History of Medicine, 2023, 9(1): 918–925
DOI: 10.17720/2409-5834.v9.1.2023.105

Prevalence of Insulin Resistance Among Apparently Healthy Medical Students of College of Health and Medical Technology – Shekhan

Rojeen Rasheed Suleiman[1*], Ardawan fathi Ali[2], Sherwan Ferman Salih[3], Barhav Issa Abdullah[4]

[1] Corresponding author, Lecturer in Clinical Biochemistry, Department of medical laboratory technology, college of Health and medical technique/Shekhan, Duhok Polytechnic University, Duhok, Iraq
EM: Rojeen.rasheed@dpu.edu.krd
[2] Lecturer in clinical biochemistry Department of medical laboratory technology, college of Health and medical technique/Shekhan, Duhok Polytechnic University, Duhok, Iraq
EM: ardawan.ali@dpu.edu.krd
[3] Assistant professor in clinical biochemistry, College of Medicine, University of Duhok, Duhok, Iraq
EM: sherwan.salih@uod.ac
[4] MSc in Biochemistry, College of Health Science, University of Duhok, Duhok, Iraq
EM: barhav.abdullah@uod.ac

*Corresponding author: Rojeen Rasheed Suleiman (Rojeen.rasheed@dpu.edu.krd)

Received: 20 January 2023 **Accepted:** 15 April 2023

Citation: Suleiman RR, Ali AF, Salih SF, Abdullah BI (2023) Prevalence of Insulin Resistance Among Apparently Healthy Medical Students of College of Health and Medical Technology − Shekhan. History of Medicine 9(1): 918−925. https://doi.org/10.17720/2409-5834.v9.1.2023.105

Abstract

Background: Insulin resistance is an impairment of insulin biological action with reduction in muscle and adipose tissue sensitivity to insulin level resulting in decreased glucose uptake in the muscle and increased glucose production from liver causing hyperglycemia in both the fasting and postprandial states. Worldwide, the prevalence of insulin resistance varies between 15.5% to 46.5% among adults. Objectives: The present study was conducted with the objective to determine the relationship between insulin resistance and Body mass index ,waist circumference , residency and alcohol consumption among apparently healthy Shekhan medical students. Materials and Methods: The study was carried out as across sectional study among 200 Shekhan medical students ranging from 18- 39 years old who were randomly selected from the student population. Under strict aseptic precautions blood samples was collected from all the participants, the serum was investigated for glucose, insulin, and lipid parameters (cholesterol, triglyceride, HDL-C, LDL-CH). Insulin resistance was determined using (HOMA-IR). Results: The prevalence of insulin resistance was 21.50% among Shekhan medical students. The mean homeostatic model assessment was higher in those married, older than 25years, overweight and obese. The mean BMI and WC were significantly higher in those with HOMA IR >3.0 as well as the majority of those with IR were leaving in urban area. Moreover, there was a positive and significant correlation of insulin resistance with BMI, WC and residency ($P < 0.05$). Conclusion: Prevalence of insulin resistance among the Shekhan medical students was high ranging about 21.50% especially obese female leaving in urban area.

Keywords
insulin resistance, medical students, obesity

Insulin resistance is defined as an impairment of insulin biological action with reduction in muscle and adipose tissue sensitivity to insulin level resulting in decreased glucose uptake in the muscle and increased glucose production from liver causing hyperglycemia in both the fasting and postprandial states. (Wolosowicz., et al, 2020). Worldwide, the prevalence of

insulin resistance ranges between 15.5% to 46.5% among adults. (Fahed., et al, 2020).
The development of insulin resistant is associated with many risk factors such as sedentary life, metabolic syndrome and obesity that are regarded as promotor factors for cardiovascular disease development (Freeman and Pennings, 2022). The prevalence rate of obesity is highly increasing all over the world, and has been reached 2.1 billion people. Obesity is associated with dysregulation of many pathways in the body including endocrine, inflammatory, neural, and cell intrinsic pathways. (Beckerman., et al, 2021)
Insulin resistance is a chronic pathological condition leads to metabolic, endothelial dysfunction and hemodynamic disturbances, atherogenic dyslipidemialike (reduced HDL-C, elevated LDL-C and hypertriglyceridemia), hypertension, impaired glucose tolerance, hyperuricemia, hypercoagulability, abnormalities in fibrinolytic system, fatty liver and some cancers. (Ibrahim and Sherwan, 2022).
As different studies in different area were done among adolescent and medical students and shown different results regarding the prevalence rate of insulin resistant. (Barbosa., et al, 2016), (Parajuli., et al, 2019)
Therefore, the present study was aimed to evaluate the prevalence rate of insulin resistant in relation to BMI, WC, residency and alcohol consumption among medical students in sheckhan .

Method

A cross-sectional study was carried out at Duhok Polytechnic University - College of Health and Medical Technology – Shekhan. The study was conducted over a period of 4 months, from November 2021 to March 2022. A total of 200 medical students ranging from 18-39 years old who were randomly selected . Samples analysis for biochemical parameters were measured in clinical biochemistry department in Azadi Teaching Hospital.
Five milliliter of blood samples was collected from each participant and allow to clot, then centrifuged for separation of serum. All the biochemical parameters including glucose, insulin, lipid parameters (cholesterol, triglyceride, HDL-C, LDL-C) and HbA1c were determined by Cobas 6000 (Hitachi, Roch) depending on different principle (Saadi., et al 2022). Serum fasting glucose concentration and lipid profile was done by enzymatic-colorimetric method, Fasting insulin was done by electrochemiluminescence and blood HbA1c was done by turbidimetric assay. (Khan et al, 2018).
Insulin resistance was determined by using HOMA-IR as follows: HAMA-IR = Glucose (mg/dl) Ч insulin (μu/l)/ 405 (HOMA-IR >3.0 was regarded as insulin resistance). Biagetti., et al, 2021.Anthropometric parameters such as weight, Height and waist circumference were measured depending up on the protocol of World Health Organization. BMI calculation depends on division of weight in kilogram by square of the height in meters (kg/m^2). (Mohammed., et al ,2022)

Ethical approval

Fully informed written consent was obtained from each participant. The study was approved by the Medical Research & Ethics Committee of College of Health and Medical technology-Shekhan 2021.

Statistical Analyses

Statistical analyses were done using the SPSS Version 26.0 program (IBM). The general information of study participants was presented in mean (SD) or number (%). Pearson chi-square and independent t-test were performed to evaluate the mean level of HOMA-IR in the different characteristics of study participants. The correlations of HOMA-IR level with participant characteristics were examined in a bivariate regression model and were presented in a scatter plot. A p-value of less than 0.05 was used to assess the significance level.

Results

The general and biochemical characteristics of 200 participants were shown in table 1. The mean age was 21.27 ± 3.13 year with female predominate 110 (55%). The mean BMI and WC were 22.13 ± 3.76 and 77.86 ± 11.14 respectively. Obese and overweight constitute 36 (18%) of participants. The mean fasting glucose

level among participants was 85.71±8.58 and the mean insulin level was 10.44±5.16, whereas, the mean HOMA IR was 2.27±1.34 and 43 (21.5%) had HOMA-IR more than 3.0 indicating insulin resistance.

Table 1. General characteristics and biochemical parameters of studied participants

Characters		No%	Mean ±SD
Age (years)	18-25	181 (90.5%)	21.27±3.13
	26-39	19 (9.5%)	
Gender	Male	90 (45%)	
	Female	110 (55%)	
BMI (kg/m2)	Normal weight	164 (82%)	22.13±3.76
	Overweight	32 (16%)	
	Obese	4 (2%)	
WC (cm)	Male		77.86±11.14
	< 102	88 (44%)	
	≥ 102	2 (1%)	
	Female		
	< 88	105 (52.5%)	
	≥ 88	5 (2.5%)	
Smoking habit	Non-smoker	171 (85.5%)	
	Smoker	29 (14.5%)	
Alcoholic	Drinker	6 (3%)	
	Non-drinker	194 (97%)	
Residence	Rural	68 (34%)	
	Urban	132 (66%)	
marital status	Single	187 (93.5)	
	Married	13 (6.5%)	
Fasting glucose (mg/dl)			85.71±8.58
Insulin (μIU/mL)			10.44±5.16
HOMA-IR	< 3.0	157 (78.5%)	2.27±1.34
	≥ 3.0	43 (21.5%)	

The association of mean HOMA-IR with different risk factors were shown in table 2. The mean of HOMA-IR was significantly higher in those married and older than 25-year-old, central obesity, overweight and obese participants (p value < 0.05).

Table 2. Association of HOMA-IR with different characteristics of study participants

Characters		N (%) N=200	HOMA-IR Mean ±SD	p value
Age (years)	18-25	181 (90.5%)	2.14±1.15	<0.0001
	26-39	19 (9.5%)	3.45±2.28	
Gender	Male	188 (94%)	2.38±1.36	0.293
	Female	12 (6%)	2.19±1.32	
BMI (kg/m2)	Normal weight	164 (82%)	1.78±0.63	<0.0001
	Overweight	32 (16%)	4.09±0.74	
	Obese	4 (2%)	7.51±0.81	
WC (cm)	Male			<0.0001 <0.0001
	< 102	88 (44%)	2.29±1.24	
	≥ 102	2 (1%)	6.02±2.11	
	Female			
	< 88	105 (52.5%)	2.08±1.11	
	≥ 88	5 (2.5%)	4.39±3.05	
Smoking habit	Non-smoker	171 (85.5%)	2.64±1.71	0.107
	Smoker	29 (14.5%)	2.21±1.27	
Alcoholic	Drinker	6 (3%)	2.29±1.36	0.543
	Non-drinker	194 (97%)	1.94±0.51	
Residence	Rural	68 (34%)	1.88±0.84	0.003
	Urban	132 (66%)	2.47±1.50	
Status	Single	187 (93.5)	2.19±1.22	0.001
	Married	13 (6.5%)	3.42±2.28	
	Pearson Chi-Square and Independent t-test were performed for statistical analysis. The black bold numbers show the significant correlations.			

The association of normal and abnormal HOMA-IR among participants were shown in table 3. The mean BMI and WC were significantly higher in those with HOMA-IR more than 3.0 compared to those with HOMA-IR less than 3.0. Moreover, majority

of those with IR were from urban residence (34, 17%).

Table 3. Association of different level of HOMA-IR with characteristics of studied participants

Characters	HOMA-IR		p value
	< 3.0 N% (157)	**≥** 3.0 N% (43)	
Age (years) 18-25 26-39	20.89±2.60 148 (74%) 9 (4.5%)	22.63±4.35 33 (16.5%) 10 (5%)	0.001 0.002
Gender Male Female	74(37%) 82(41.5%)	16(8.0%) 27(13.5%)	0.010
BMI (kg/m2) Normal weight Overweight Obese	20.86±2.37 157 (78.5%) 0 0	26.81±4.31 7 (3.5%) 32 (16%) 4 (2%)	<0.0001 <0.0001
WC (cm) Male < 102 ≥ 102 Female < 88 ≥ 88	76.09±10.79 63 (31.5%) 0 92 (46%) 2 (1%)	85.28±11.58 25 (12.5%) 2 (1%) 13 (6.5%) 3 (1.5%)	<0.0001 0.088 0.021
Smoking habit Non-smoker Smoker	137 (68.5%) 20 (10%)	34 (17%) 9 (4.5%)	0.220
Alcoholic Drinker Non-drinker	0 157 (78.5%)	6 (3%) 37 (18.5%)	0.344
Residence Rural Urban	59 (29.5%) 98 (49%)	9 (4.5%) 34 (17%)	0.046
Status Single Married	150 (75%) 7 (3.5%)	37 (18.5%) 6 (3%)	0.036
Pearson Chi-Square and Fisher's Exact Test were performed for statistical analysis. The black bold numbers show the significant correlations.			

There was a positive and significant correlation of insulin resistance with BMI, WC and residency (P<0.005), as determined by the "Pearson correlation coefficient (r)" as shown in table 4 and figures (1-3).

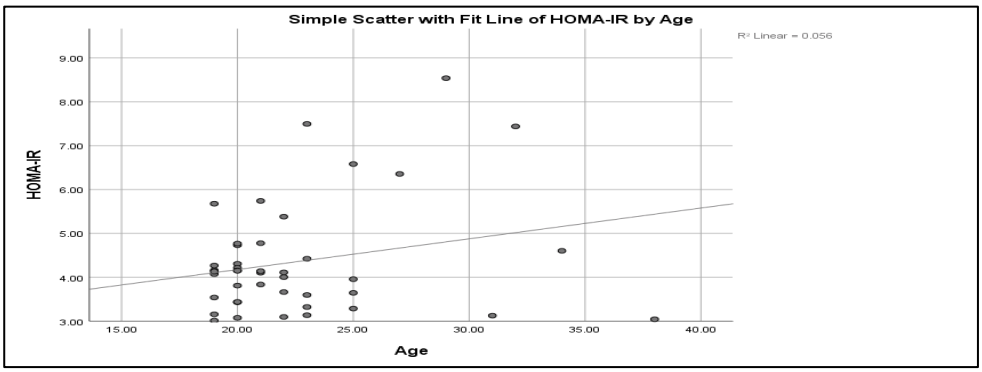

Figure 1 association of HOMA IR with age

Table 4. Correlation of abnormal levels of HOMA-IR with different characteristics of studied participants

Character N=43	HOMA-IR ≥ 3.0	
	Pearson Correlation	Sig. (2-tailed)
Age (years)	0.237	0.126
Gender	0.254	0.101
BMI (kg/m^2)	0.700	<0.0001
WC (cm)	0.354	0.020
Smoking habit	0.120	0.444
Alcoholic	0.282	0.067
Residence	0.306	0.046
Status	0.249	0.108
Bivariate regression was performed for statistical analyses. The black bold numbers show the significant correlations.		

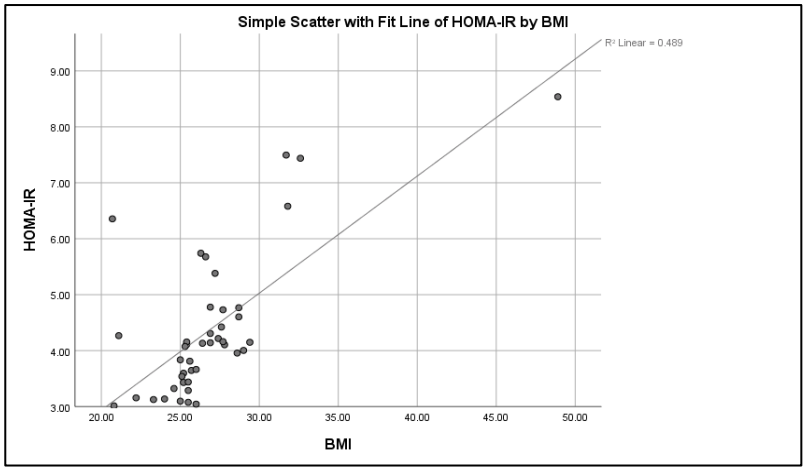

Figure 2 association of HOMA IR with BMI

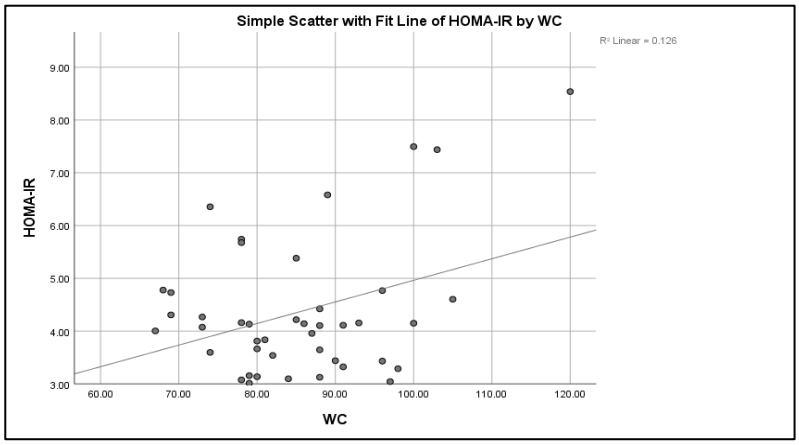

Figure 3 association of HOMA IR with WC

Discussion

Insulin resistance is a pathological condition in which cells fail to respond to normal or increase insulin level due to losing of the body cells sensitivity to insulin and preventing glucose delivery into the cells for energy production that associated with increase in blood glucose concentration leading to a variety of conditions such as prediabetes, diabetes mellitus, metabolic syndrome, dyslipidemia that are independent risk factors for development of cardiovascular diseases. (Aresta., et al, 2019)

The most striking results of the present study was a high prevalence rate of IR (43, 21.5%) among apparently healthy medical students particularly female gender (27, 13.5%) and with urban residency (34, 17.0%). Moreover, the mean level of BMI (26.81 ± 4.31, 20.86 ± 2.37) and WC (85.28 ± 11.58, 76.09 ± 10.79) were higher among those with IR group with positive and significant association of IR with BMI and WC (p value < 0.05).

Worldwide, the prevalence of IR ranges from 15.5 to 46.5% among apparently healthy adults. (fahed., et al 2020). The current study revealed that medical students at the College of Health and Medical Technology Shekhan had a higher incidence rate of IR (43, 21.5%). There are numerous potential causes for the high prevalence rate of IR. First, Insulin resistance is brought on by a decrease in insulin signaling, particularly in the insulin receptor substrate (IRS)/phosphoinositide-3-kinase (PI-3K)/protein kinase B (PKB) axis, which may impair insulin's metabolic effects. (Qaid et al ,2016) Second, Insulin resistance is commonly linked with obesity, as 36,18% of overweight and obese individuals had IR, as well as the obesity is accompanied by an increase in circulating concentrations of inflammatory cytokines, such as interleukin-6 and tumor necrosis factor-α. (Gobato., et al, 2014). This finding was consistent with study done be Alfarai et al among Omani medical

students and khan et al among medical students of Lahore whereas inconsistence with that study done among students of university of Benin in Nigeria that shown lower prevalence rate of IR (3.3%). This was mostly explained by the presence of the difference in the body weight and waist circumference of students between all universities. There was higher mean of BMI and WC among medical students of Duhok polytechnic university-collage of health and medical technology-Shekhan, Omani medical students and Lahore medical students compared to lower mean of BMI and WC students of university of Benin. (Alfarai., et al ,2014; Khan., et al, 2016)

The current study observed a positive correlation between HOMA-IR and residency. The study shown that mean HOMA-IR was significantly higher among urban medical students (2.47 ± 1.5) compared to rural medical students (1.88 ± 0.84) as well as (34, 17.0%) of those students with IR were from urban area compared to (9.0, 4.5%) from rural area. This can be explained by the pattern of lifestyle and food habits as the urban area medical students were less physically active and mainly depend on fast food and unhealthy diet. This study was consistent with a study done by Elfaki et al among Adolescents in Khartoum State, Sudan and Al-Sejari among students of Kuwait university as they shown higher prevalence rate of IR among urban medical students compared to rural medical students. (Elfaki., et al 2022; Al-Sejari, 2017)

The current study observed the presence of significant association of IR with gender as two third of medical students with IR were female. This finding could be as a result of either higher adipocyte found in females than their male counterparts and female might have polycystic ovary syndrome, as it is now clear that PCOS is often associated with profound insulin resistance as well as with defects in insulin secretion (Suleiman, R.R. and Sulaiman, D.M, 2018). The present study shown statistically insignificant correlation between alcohol consumption and insulin resistance as the mean level of HOMA-IR was higher insignificantly among medical students who were alcoholic drinker compared to those with nonalcohol drinker. This was consistent with study done by Goel et al and Chetna et al that found higher mean HOMA-IR among alcoholic drinker medical students. (Goel., et al ,2015; Chetna, et al ,2017)

Conclusion

The prevalence rate of insulin resistance was high among the medical students and constitute about one quarter of the participants medical students. Insulin resistance was higher among obese female medical students than their male counterparts with particularly those leaving in urban area. There was insignificant relation between marital status and alcohol consumption this may be due to decrease sample size for them. This study's primary flaw was the convenience sampling technique utilized to pick the medical colleges. The other constraint was a poor response rate or reluctance to respond to queries about alcohol intake at several of the medical institutions. Furthermore, because this study was cross-sectional in nature, this restriction will be resolved by subsequent research investigations. Future research studies will be able to address this issue.

We recommend an urgent need for health education, routine medical checkup and instituting therapeutic lifestyle modification among the medical students like weight loss, healthy diet like low carb diet to avert the danger of non-communicable diseases later in future when the society would be in dire need of qualified healthcare professionals.

List of abbreviation

PKB Protein Kinase B
AKt Protein Kinase B
T2DM Type 2 Diabetes Mellitus
IR Insulin Resistance
IS Insulin Sensitivity
CAD Coronary Artery Disease
HDL-C High Density Lipoprotein- Cholesterol
VLDL Very Low-Density Lipoprotein
LDL-C Low-Density Lipoprotein- Cholesterol
HOMA Homeostatic Model Assessment
HOMA-IR Homeostatic Model Assessment-Insulin
Resistance
TG Triglyceride
WC Waist Circumference

BMI Body Mass Index
ECL Electrochemiluminescence
St. Deviation Standard Deviation

Reference

Artese, A., Stamford, B.A. and Moffatt, R.J., 2019. Cigarette smoking: an accessory to the development of insulin resistance. American journal of lifestyle medicine, 13(6), pp.602-605.

Al-Farai, H.H., Al-Aboodi, I., Al-Sawafi, A., Al-Busaidi, N. and Woodhouse, N., 2014. Insulin resistance and its correlation with risk factors for developing diabetes mellitus in 100 omani medical students. Sultan Qaboos University Medical Journal, 14(3), p.e393.

Al-Sejari, M., 2017. Sociocultural characteristic, lifestyle, and metabolic risk factors among a sample of Kuwaiti male university students. American Journal of Men's Health, 11(2), pp.308-317.

Beckerman, M., Harel, C., Michael, I., Klip, A., Bilan, P.J., Gallagher, E.J., LeRoith, D., Lewis, E.C., Karnieli, E. and Levenberg, S., 2021. GLUT4-overexpressing engineered muscle constructs as a therapeutic platform to normalize glycemia in diabetic mice. Science advances, 7(42), p.eabg3947.

Barbosa, J.B., Santos, A.M.D., Barbosa, M.M., Barbosa, M.M., Carvalho, C.A.D., Fonseca, P.C.D.A., Fonseca, J.M., Barbosa, M.D.C.L., Bogea, E.G. and Silva, A.A.M.D., 2016. Metabolic syndrome, insulin resistance and other cardiovascular risk factors in university students. Cіkncia & saъde coletiva, 21, pp.1123-1136.

Biagetti, B., Aulinas, A., Casteras, A., Pйrez-Hoyos, S. and Simy, R., 2021. HOMA-IR in acromegaly: a systematic review and meta-analysis. Pituitary, 24(2), pp.146-158.

Saadi, A.B., Salih, S.F. and Mosa, A.A., (2022). Serum magnesium levels among type 2 diabetic patients and prediabetic subjects in Duhok city/Iraq. Duhok Medical Journal, 16(1), pp.1-14.

Charpe, C., Biswas, S. S., & Jain, V. (2017). Prevalence of Insulin Resistance and its Association with Obesity and Alcoholism in Male Medical Students of Bhopal. Int. J. Life. Sci. Scienti. Res, 3(3), 1094-1099.

Chetna Charpe1, S. S. B. V. J., 2017. Chetna Charpe1, S. S. B. V. J., 2017. Prevalence of Insulin Resistance and its association with obesity and alcholism in male medical students of bhopal.. Int. J. Life. Sci. Scienti. Res.,

Elfaki, F.A., Mukhayer, A.I., Moukhyer, M.E., Chandika, R.M. and Kremers, S.P., 2022. Prevalence of Metabolic Syndrome among Early Adolescents in Khartoum State, Sudan. International Journal of Environmental Research and Public Health, 19(22), p.14876.

Fahed, M., Abou Jaoudeh, M.G., Merhi, S., Mosleh, J.M.B., Ghadieh, R., Al Hayek, S. and El Hayek Fares, J.E., 2020. Evaluation of risk factors for insulin resistance: a cross sectional study among employees at a private university in Lebanon. BMC endocrine disorders, 20(1), pp.1-14.

Freeman, A.M. and Pennings, N., 2021. Insulin Resistance. 2021 Jul 10. StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing.

Gobato, A.O., Vasques, A.C.J., Zambon, M.P., Barros Filho, A.D.A. and Hessel, G., 2014. Metabolic syndrome and insulin resistance in obese adolescents. Revista paulista de pediatria, 32, pp.55-59.

Goel, N., Khandelwal, V., Pandya, K. and Kotwal, A., 2015. Alcohol and tobacco use among undergraduate and postgraduate medical students in India: A multicentric cross-sectional study. Central Asian journal of global health, 4(1).

Ibrahim, I. and Salih, S., 2022. Serum Irisin In Individuals with Type 2 Diabetes Mellitus and Prediabetes in Duhok City. Journal of Life and Bio Sciences Research, 3(02), pp.59-64.

Khan, Z.N., Assir, M.Z.K., Shafiq, M., Chaudhary, A.E.G. and Jabeen, A., 2016. High prevalence of preobesity and obesity among medical students of Lahore and its relation with dietary habits and physical activity. Indian journal of endocrinology and metabolism, 20(2), p.206.

Mohammed, A.M., Al-Rawi, R.A., Abdulmajeed, B.Y. and Ayoub, N.I., 2022. The relationship between blood pressure and body mass index among primary-school children. Medical Journal of Babylon, 19(3), p.482.

Parajuli, K., Narasannavar, A. and Shivaswamy, M.S., 2019. Obesity and Overweight Among Medical College Students in Belagavi, Karnataka. J Health Educ Res Dev, 7(301), p.2.

Qaid, M.M. and Abdelrahman, M.M., 2016. Role of insulin and other related hormones in energy metabolism—A review. Cogent Food & Agriculture, 2(1), p.1267691.

Suleiman, R.R. and Sulaiman, D.M., 2018. Studying levels of homocysteine in diagnosed cases of polycystic ovary syndrome. Medical Journal of Babylon, 15(4), p.291.

Wolosowicz, M., Lukaszuk, B. and Chabowski, A., 2020. The causes of insulin resistance in type 1 diabetes mellitus: is there a place for quaternary prevention?. International Journal of Environmental Research and Public Health, 17(22), p.8651.