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Original Article

Association of Serum Resistin with Insulin Sensitivity in Self-Reported Healthy Individuals of Pakistan: A Cross-Sectional Study

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Abstract

Objective: In current study, it was aimed to evaluate relationship between level of serum resistin and some metabolic and anthropometric parameters of healthy individuals.

Methods: Eighty healthy subjects with mean body mass index of 25 kg/m2 or greater were added. Waist to hip ratio, body mass index, weight and height were calculated as anthropometric parameters. Lipid profiles, blood insulin level, plasma glucose level, fasting serum resistin and insulin resistance (by homeostasis model assessment, HOMA) were measured as metabolic parameters.

Results: The results showed no correlation between markers and serum resistin level for uric acid level, glucose, blood pressure and adiposity. Level of serum resistin did not correlate with HOMA and fasting insulin level in women only and with high-density lipoprotein cholesterol level in men only. HDL-C level was an independent significant predictor for resistin in men only and HDL-C level and HOMA were independent significant predictors for resistin in women only, revealed by multiple linear regression analysis using the logarithm of resistin as a dependent variable.

Conclusion: In summary, resistin was not linked to the majority of lipid profiles, insulin resistance, blood pressure, obesity, or fasting plasma glucose levels. For both men and women, resistin had a negative correlation with HDL-C levels. More research is necessary to fully understand the role of resistin in metabolic syndrome.

Keywords: Adipocytokines, diabetes mellitus, resistin, obesity, insulin resistance

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Introduction

Glucose homeostasis in the organisms is tightly controlled through secretion of insulin. The major insulin effects comprise of increased glucose uptake, synthesis of glycogen from muscle and liver, triglycerides synthesis which is stored as adipocytes and protein synthesis. Insufficient insulin secretion and impaired action of insulin results in a disorder known as diabetes mellitus. Hyperglycemia for prolonged time results in glucose resistance because of insulin deficiency that pressurizes the cells to inquire other sources of mobilizable energy.[1] Therefore, hyperglycemia is both a cause and effect of the disturbance in islet cell action and insulin sensitivity. Many other factors play a prominent role in the insulin resistance including aging, obesity, inadequate energy utilization, alcohol consumption, smoking; etc.[2] The compliance of HOMA, hyper insulinemic euglycemic clamps has been applied more widely to assess insulin sensitivity.[3]

Resistin is a putative signalling polypeptide derived from adipocytes. Resistin is a 114-amino acid polypeptide encoded by Retn gene.[4,5] Resistin is usually expressed by adipocytes but the origin of resistin has remained argumentative. Studies on rodent models revealed the up-regulated level of leptin in obesity and insulin resistance while its level is down-regulated by RSG (rosiglitazone), an insulin sensitizer.[6] Increased resistin expression was reported in abdominal adipose tissues of

humans. Human studies highlighted the positive correlation between body fat content and serum resistin. Therefore, in adipogenesis, resistin plays role in regulatory feedback mechanism acting as an adipose sensor for nutritional status. Overexpression of resistin is positively correlated with visceral fat area and change in body mass index (BMI). A significant reduction of circulating resistin was observed following weight loss and post gastric bypass. Resistin is indirectly involved in nutritional regulation in humans.[7] A number of controversies are reported regarding the role of resistin in obesity. Study on obese subjects have reported undetectable resistin level in serum of obese mice with reduced mRNA and protein expression of resistin in obesity.[8] There are contrasting results about relationship of resistin with insulin sensitivity. The two previously carried out studies[9,10] reported this relationship in exclusively obese patients. Our study is aimed to further elucidate this relationship by checking the association.

Methods

Participants' agreement was sought before their demographic information was collected. We measured weight and height. Every procedure used in studies with human subjects complied with the 1964 Helsinki Declaration and its subsequent amendments, the institutional and national research committee's ethical standards, or similar ethical standards. Every participant's information was kept private.

Resistin concentrations in obese diabetics (14.7 ± 2.8 ng/mL) and obese non-diabetics (14.4 ± 3.6 ng/mL) did not differ substantially, according to the study; nevertheless, the concentration level in these two groups was significantly greater than in non-obesity non-diabetics (10.8 ± 6.1 ng/mL, P = 0.01)[11]. The variance was 4.6 and the mean standard deviation (S.D.) was 2.15. Power was set at 80 and the confidence interval at 95. Although four was the predicted sample size, we chose to use 80 in order to increase the study's power. The whole experimental work was performed in Centre of Research in Molecular Medicine, Institute of Molecular Biology and Biotechnology, The University of Lahore considering cross sectional study design using Non probable convenient sampling technique. All individuals aged 18 and above having either gender were included in this study while Pregnant females, Individuals with BMI less than 18 and Patients currently or recently diagnosed with COVID-19 were excluded from study.

The experimental design was to find the role of resistin in 80 normal healthy individuals meeting the inclusion criteria. The Homeostatic Model Assessment (HOMA) is a widely used method to evaluate insulin resistance (IR) and beta-cell function from fasting blood glucose and insulin levels. It is especially important in studies of metabolic disorders like Type 2 Diabetes and obesity. The formula used to calculate HOMA-IR: Fasting Insulin (μU/mL)×Fasting Glucose (mg/dL) / 405. A questionnaire was filled by all participants for their demographic, insulin as well as risk factor history. This is a cross-sectional analytical study.

Body mass index were measured and 5 ml blood sample was taken from vein and was further processed for blood analysis. Lipid profile and resistin level in samples collected from obese patients. Blood was centrifuged at 4000 rpm for 10 minutes and serum was separated. Blood samples were collected into EDTA tubes. Assessment of insulin resistance was performed by following research study.[13] Serum Resistin levels were measured via a specific ELISA kit.

The data was entered and analysed using P.A.S.W 18.0 version and Statistical Package for Social Sciences (SPSS) version 22.0. Mean ± S.E.M will be given for quantitative variables like size, weight etc. Partial correlation test will be applied to measure degree of association of resistin with insulin sensitivity while controlling for BMI and serum lipids. A p value ≤ 0.05 will be considered as statistically significant.

Results

The obtained data from patients was entered and analyzed. Median ± IQR is given for non-normally distributed quantitative variables and Mean ± SD is given for normally distributed quantitative variables. Percen-

Table 1: *Distribution of all parameters in study subjects (n = 80*

Sr#	Parameter	Mean ± SD	Median(IQR)	Normality
1	Ages of subjects in years	33.64±12.08	31.50 (23.00-43.00)	Non-normal
2	Body mass index	27.14±7.35	26.00 (20.00-34.50)	Non-normal
3	Serum cholesterol level (mg/dl)	54.56±74.32	5.54 (4.21-132.25)	Non-normal
4	Serum HDL Level (mg/dl)	13.31±18.10	1.20 (0.915-32.75)	Non-normal
5	Serum LDL Level (mg/dl)	29.60±41.32	3.11 (2.19-68.25)	Non-normal
6	Serum VLDL Level (mg/dl)	10.77±17.95	1.35 (0.74-15.00)	Non-normal
7	Serum Triglycerides level (mg/dl)	49.33±81.52	3.35 (1.61-77.75)	Non-normal
8	Serum Resistin	1.03± 0.63	1.02 (0.56-1.43)	Non-normal

Table 2: *Spearmans Correlation between BMI, serum cholesterol level, HDL, LDL, serum triglycerides and serum resistin*

Parameters		BMI	Serum cholesterol level (mg/dl)	Serum HDL Level (mg/dl)	Serum LDL Level (mg/dl)	Serum VLDL Level (mg/dl)	Serum Trigylcerides Level (mg/dl)	Serum Resistin Level
Age of subject (years)	Rho	0.742		0.352		-0.96		-0.116
	P	<0.00	0.85	0.003	0.226	0.380	0.36	0.320
	N	80	80	80	80	80	80	80
BMI	Rho		0.11	-0.330	-0.75	0.045	0.07	-0.033
	P		0.328	0.005	0.486	0.667	0.66	0.750
	N		80	80	80	80	80	80
Serum cholesterol level	Rho			0.670	0.880	0.855	0.88	0.536
	P			<0.002	<0.00	<0.001	<0.0	0.752
	N			80	80	80	80	80
HDL level	Rho				0.717	0.630	0.620	-0.287
	P				<0.001	<0.001	<0.001	0.009
	N				80	80	80	80
LDL level	Rho					0.750	0.78	-0.406
	P					<0.002	<0.001	<0.001
	N					80	80	80
VLDL level	Rho						0.96	-0.476
	P						<0.001	<0.001
	N						80	80
Triglycerides level	Rho							-0.504
	P							<0.001
	N							80

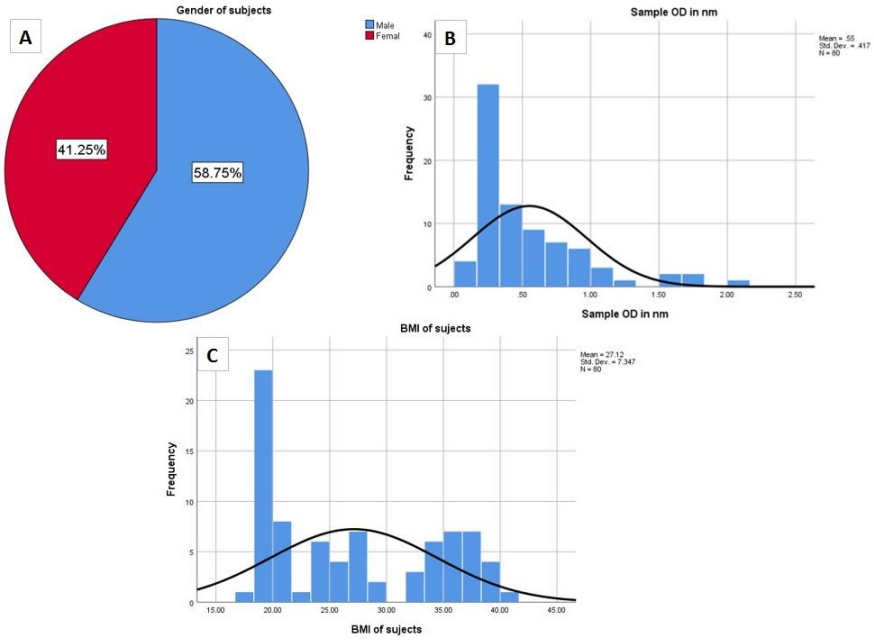

Figure 1: *A is showing results regarding gender showed that there were 47 (58.8%) male and 33 (41.3%) females in a cohort. B is showing histogram with curve regarding sample OD showed mean and standard deviation of 0.55+0.417 while the curve was negatively skewed towards lesser values. C is showing histogram with curve regarding sample BMI of subjects showed mean and standard deviation of 27.12+7.34 while the curve was slight negatively skewed towards lesser values.*

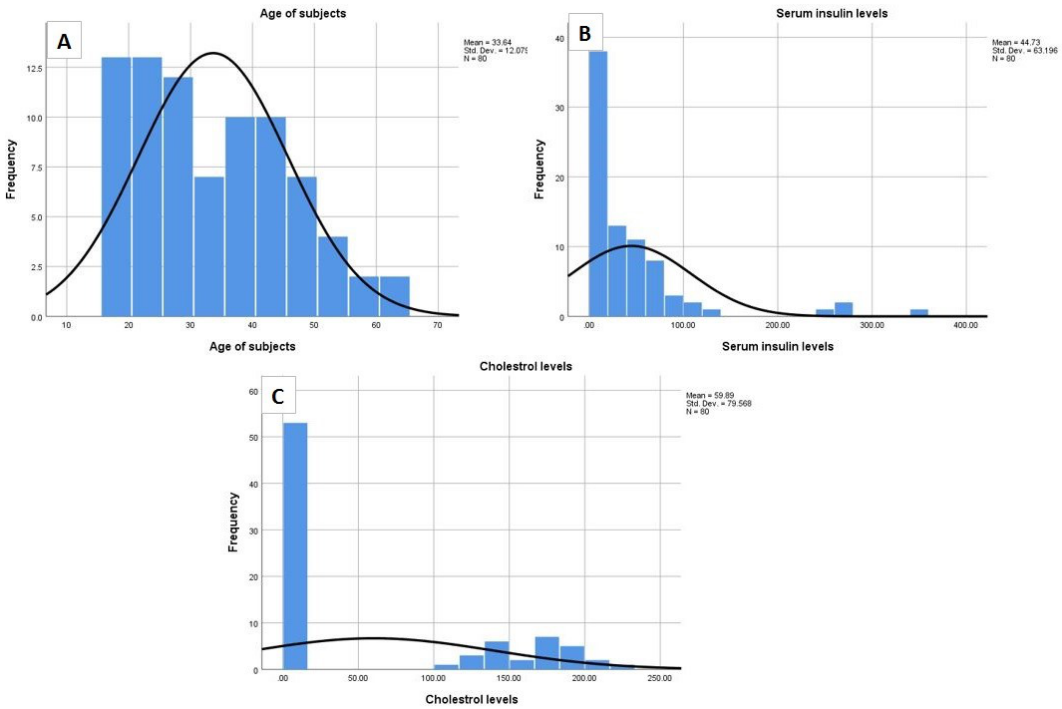

Figure 2: *A is showing histogram with curve regarding sample age of subjects showed mean and standard deviation of 33.64+12.07 while the curve was slight negatively skewed towards lesser values. B is showing histogram with curve regarding sample serum insulin levels showed mean and standard deviation of 44.73 +63.19 while the curve was negatively skewed towards lesser values. C is showing histogram with curve regar-ding sample cholesterol levels showed mean and standard deviation of 59.89+79.57 while the curve was negatively skewed towards lesser values.*

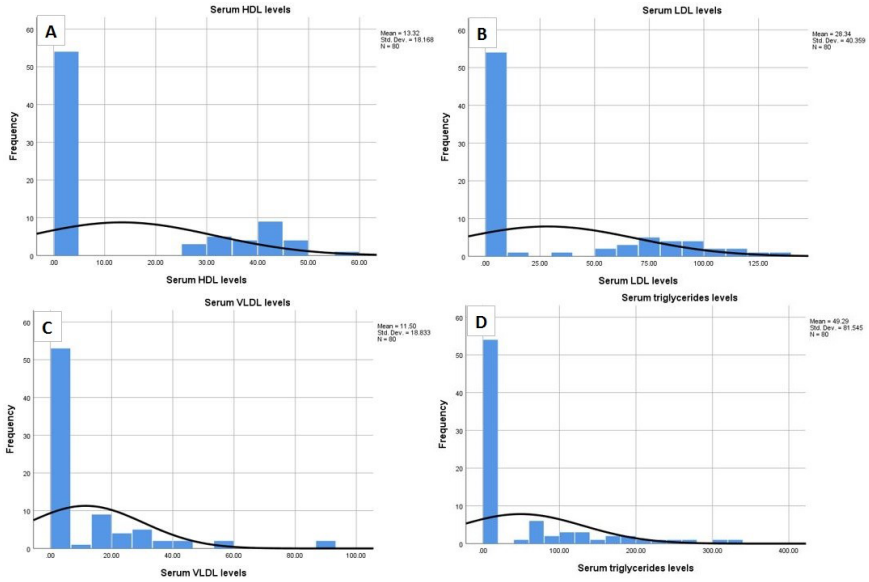

Figure 3: *A is showing histogram with curve regarding sample serum HDL levels showed mean and standard deviation of 13.32+18.17 while the curve was negatively skewed towards lesser values. B is showing histogram with curve regarding sample serum LDL levels showed mean and standard deviation of 28.34+40.35 while the curve was negatively skewed towards lesser values. C is showing histogram with curve regarding sample serum VLDL levels showed mean and standard deviation of 11.50+18.83 while the curve was negatively skewed towards lesser values. D is showing histogram with curve regarding sample serum triglycerides levels showed mean and standard deviation of 49.29+81.54 while the curve was negatively skewed towards lesser values.*

tages and frequencies were given for categorical variables. Shapiro-Wilk's statistics was used to evaluate normal distribution of data and if p-value was ≤ 0.05, data was considered non-normally distributed. Spearman's correlation (rho) was used to observe the correlation between non-normally distributed quantitative variables. A p-value of ≤ 0.05 was considered statistically significant for all purposes.

Median (IQR) age of all subjects was 31.5 (23.00-43.00) years. Average age of all subjects was 33.64 years with standard deviation of 12.08. Median (IQR) of Body Mass Index was 26.00 (20.00-34.50) kg/m2. Average Body Mass Index of all subjects was 27.14 kg/m2 with standard deviation of 7.35 kg/m2. Median (IQR) of serum cholesterol level was 5.54 (4.21-132.25) mg/dl. Average serum cholesterol level was 54.56 mg/dl with standard deviation of 74.32. Median (IQR) of serum HDL level was 1.20 (0.915-32.75) mg/dl. Average serum HDL level was 13.31 mg/dl with standard deviation of 18.10.

Median (IQR) of serum LDL was 3.11 (2.19-68.25) mg/dl. Average serum LDL level was 29.60 mg/dl with standard deviation of 41.32. Median (IQR) of serum VLDL level was 1.35 (0.74-15.00) mg/dl. Average serum VLDL level was 10.77 mg/dl with standard deviation of 17.95. Median (IQR) of serum cholesterol level was 3.35 (1.61-77.75) mg/dl. Average serum triglycerides level was 49.33 mg/dl with standard deviation of 81.52. Median (IQR) of serum resistin level was 1.04 (0.53-1.47) mg/dl. Average serum resistin level was 1.03 ng/ml with standard deviation of 0.64.

In this study, to determine the correlation of various parameters Spearmens correlation is being used. Following table is showing the correlation between them.

Discussion

The present study was performed to investigate the association of serum resistin levels with insulin sensitivity although controlling for BMI, as well as serum lipids. In this study we examined the relationship of serum resistin with insulin sensitivity and whether insulin sensitivity and serum resistin are directly proportional to each other or not. Resistin is known to interfere with uptake of glucose and insulin sensitivity. Different proinflammatory boosts advance the expression and omission of resistin from human macrophages proposing that resistin plays a pivotal part in inflammation. Diabetes is a chronic disease that affects the body to convert food into energy. Most of the food we take on daily bases is first broken down into glucose (sugar) and then released into the bloodstream. This is a signal for the pancreas to release insulin. Glial cells cause the uptake of glucose to the brain cells. Diabetes disrupts the function of glial cells. Fluctuations in glucose levels induce changes in glial metabolism. It also induces oxidative stress and inflammation.

The chronic inflammatory state in corpulence is known to be a noteworthy pathogenic component for obesity-associated complications.[14] Fat tissue macrophages or adipocytes release few polypeptides called as pro-inflammatory cytokines or adipokines play crucial role in molecular changes of obesity such as insulin sensitivity, energy regulation and inflammatory responses.[15,16,17] Resistin is one of adipokines which is related to pathogenicity of obesity like other markers such as monocyte chemo attractant inhibitor-1, plasminogen activator inhibitor-1, interleukin-6, leptin and adiponectin.[18] Increased weight in obesity contribute to increased level of reactive oxygen species which lead to inflammation of surrounding area. This inflammation is further worsened by two factors i.e., tumor necrosis factor alpha and resistin. This creates insulin resistance problem in affected patients.[19]

Gluconeogenesis and lipolysis produce glucose in absence of insulin, but when insulin is produced from pancreas, it metabolized glucose from blood to tissues via its receptor known as glucose transporter 4 which needs translocation.[20] This involves activation of further cellular pathways via phosphorylation such as mitogen-activated protein kinase pathway and phosphoinositole 3-kinase pathway.[21] During insulin resistance, cells are unable to respond to insulin properly which leads to increased level of glucose in blood and whole mechanism failed to shifting of glucose to tissues for energy production. This event leads to more transport of glucose towards liver and fat cells, and enhance obesity.[22] Studies have proved increased levels of some biomarkers during insulin resistance. One such biomarker is resistin which was evaluated in this study if it has any correlation in healthy individuals. Study revealed that level of resistin in participants showed no correlation with their parameters. Although our study depicted level of resistin via blood, but it can also be estimated by salivary sample which is more convenient and easy to handle as performed in previous study.[23]

Conclusion

Current evidence indicates that resistin does not appear to be associated with insulin sensitivity. The study is limited by a small sample size and a focus on a specific patient group, which may affect the generalizability of the findings. In Pakistan, where type 2 diabetes affects an estimated 17% of the population and obesity rates are increasing, further research is needed to explore metabolic biomarkers in local populations. Future studies could examine type 2 diabetic patients with obesity and compare biomarker levels in both blood and saliva.

Including additional relevant biomarkers may provide a more comprehensive understanding of resistin's role in metabolic regulation in the Pakistani population.

Ethical Approval: The IRB/EC approved this study via letter no. IMBB/BBBC/22/271 dated February 04, 2022.

Conflict of Interest: None

Funding Source: None

Authors' Contribution

KA: Conception.

MS, MM, FH: Design of the work.

MI, AM: Data acquisition, analysis, or interpretation.

KA, MM, FH: Draft the work.

MS, MI: Review critically for important intellectual content.

All authors approve the version to be published.

All authors agree to be accountable for all aspects of the work.

References

1. Sah SP, Singh B, Choudhary S, Kumar A. Animal models of insulin resistance: a review. Pharmacol. Rep. 2016; 68(5): 1165-77.
2. Kolb H, Martin S. Environmental/lifestyle factors in the pathogenesis and prevention of type 2 diabetes. BMC medicine. 2017; 15(1): 131
3. So A, Sakaguchi K, Okada Y, Morita Y, Yamada T, Miura H, et al. Relation between HOMA-IR and insulin sensitivity index determined by hyperinsulinemic-euglycemic clamp analysis during treatment with a sodium-glucose cotransporter 2 inhibitor. Endocr J. 2020; 67(5): 501-7.
4. Mostafazadeh M, Haiaty S, Rastqar A, Keshvari M. Correlation between resistin level and metabolic syndrome component: a review. Horm Metab Res. 2018; 50(07): 521-36.
5. Mohammadi M, Hedayati M, Zarghami N, Ghaemmaghami S. Resistin effect on telomerase gene expression in gastric cancer cell line AGS. Acta Endocrinol (Buchar). 2016; 12(2): 145.
6. Di Raimo T, Azzara G, Corsi M, Cipollone D, Lo Vasco VR, Businaro R. Adipokines and their involvement as a target of new drugs. J Pharmacovigil. 2015; 3(3) :1.
7. Zieba DA, Biernat W, Barć J. Roles of leptin and resistin in metabolism, reproduction, and leptin resistance. Domest Anim Endocrinol. 2020; 73: 106472.
8. Christou KA, Christou GA, Karamoutsios A, Vartholomatos G, Gartzonika K, Tsatsoulis A, et al. The regulation of serum resistin levels in metabolically healthy and unhealthy obese individuals. Horm. 2020; 19(4): 523-9.
9. Zaidi SI, Shirwany TA. Relationship of serum resistin with insulin resistance and obesity. JAMC. 2015; 27(3): 552–5.
10. Ashfaq F, Farasat, T. Association of serum resistin with indices of obesity in young Pakistani subjects. Pak J Zool. 2017; 49(10): 1587-93.
11. Abdalla MM. Salivary resistin level and its association with insulin resistance in obese individuals. World J Diab. 2021; 12(9):1507.
12. Sperrin M, Marshall AD, Higgins V, Renehan AG, Buchan IE. Body mass index relates weight to height differently in women and older adults: serial cross-sectional surveys in England (1992–2011). J Public Health. 2016; 38(3): 607-13.
13. Ogbodo EC, Onah CE, Amah AK, Okeke CS, Obiorah MO, Okezie AO, et al. Assessment of fasting plasma glucose, insulin, insulin resistance and glycated haemoglobin as markers of glycemic control in apparently healthy older adults in Nnewi. Indian J Forensic Community Med. 2024; 11(2): 49-55.
14. Engin A. The pathogenesis of obesity-associated adipose tissue inflammation. Obesity and Lipotoxicity. 2017: 221-45.
15. Pluta W, Radecka A, Dudzińska W, Lubkowska A. Adipose tissue and its proinflammatory properties. Journal of Education, Health and Sport. 2020; 10(8): 138-49.
16. Herrera-Martínez AD, Herrero-Aguayo V, Pérez-Gómez JM, Gahete MD, Luque RM. Inflammasomes: Cause or consequence of obesity-associated comorbidities in humans. Obesity. 2022; 30(12): 2351-62.
17. Supriya R. Role of proinflammatory and anti-inflammatory adipokines in metabolic diseases. 2018.
18. Engin A. The pathogenesis of obesity-associated adipose tissue inflammation. Obesity and lipotoxicity. 2017; 960(1): 221-45.
19. Bakinowska E, Krompiewski M, Boboryko D, Kiełbowski K, Pawlik A. The role of inflammatory mediators in the pathogenesis of obesity. Nutrients. 2024; 16 (17):2822..
20. Mann E, Sunni M, Bellin MD. Secretion of insulin in response to diet and hormones. Pancreapedia: The Exocrine Pancreas Knowledge Base. 2020. Available from: [https://pdfs.semanticscholar.org/2867/ 64f2ee 6e4124b1482cd8c49324073fb5da12.pdf]
21. Ieronymaki E, Daskalaki MG, Lyroni K, Tsatsanis C. Insulin signaling and insulin resistance facilitate trained immunity in macrophages through metabolic and epigenetic changes. Front Immunol. 2019; 10(9): 1330.
22. Smith U, Kahn BB. Adipose tissue regulates insulin sensitivity: role of adipogenesis, de novo lipogenesis and novel lipids. J Intern Med. 2016; 280(5): 465-75.
23. Rao NL, Ali S, editors. Explore the Systemic Applications of Saliva-Diagnostics. 2024. ISBN: 1-0364-0339 -4.