		> 102	< 2.85	0	0
			> 2.85	6	100%

Table 4: *HOMA-IR variations according to the gender, BMI, and waist circumference.*

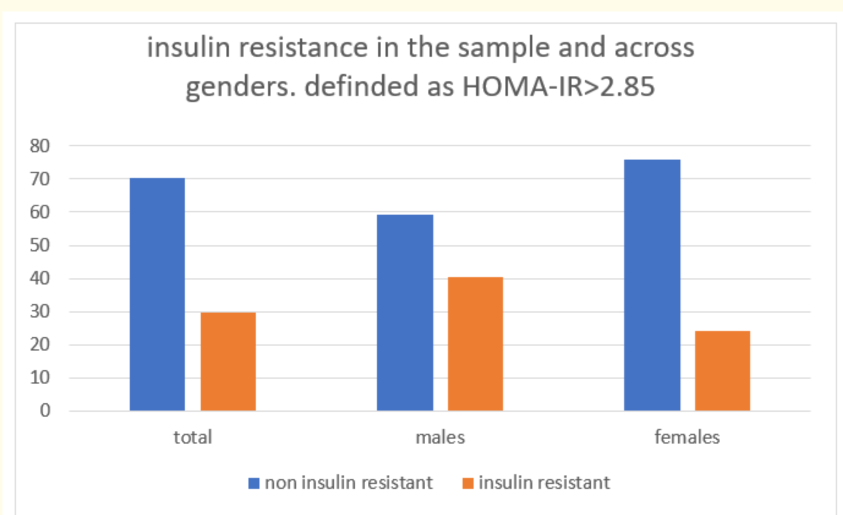

Figure 1: *HOMA-IR in males and females.*

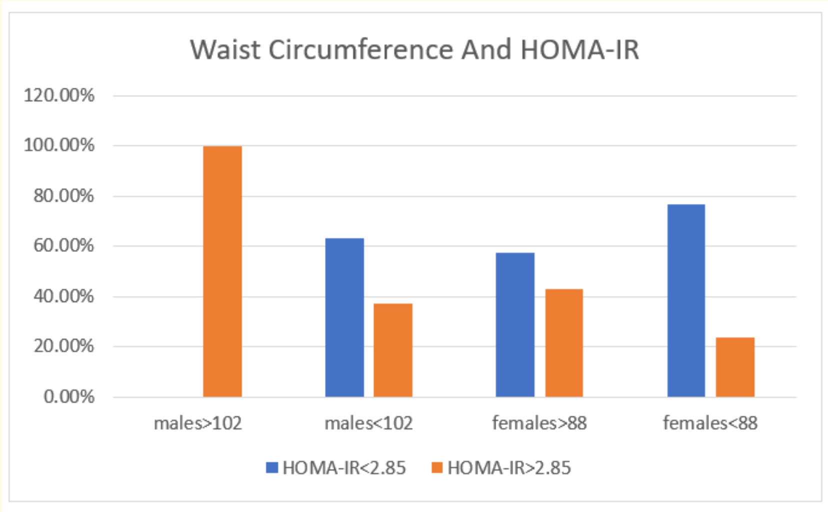

Figure 2: *Waist circumference and HOMA-IR.*

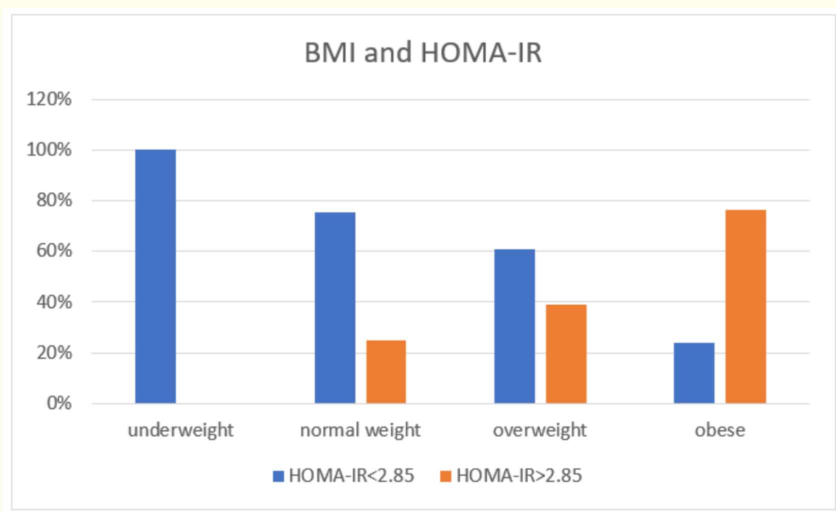

Figure 3: *BMI and HOMA-IR.*

Multiple linear regression model

In order to find out the relationship between the HOMA-IR and [BMI, Waist Circumference, Smoking, Sports, Family history of type2 DM, Number of daily meals, Fast-food (meal\week), and Sleeping hours]; a multiple linear regression model was used. As BMI, Waist Circumference, Smoking, Sports, Family history of type2 DM, Number of daily meals, Fast-food (meal\week), and Sleeping hours; were considered as explanatory variables, and HOMA-IR as depended on variable.

The results of the regression model demonstrated that there were statistically significant relationships between HOMA-IR and some of the explanatory variables ((BMI, p = 000), (Waist Circumference, p = 0.000), (Smoking, p = 0.008), and (Fast food, p = 0.001)).

The whole explanatory variables explain 17.5% of variations in HOMA-IR (as r2 = 0.175), showing that the strength of the relationship between HOMA-IR and the explanatory variables was moderate. To verify the existence of the mentioned relationship, a multicollinearity test was carried out. The result revealed the VIF factors of the model were (< 3), indicating the non-existence of multicollinearity problem (Table 5).

	HOMA-IR (Homeostatic Model Assessment for Insulin Resistance)			
	Pearson Correlation	**P Value**	**R^2**	**VIF Factor**
BMI	0.368	0.000*	0.175	2.208
Waist Circumference	0.360	0.000*		2.403
Smoking	0.133	0.008*		1.159
Sports	0.012	0.413		1.020
Family History of DM type 2	0.062	0.132		1.029
Daily Meals	-0.39	0.244		1.028
Fast Food (meal\week)	0.166	0.001*		1.097
Daily sleeping hours	-0.055	0.161		1.020

Table 5: *Multiple Linear Regression Model to Determine the Correlation Between the Independent Variables and HOMA-IR.*
**= Statically significant at P < 0.05.*

Discussion

In this study of An-Najah National Uniersiyty -new campus students, the cut-off value of HOMA-IR was 2.85 (75^{th} percentile). This study shows high HOMA-IR score in 29.54% of students, the percentage was significantly higher among males compared to females (40.57%, 24.20% respectively). this implicates a higher risk for developing insulin resistance and type 2 diabetes mellitus among males. These results are similar to those of employees at a private university in Lebanon [15].

The average BMI in this study was 23.35 (SD = 3.84). As results have shown, the percentage of HOMA-IR > 2.85 was increasing with increasing BMI so that it was 0% in the underweight group, 24.88% in the normal weight group, 39.19% in the overweight group and 76.19% in the obese group with a P value of <.001. This implicates that increasing BMI increasing the risk for insulin resistance.

Many studies suggest that central obesity is associated with insulin resistance, and that was found in our study among male group, with a 100% of participants, who have waist circumference > 102 cm, have a HOMA-IR > 2.85, and 37% of those with waist circumference < 102 cm (P value 0.002).

However, this was not significant among females with only 42.86% have HOMA-IR > 2.85 of those with waist circumference > 88 cm, and 23.58% in those whose waist circumference < 88, with a P value of 0.241.

Strengths and Limitations

Limitations of this study included: the study was cross-sectional; it was also limited to a convenience sample of students. another limitation, is that there are no exact reference values for this index which makes it of limited use in clinical practice.

Regarding strengths of our study, it is the first one to investigate insulin resistance in Palestine. Another strength point that is worth mentioning, is that the age group of the participants is ideal for starting lifestyle modifications to decrease their chances of developing type 2 DM in cases of high HOMA-IR.

Conclusion and Recommendations

this study shows a high prevalence of insulin resistance among male students at An-Najah National University which makes them at higher risk for developing type 2 DM in the future, so education regarding lifestyle modification including improvement of their eating habits and exercise programs are needed.

Bibliography

1. Elessi K and Albaraqouni L. "Prevalence of obesity and overweight in Palestine: a systematic review". *The Lancet* 393 (2019): S20.
2. Scheen AJ. "Pathophysiology of type 2 diabetes". *Acta Clinica Belgica* 58.6 (2003): 335-341.
3. Field AE., *et al.* "Impact of overweight on the risk of developing common chronic diseases during a 10-year period". *Archives of Internal Medicine* 161.13 (2001): 1581-1586.
4. Feller S., *et al.* "Body mass index, waist circumference, and the risk of type 2 diabetes mellitus: implications for routine clinical practice". *Deutsches Ärzteblatt international* 107.26 (2010): 470-476.
5. Gutch M., *et al.* "Assessment of insulin sensitivity/resistance". *Indian Journal of Endocrinology and Metabolism* 19.1 (2015): 160-164.
6. Lebovitz HE. "Insulin resistance: definition and consequences". *Experimental and Clinical Endocrinology and Diabetes*: official journal, German Society of Endocrinology [and] German Diabetes Association 109.2 (2001): S135-148.
7. Mercado MM., *et al.* "Genetics of insulin resistance". *Current Diabetes Reports* 2.1 (2002): 83-95.
8. Bajaj M and DeFronzo RA. "Metabolic and molecular basis of insulin resistance". *Journal of Nuclear Cardiology* 10.3 (2003): 311.
9. Hajian-Tilaki K and Heidari B. "Is waist circumference a better predictor of diabetes than body mass index or waist-to-height ratio in Iranian adults?" *International Journal of Preventive Medicine* 6 (2015): 5.
10. Tchoukalova YD., *et al.* "Regional differences in cellular mechanisms of adipose tissue gain with overfeeding". *Proceedings of the National Academy of Sciences of the United States of America* 107.42 (2010): 18226-18231.
11. Hardy OT., *et al.* "What causes the insulin resistance underlying obesity?" *Current Opinion in Endocrinology, Diabetes and Obesity* 19.2 (2012): 81-87.
12. Preis SR., *et al.* "Abdominal subcutaneous and visceral adipose tissue and insulin resistance in the Framingham heart study". *Obesity (Silver Spring, Md)* 18.11 (2010): 2191-2198.
13. McLaughlin T., *et al.* "Preferential fat deposition in subcutaneous versus visceral depots is associated with insulin sensitivity". *The Journal of Clinical Endocrinology and Metabolism* 96.11 (2011): E1756-1760.
14. Nakagami T., *et al.* "Age, body mass index and Type 2 diabetes-associations modified by ethnicity". *Diabetologia* 46.8 (2003): 1063-1070.
15. (Fahed, 2020 #9)

Volume 11 Issue 2 February 2022
©All rights reserved by Fadwa Sharabati., *et al*.