



A NOVEL CROSS SECTIONAL STUDY OF SYMPTOMS ON INSULIN RESISTANCE AMONG THE POPULATION OF SAUDI ARABIA

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Introduction

More than 500 million individuals throughout the globe have type 2 diabetes mellitus (T2DM), a chronic metabolic condition. The second highest incidence of T2DM in the Middle East is found in the Kingdom of Saudi Arabia (KSA), raising severe public health concerns owing to the disease's high mortality and morbidity rates [1, 2]. However, KSA's demographic characteristics, patient-reported implications on quality of life (QoL), and treatment preferences of patients with diabetes are less well characterized, despite the incidence of diabetes in KSA being widely documented [3].

Insulin resistance (IR) and insulin deficiency (IDA) are hallmarks of type 2 diabetes mellitus (T2DM). Chronic inflammation (IR) plays an important role in T2DM and is a major risk factor for cardiovascular disease (CVD). Because of the high rate of diabetes in Saudi Arabia, much work is being done to enhance patient treatment [4,5]. The importance of assessing and monitoring the quality of life (QoL) as an outcome of diabetes management is becoming more widely recognized by health care providers. The importance of assessing and monitoring the quality of life (QoL) due to diabetes treatment is becoming recognized by medical practitioners. A person's quality of life (QoL) measures how happy or unhappy they are with their current situation [6,7]. These researchers believe evaluating QoL should focus on the individual's subjective assessment of their own QoL rather than what others think should be measured. The pursuit of optimal health may be detrimental to one's quality of life (QoL) [8].

Insulin resistance signs, such as skin tags, sleep apnea, and obesity, were identified in this cross-sectional research of 841 diabetes individuals.

Methods

Study design

The design of this study is a cross-sectional survey to collect information on Quality of Life regarding symptoms of insulin resistance by collecting Electronic patient-reported outcomes (PRO) from the public in the western region of the Kingdom of Saudi Arabia by publishing the questionnaire on social media. This questionnaire was collected using databases such as Google Scholar and PubMed and contained open-ended and closed-ended questions divided into three sections: demographic, cognitive, and diagnostic.

Demographic section

Demographic section questions were related to the age, weight, height, gender, level of education, diabetes or not, body mass index (underweight (less than or equal to 18.4), normal (18.5-24.9), overweight (25-29.9), obese (more than 30)) and waist size.

Cognitive section

Cognitive section questions were to be made to measure people's knowledge of the symptoms of insulin resistance by applying a scoring system to the questions. If the participant's answer was yes, they got one(1) point, and in the case of no, they got zero(0). In the end, we calculated the total points and then classified the participants into low knowledge (less than eight(8) out of twenty-two points), medium knowledge (eight(8) to fourteen(14) points), or high knowledge (more than fourteen points(14)).

Diagnostic section

Diagnostic section questions were designed to know the possibility of insulin resistance in patients by developing a scoring system for the participants' responses to the question. For example, if the participants answered yes, they got two(2) points. For answered "I don't know," they got one (1) point, and if they answered "No," they got zero (0). Finally, we calculated the total points and then classified the participants into low risk(less than eleven (11) points), medium risk(eleven(11) to sixteen(16) points), or high risk(more than sixteen (16) points).

Validity and piloting

The questions of this questionnaire were reviewed by a team of expert medical professionals, viz. a doctor and two academic doctors, to know the validity of the questions and ensure that the questions' wording is correct and easy to understand for the public. In addition, the questionnaire was tested on 9 non-health professionals, and some modifications were made based on the recommendations of specialists and participants in the research.

Sampling and sample size:

The questionnaire was conducted through Google Form, and then the questionnaire link was sent through social media to collect the participants, and the required number was three hundred participants. The inclusion criteria of the participants in the study were to be between the ages of 18 to 49, be either a student in high school, university, or postgraduate student, and have

diabetes. As a result, 1,021 were obtained, and 180 people were excluded because they did not meet the condition(s) of the criteria.

Statistical analysis

The data collected from the survey were bio statistically analyzed by IBM SPSS (version 26.0) for descriptive and inferential analysis. The descriptive analysis outlined participants' demographic characteristics and responses regarding frequencies and percentages. The inferential analysis was conducted to decide any significant association between the participants' demographic characteristics and other responses by employing the ANOVA and T-test. The statistical significance was set at a p-value of more than 0.05.

Results

Participants

A sample of 841 out of 1021 participants (male: 64.1%; female: 35.9%) were enrolled. We excluded 180 out of 1021 participants because they didn't meet our criteria of not having the diabetic condition, their education was not primary or secondary, and their age was not over 50 years.

Descriptive parameters

After excluding those who didn't meet our criteria, a total is 841 participants included in the study. The majority of participants were aged between 18-29 (63.5%), 30-39(17.8%) and 40-49(18.7%), were male (64.1%) and female (35.9%), and the level of

education in high school was 20.6%, University 74.2% and post-graduate 5.2%. We divided BMI into four categories viz Underweight were 8.3%, Normal at 36.6%, Overweight at 32.6% and Obese at 22.4%(Table 1.).

Demographic characteristic	Number of participants (%)
Gender	
Male	539 (64.1)
Female	302 (35.9)
Age	
18-29	534 (63.5)
30-39	150 (17.8)
40-49	157 (18.7)
Level of education	
High school	173 (20.6)
University	624 (74.2)
Post – grad	44 (5.2)
BMI	
Under weight (category 1)	69 (8.2)
Normal (category 2)	303 (36.0)
Over weight (category 3)	270 (32.1)
Obese (category 4)	185 (22.0)

Table 1. Demographic information on study participants

The three symptoms participant don't know Sleep apnea: male 53.5% and females 28.4%(Figure 1.1.), Skin tags: male 53% and females 25.9%(Figure 1.2.) and Memory problems: male 52.2% and females 26.2%(Figure 1.3.).

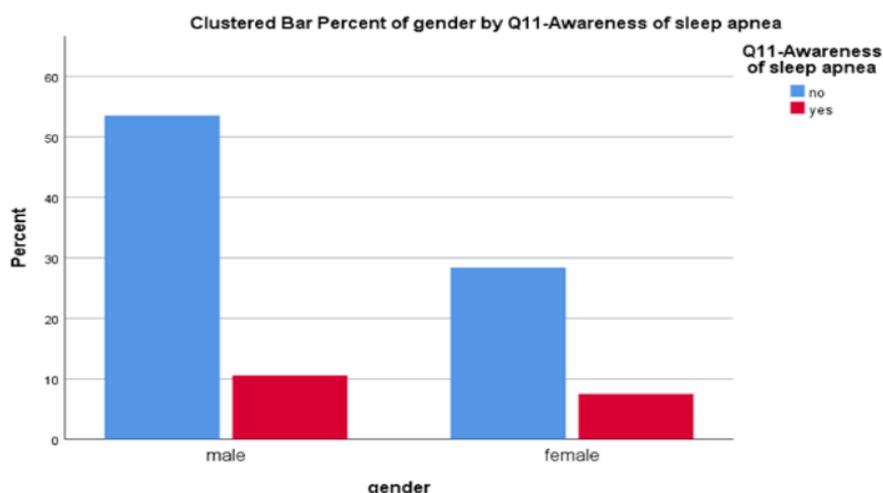


Figure 1. Showing the Clustered Bar Percent of gender by Q11-Awareness of sleep apnea

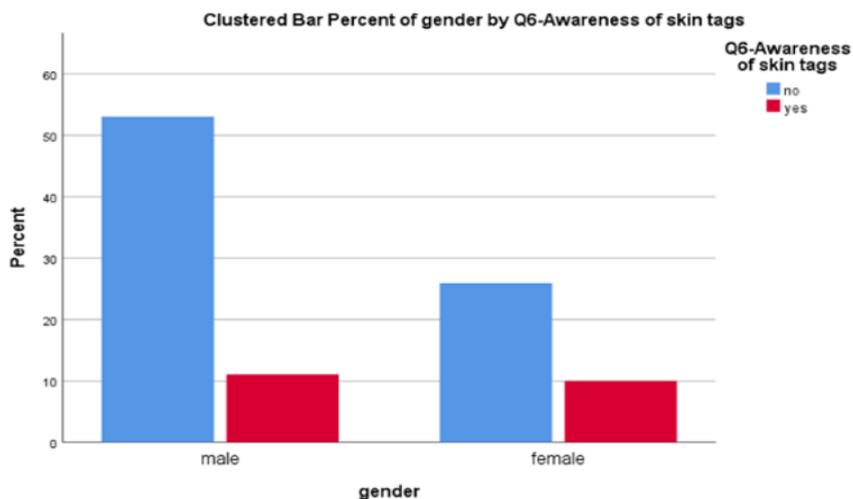


Figure 2. Showing the Clustered Bar Percent of gender by Q6-Awareness of skin tags

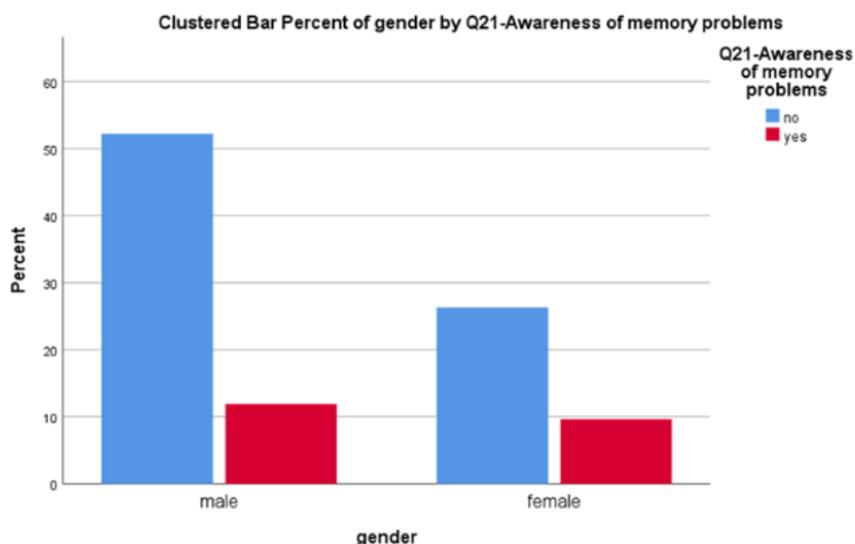


Figure 3. Showing the Clustered Bar Percent of gender by Q21-Awareness of memory problems

Common three symptoms spread Prevalence of fatigue in males was 28.4% and females 15.7% (Figure 1.4.), Belly fat: male 27.6% and females

17.7% (Figure 1.5.), and Sleep disturbance: male 31.8% and females 17.8% (Figure 1.4.).

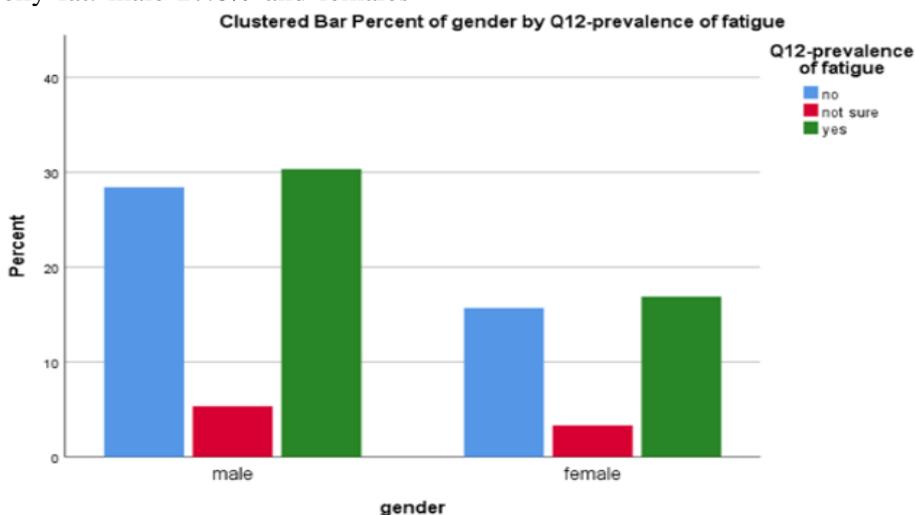


Figure 4. Showing the Clustered Bar Percent of gender by Q12-prevalence of fatigue

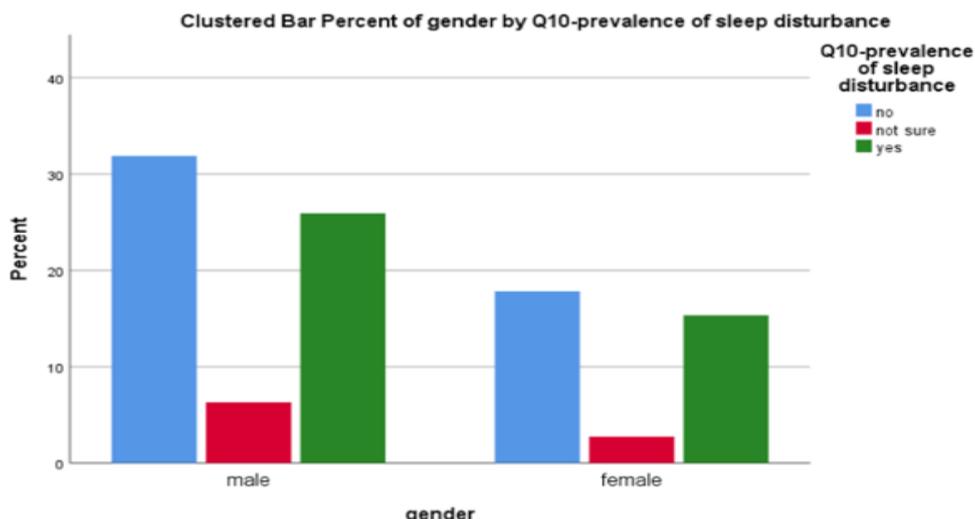


Figure 5. Showing the Clustered Bar Percent of gender by Q10-Awareness of sleep disturbance

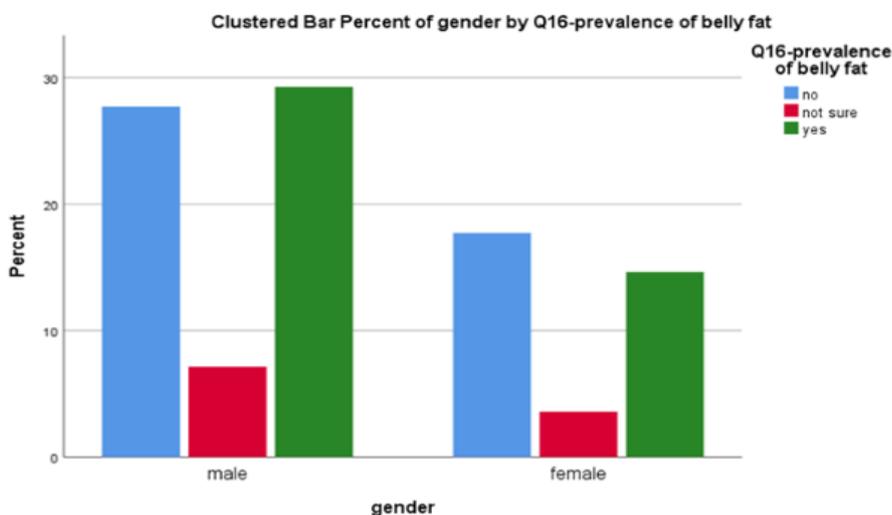


Figure 6. Showing the Clustered Bar Percent of gender by Q16-prevalence of belly fat

Inferential Parameters

Based on the p-value of the individual (Table 2.) and group (Table 3.) T-test and simple boxplot between score-k(Figure 7.) were performed to compare males' and females' knowledge about

insulin resistance symptoms and show that there was a significant difference and showed that males have more knowledge about symptoms of insulin resistance than females.

		Levene's Test for Equality of Variances				t-test for Equality of Means		95% Confidence Interval of the Difference		
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
score_k	Equal variances assumed	2.195	.139	-4.419	795	.000	-1.96769	.44531	-2.84182	-1.09356
	Equal variances not assumed			-4.462	613.285	.000	-1.96769	.44104	-2.83381	-1.10156

Table 2. Independent sample Test showing the information on study participants for the comparison between knowledge in males and females about symptoms of insulin resistance

	gender	N	Mean	Std. Deviation	Std. Error Mean
score_k	male	509	7.2927	6.11397	.27100
	female	288	9.2604	5.90502	.34796

Table 3. Group Statistics showing the information on study participants for the comparison between knowledge in males and females about symptoms of insulin resistance

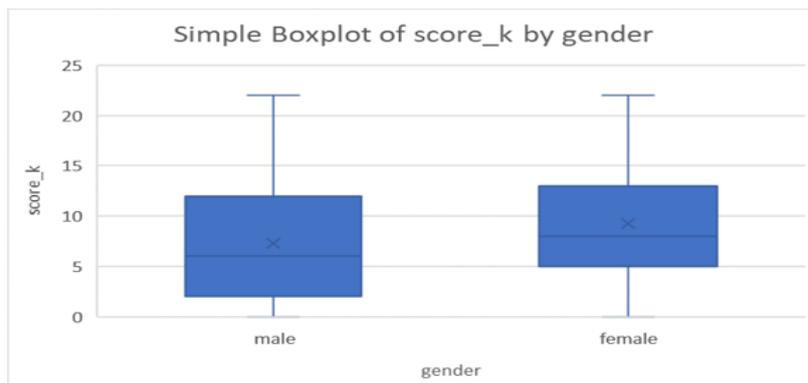


Figure 7. Showing the simple boxplot between score-k and gender for the comparison between knowledge in males and females about symptoms of insulin resistance

Based on the p-value analysis of variance (ANOVA) (Table 3.) and standard error of the mean (SEM)(Figure 8.), statistics were performed for the comparison between the education level and knowledge of the participants about symptoms of

insulin resistance which were shown that there was no significant difference between the education level and knowledge of the participants about symptoms of insulin resistance

score_k	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.933	2	6.466	.173	.841
Within Groups	29696.056	794	37.401		
Total	29708.989	796			

Table 3. Showing the information on study participants for the comparison difference between the education level and knowledge of the participants about symptoms of insulin resistance

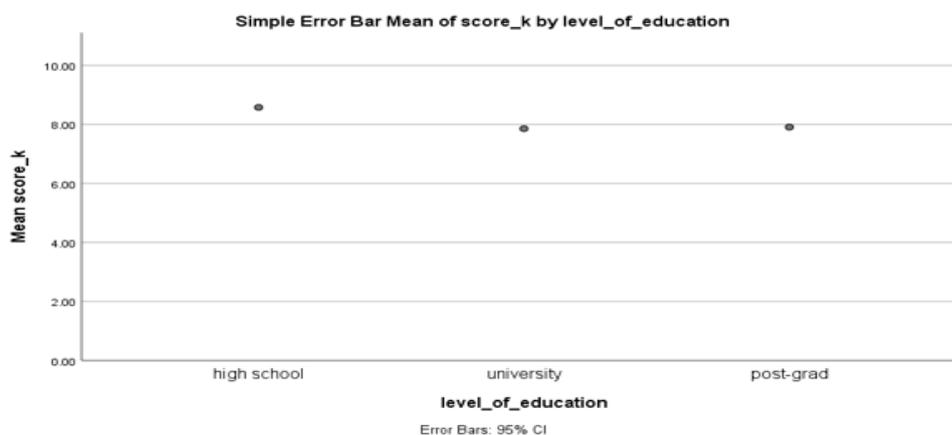


Figure 7. Showing the standard error of the mean (SEM) of score-k for the comparison difference between the education level and knowledge of the participants about symptoms of insulin resistance

The severity of risk

After collecting the results of the participants, it was found that 7.5% of them had a low probability

of insulin resistance, while the vast majority had a moderate probability, and they represented 90.8% of the participants, while 1.7% of the participants

had a high probability of developing insulin resistance. Figure 8. shows the difference between ages and the risk of developing insulin resistance. And most of the participants had a medium probability, and most were between 18-29. Finally, figure 9. shows the difference between gender and

the risk of developing insulin resistance. Again, most of the participants had a medium probability, and the proportion of males was higher than females.

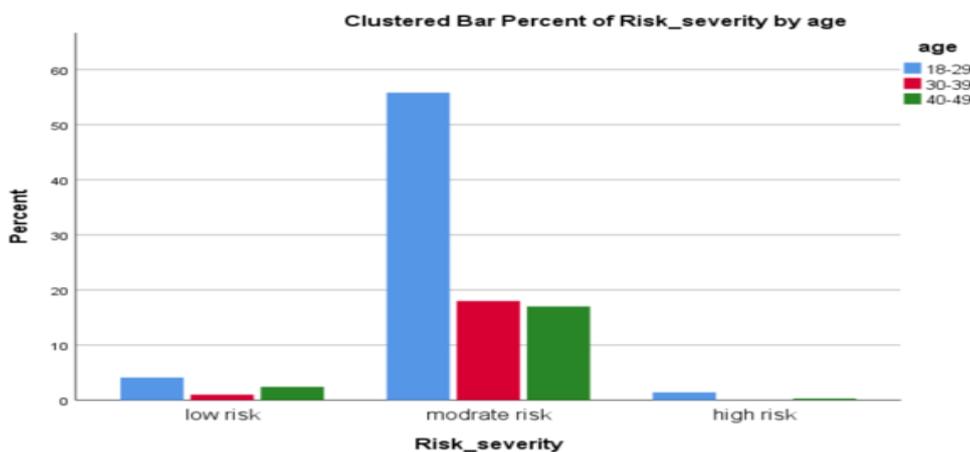


Figure 8. Showing the difference between ages and the risk of developing insulin resistance

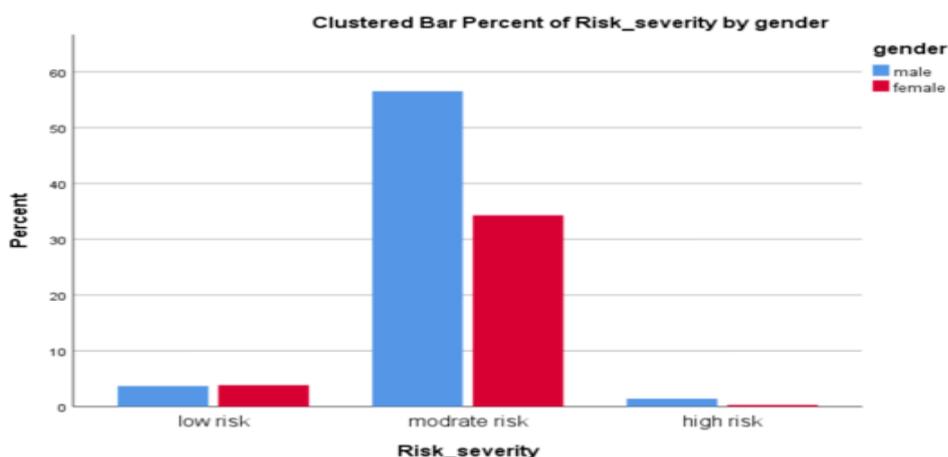


Figure 9. Showing the difference between gender and the risk of developing insulin resistance

Discussion

The databases of the existing questionnaire available for the public about the diseases and disorders and their associated complications require the validation, evaluation and statistical analysis of the responses of the patient(s) and the questionnaire to maintain the quality of life of the patient(s) in these complicated conditions. This is mostly achieved through bio-statistical analysis of correlation and mean differences between or among responses collected through the questionnaire survey.

The demographics of the participants in this study represent the population of people living with diabetic conditions in the western region of Saudi Arabia. All populations must benefit from such improvement when discovering and developing existing therapeutics and technologies for diseases
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and disorders and their associated complications. Therefore, a heterogeneous sample of patients participated in this study, providing they could read, understand and respond to the questionnaire.

The present findings suggest assessing health-related quality of life specific to insulin resistance in diabetes metabolic disorder. Information regarding the symptoms of insulin resistance in diabetic conditions on a Web-based platform is easy and reliable. The questionnaire prepared using these platforms fulfills the criteria for collecting the information about the population's awareness of their quality of life in disease conditions.

In our study total of 841 diabetic patients, both males (64.1%) and females (35.9%), aged between the 18 to 49 years old and having education equal to or more than high school were selected in that

way they easily understand the well-reviewed questionnaire relating to the symptoms of insulin resistance by medical professionals. Both high BMI and high BF% were strongly related to insulin resistance, and all the participants, according to their responses on BMI, were categorized into four types according to the BMI viz. Under Weight (8.2%), Normal (36.0%), Over-Weight (32.1%) and Obese (22.0).

People should be aware of insulin resistance and its symptoms because insulin resistance can induce an imbalance in glucose metabolism that generates chronic hyperglycemia, which triggers oxidative stress and causes inflammatory responses that lead to cell damage. Most common symptoms of insulin resistance include the extreme thirst or hunger, feeling hungry even after a meal, increased or frequent urination, tingling sensations in hands or feet, feeling more tired than usual, frequent infections, high blood sugar, sleep apnea, sleep disturbance, memory problems and skin tag. All the participants were mostly aware of all symptoms of insulin resistance except sleep apnea (male 53.5% and females 28.4%), memory disturbance (male 52.2% and females 26.2%) and skin tag (male 53% and females 25.9%), and it was found that most commonly spread symptoms of insulin resistance among the participants were fatigue (males 28.4% and females 15.7%), belly fat (male 27.6% and females 17.7%) and sleep disturbances (male 31.8% and females 17.8%)

Based on The p-value for the comparison between knowledge in males and females about symptoms of insulin resistance has shown that there is a significant difference in the knowledge about symptoms of resistance, with the male having more knowledge than the female, and it might be due to the difference in the level of education in males and females and gender variation (female participants were less than male in the study). But we had not found a significant difference when we performed statistic analysis between the level of education in males and females and knowledge of symptoms of insulin resistance by analysis of variance (ANOVA).

Conclusion:

Awareness of the symptoms of insulin resistance in the population with a diabetic or pre-diabetic and non-diabetic will help overcome the problems associated with blood glucose levels. Our study concluded that most of the participants were aware of the symptoms of insulin resistance except sleep apnea, skin tag and memory disturbance, and male

participants had more knowledge about the symptoms of insulin resistance than female participants.

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