Journal of Advanced Zoology

ISSN: 0253-7214

Volume 44 Issue 03 Year 2023 Page 522:530

Relationship Between Lipids, Proteins, and Blood Sugar in Type 2 Diabetes

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Article History

Received: 06 June 2023
Revised: 05 Aug 2023
Accepted: 11 Sept 2023

Abstract

The relationship between dietary components and blood sugar regulation holds critical implications for individuals with type 2 diabetes. This research investigates the intricate interplay between lipids, proteins, and blood sugar in the context of type 2 diabetes. The study examines the impact of dietary lipids and proteins on postprandial blood sugar levels, insulin sensitivity, and overall glycemic control. In this study, we included a total of 58 subjects of type 2 diabetes between 33 males and 25 females. We go a data set which includes different rates of: LDL, HDL, and protein level. Statical analysis on a dataset was conducted to find the relationship between lipids, proteins, and blood sugar in type 2 diabetes. Based on SPSS analysis, we found that the highest HDL rates are among males, while the highest HDL rates are among females. we found that the number of males having normal LDL rate are 17, while females with normal LDL rate are just 10. On the other hand, results found that men with normal HDL rate are 18, while there are only 17 females within the normal rate. By using P-value test, we found that there is a significant relationship between LDL rate and HDL rate. Also, a moderate positive Pearson Correlation [.510], indicates that there is a positive linear Correlation between LDL rate and HDL rate. In addition to the previous results, we found that the ranges of protein levels are between 50-120 mg/dL. By Using spearman correlation test, we found that, P-value [0.000047] for both LDL rates and protein levels are less than [α=.01], which means that there is a significant relationship between LDL rate, HDL rate, and protein rate. Also, P-value [. 0000000028] for both HDL rates and protein levels are less than [α=.01], meaning that there is a significant relationship between HDL rate and protein rate. A highly positive Spearman Correlation [.736] and [.942], indicate that there is a positive significant linear Correlation between LDL rate, HDL rate, and protein rate

Keywords: *Lipids, Proteins, Blood Sugar, Type 2 Diabetes.*

1. Introduction

Type 2 diabetes is a prevalent metabolic disorder characterized by chronically elevated blood sugar levels, often resulting from impaired insulin sensitivity and secretion. The intricate relationship between dietary components and blood sugar regulation plays a pivotal role in managing this condition effectively [1]. This research aims to explore the multifaceted interplay between lipids, proteins, and blood sugar in the context of type 2 diabetes. The investigation delves into the diverse roles that dietary lipids and proteins play in influencing postprandial blood sugar levels, insulin sensitivity, and overall glycemic control [2].

Lipids, including triglycerides and cholesterol, are a major class of molecules that serve as a significant energy source and play vital roles in various biological processes. In type 2 diabetes, abnormalities in lipid metabolism often occur. Insulin resistance, a hallmark of this condition, can lead to the overproduction of lipids by the liver and impaired clearance of triglycerides from the bloodstream [3]. As a result, individuals with type 2 diabetes may have elevated levels of triglycerides and low levels of high-density lipoprotein [HDL] cholesterol, commonly referred to as "good" cholesterol.

The relationship between lipids and blood sugar in type 2 diabetes is multifaceted. High levels of circulating free fatty acids, a type of lipid, can interfere with insulin signaling and contribute to insulin resistance. This can further exacerbate the dysregulation of blood sugar levels by impairing glucose uptake in peripheral tissues such as muscle and adipose tissue [4]. Additionally, elevated levels of triglycerides can lead to the accumulation of lipid metabolites in insulin-sensitive tissues, promoting inflammation and further disrupting insulin action [5].

Proteins, on the other hand, are essential macromolecules involved in various physiological processes, including the regulation of blood sugar levels [6]. In type 2 diabetes, abnormal protein metabolism can occur. Chronic hyperglycemia, a characteristic feature of diabetes, can lead to the formation of advanced glycation end products [AGEs], which are proteins or lipids that become glycated and damaged by excess glucose. AGEs can accumulate in tissues and contribute to oxidative stress, inflammation, and insulin resistance [7].

The intricate balance of our body's metabolism is orchestrated by an array of physiological factors and dietary intakes [8]. Diabetes, particularly type 2 diabetes, stands as a testimony to the consequences of this imbalance [9]. As the global prevalence of type 2 diabetes continues to rise, the quest to understand its underlying mechanisms and potential dietary interventions becomes ever more crucial [10].

A fasting blood sugar test [FBS] measures sugar [glucose] in individual’s blood. It’s a simple, safe, and common way to diagnose prediabetes, diabetes, or gestational diabetes [11].

While carbohydrates have traditionally been the focal point in the discourse of blood sugar management, recent research has begun shedding light on the roles that othermacronutrients, notably lipids and proteins, play in influencing blood sugar levels. The potential for these dietary components to mitigate or exacerbate blood sugar irregularities, either directly or indirectly, calls for a more comprehensive examination [12]. The research endeavors to achieve the following specific objectives; (1) The primary objective of this study is to comprehensively examine the relationship between lipids, proteins, and blood sugar in individuals with type 2 diabetes; (2) To investigate the impact of dietary lipids on postprandial blood sugar levels and insulin sensitivity in individuals with type 2 diabetes; (3) To analyze the role of dietary proteins in gluconeogenesis, amino acid-mediated insulin secretion, and blood sugar regulation.

2. Methods

This included 58 subjects [33 males and 25 females] with varying lipid profiles of LDL [mg/dL] and HDL [mg/dL]. Based on standard reference ranges, subjects were categorized into those with normal LDL [<100 mg/dL] or normal HDL [>40 mg/dL].

A total of 58 subjects [33 males and 25 females] were included in this study. The participants were divided into two groups based on their lipid profiles: subjects with normal LDL [n = 27] and subjects with normal HDL [n = 35].

The case group included 31 subjects [16 males, 15 females] with abnormal LDL levels [≥100 mg/dL]. Of these, 18 subjects [10 males, 8 females] had a confirmed diagnosis of type 2 diabetes.

Data were analyzed using SPSS version 26. Descriptive statistics including means and standard deviations were calculated for continuous variables. Frequency distributions were determined for categorical variables. Pearson's and spearman’s correlation coefficient was computed to assess correlations between lipid profiles, proteins, and type 2 diabetes diagnosis. A p-value <0.01 was considered statistically significant.

3. Results and Discussion

SIn this study, we included a total sample of 58 subjects with different rates of; (1) LDL [mg/dl]; (2) HDL [mg/dl]; (3) Protein [mg/dl].

First, we converted each name to its's corresponding gender. We found that the 58 subjects are between 33 males and 25 females.

Based on that [Normal LDL: Less than 100 mg/dL] and [Normal HDL: Greater than 40 mg/dL] [9]. The subject was divided into two groups: Subjects with normal LDL [n = 27] and subjects with normal HDL [n = 35].

Table 1: Data validity

Statistics		
Gender		
N	Valid	58
	Missing	0

Table 2 shows the data validity for our sample, all the 58 subjects were valid to be tested.

Table 2: Gender descriptive statistics

Gender					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Female	25	43.1	43.1	43.1
	Male	33	56.9	56.9	100.0
	Total	58	100.0	100.0	

Through Table 2 and figure 1, we can find that the distribution of males and females: total number of Females are 25, while total numbers of males are 33. Also, are data concerning both males and females are 100% valid.

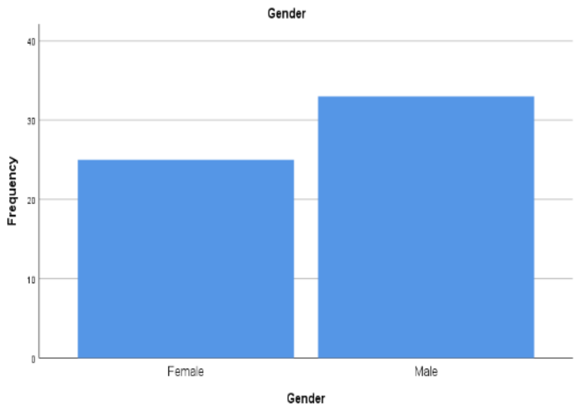

Figure 1: Gender descriptive statistics

Table 3: LDL and HDL Descriptive Statistics

Descriptive Statistics	N	Minimum	Maximum	Mean	Std. Deviation
LDL[mg/dL]	58	51.7	401.0	125.479	68.8839
HDL[mg/dL]	58	15.0	118.6	53.584	27.6847
Valid N [listwise]	58				

Table 3 shows the minimum, maximum, mean, and standard deviation for both LDL and HDL rates provided by our sample. Table explains that the maximum LDL rate was 401 mg/dl, while the maximum HDL rate is 118.6 mg/dl. On the other hand, the minimum LDL is 54.7 mg/dl, while the minimum HDL is 15 mg/dl.

From the same table we can find that the mean vale for the LDL rates is 125.47 mg/dl, while the mean value of HDL is only 53.584 mg/dl.

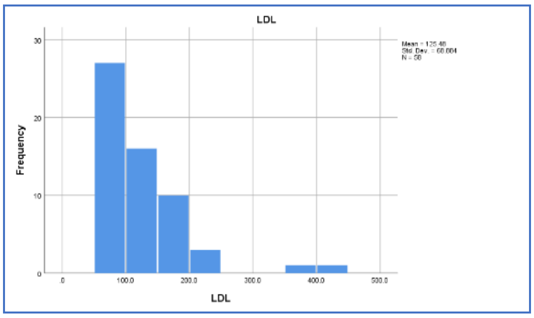

Figure 1: LDL descriptive Statistics

Figure 2 shows that, the most frequent values of LDL rate are located within the range of 50 to 150. There are a few subjects located above 150.

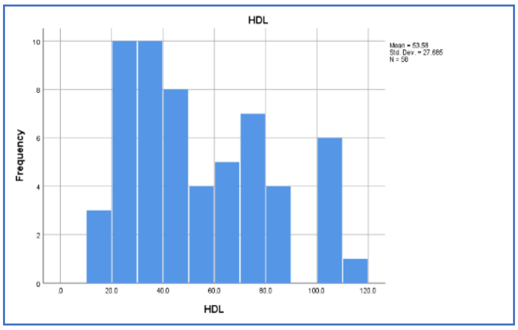

Figure 3: LDL descriptive Statistics

Figure 3 shows that, the most frequent values of HDL rate are located within the range of 30 to 60. While less subjects are located below 30 or above 60.

Table 4: Normal LDL frequency

NormalLDL					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	0	31	53.4	53.4	53.4
	1	27	46.6	46.6	100.0
	Total	58	100.0	100.0	

Table 4 explains that, among 58 persons within our sample, there are only 27 persons that have normal LDL rate.

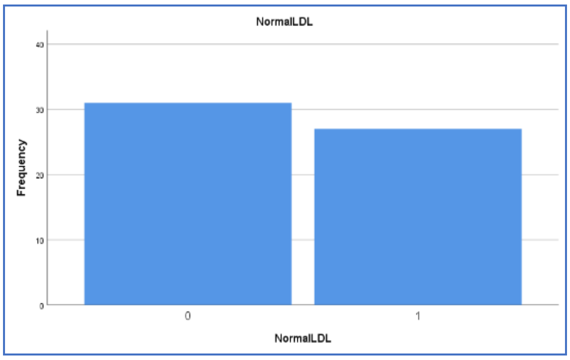

Figure 2: NormalLDL frequency

When “0” represents persons with normal LDL rate, and “1” represents persons with not normal LDL rate, Figure 4 shows that; (1) Persons with normal LDL rate are27; (2) Persons with not normal LDL rate are31. These are the adult ranges for LDL cholesterol: Optimal [Normal]: Less than 100 mg/dL [This is the goal for people with diabetes or heart disease.] Near optimal: 100 to 129 mg/dL. Borderline high: 130 to 159 mg/dL. High: 160 to 189 mg/dL. Very high: 190 mg/dL and higher

Table 2: Ranges.for.LDL

Ranges.for.LDL	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Optimal	27	.465	.465	.465
Near.opt	10	.172	.172	.637
Bo.line.high	7	.120	.120	.757
High	8	.1379	.1379	.8949
Very.high	6	.103	.103	100.0
Total	58	100.0	100.0	

Table 5. and the figure 5, illustrate the frequency of each LDL ranges, results showed that the optimal or [Normal] range is the most frequent in our sample. On the other hand, the Very High range is the lowest frequent.

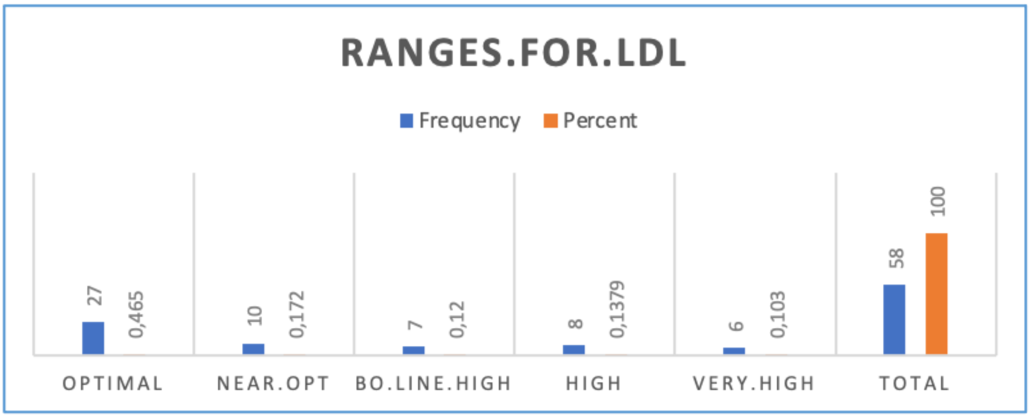

Figure 3: Ranges.for.LDL

Table 3: NormalHDL frequency

NormalHDL					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	0	23	39.7	39.7	39.7
	1	35	60.3	60.3	100.0
	Total	58	100.0	100.0	

Table 6, and Figure 6**,** explains that, among 58 persons within our sample, there are 35 persons that have normal HDL rate [Greater than 40 mg/dl].

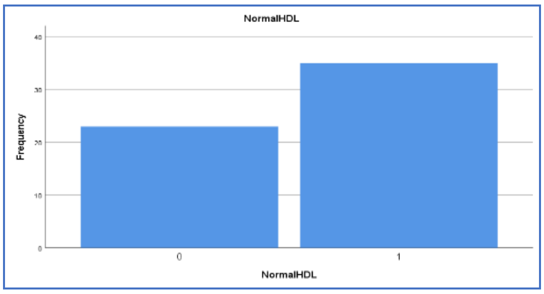

Figure 4: Norma lHDL frequency

When “0” represents persons with normal HDL rate, and “1” represents persons with not normal HDL rate, the above graph shows that; (1) Persons with normal HDL rate are: 35.

Persons with not normal HDL rate are: 23.

Based on another assumption that: optimal HDL cholesterol Levels are above 40 mg/dL in men and above 50 mg/dL in women.

Table 4: Ranges.for.HDL

Ranges.for.HDL				
	Frequency	Percent	Valid Percent	Cumulative Percent
Optimal.Male	18	0.5806	0.5806	0.5806
Optimal.Female	13	0.4193	0.4193	100
Total	31	100	100	

Table **7** and Figure 7, demonstrate that in our samples there are; (1) 18 Males with optimal [normal] HDL rate; (2) 13 Females with optimal [normal] HDL rate.

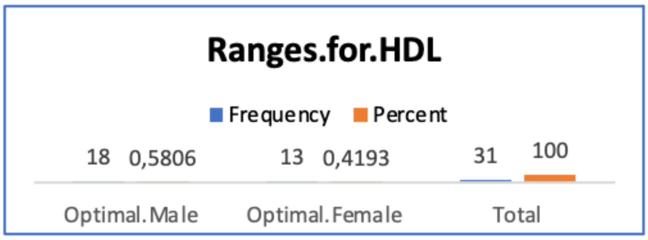

Figure 5: Ranges for HDL

Table 5: Protein frequency

Protein					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	50	8	13.8	13.8	13.8
	60	10	17.2	17.2	31.0
	70	10	17.2	17.2	48.3
	80	11	19.0	19.0	67.2
	90	9	15.5	15.5	82.8
	100	4	6.9	6.9	89.7
	110	3	5.2	5.2	94.8
	120	3	5.2	5.2	100.0
	Total	58	100.0	100.0	

Table 8 and Figure 8, indicates the frequency of the protein sample showing the Frequency, Percent, Valid Percent, and Cumulative Percent.

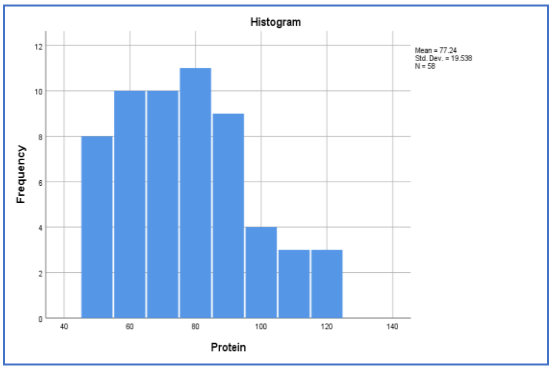

Figure 6: Protein frequency

Table 6: Protein descriptive statistics

Descriptive Statistics									
	N	**Minimum**	**Maximum**	**Sum**	**Mean**	**Std. Deviation**	**Variance**	**Skewness**	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
Protein	58	50	120	4480	77.24	19.538	381.730	.461	.314
Valid N [listwise]	58								

Table 9 presents the Protein descriptive statistics, showing Minimum, Maximum, Sum, Mean, Std. Deviation, Variance, and Skewness Statistic.

Table 7: P-value test between LDL and HDL

Correlations			
		LDL	HDL
LDL	Pearson Correlation	1	.510**
	Sig. [2-tailed]		. 0.000043
	N	58	58
HDL	Pearson Correlation	.510**	1
	Sig. [2-tailed]	0.000043	
	N	58	58

**. Correlation is significant at the 0.01 level [2-tailed].

Table 10: indicates that P-value [0.000043] for both LDL and HDL are less than [α=.01], this means that there is a significant relationship between LDL rate and HDL rate. Also, a moderate positive Pearson Correlation [.510], indicates that there is a positive linear Correlation between LDL rate and HDL rate.

Table 8: Spearman correlation test between LDL and protein levels

Correlations				
			LDL	Protein
Spearman's rho	LDL	Correlation Coefficient	1.000	.736**
		Sig. [2-tailed]	.	.00000047
		N	58	58
	Protein	Correlation Coefficient	.736**	1.000
		Sig. [2-tailed]	.00000047	.
		N	58	58

**. Correlation is significant at the 0.01 level [2-tailed].

Table 11 shows that P-value [0.000047] for both LDL rates and protein levels are less than [α=.01], this means that there is a significant relationship between LDL rate and protein rate.

Also, a highly positive Spearman Correlation [.736], indicates that there is a positive significant linear Correlation between LDL rate and protein rate.

Table 9: Spearman correlation test between HDL and protein levels

Correlations				
			HDL	Protein
Spearman's rho	HDL	Correlation Coefficient	1.000	.942**
		Sig. [2-tailed]	.	.0000000028
		N	58	58
	Protein	Correlation Coefficient	.942**	1.000

	Sig. [2-tailed]	. 0000000028	.
	N	58	58
**. Correlation is significant at the 0.01 level [2-tailed].			

Table 12 indicates that, P-value [. 0000000028] for both HDL rates and protein levels are less than [α=.01], this means that there is a significant relationship between HDL rate and protein rate. Also, a highly positive Spearman Correlation [.942], indicates that there is a positive significant linear Correlation between HDL rate and protein rate.

Table 10: Spearman correlation test between LDL, HDL, and protein levels

Correlations					
			LDL	HDL	Protein
Spearman's rho	LDL	Correlation Coefficient	1.000	.561**	.736**
		Sig. [2-tailed]	.	.000	.00000047
		N	58	58	58
	HDL	Correlation Coefficient	.561**	1.000	.942**
		Sig. [2-tailed]	.000	.	. 0000000028
		N	58	58	58
	Protein	Correlation Coefficient	.736**	.942**	1.000
		Sig. [2-tailed]	.000	. 0000000028	.
		N	58	58	58
**. Correlation is significant at the 0.01 level [2-tailed].					

Table 13: indicates that, P-values less than [α=.01], indicate that there is a relationship between LDL, HDL, and proteins in type 2 diabetes.

The relationship between dietary components and blood sugar regulation is of paramount importance for individuals with type 2 diabetes, as it directly influences their ability to manage glycemic control effectively [13]. This research delved into the intricate interplay between lipids, proteins, and blood sugar in the context of type 2 diabetes [14], aiming to enhance our understanding of how dietary choices impact glucose metabolism and insulin response [15]. By exploring the mechanisms through which lipids and proteins influence postprandial blood sugar levels, insulin sensitivity, and overall glycemic control[16]. this study contributes to the broader understanding of nutritional strategies for diabetes management [17].

The findings of this study shed light on several key aspects of the relationship between dietary components and blood sugar regulation. The investigation into the effects of dietary lipids on postprandial blood sugar levels is particularly noteworthy [18].

Conclusion

In conclusion, this research provides valuable insights into the complex relationship between lipids, proteins, and blood sugar regulation in individuals with type 2 diabetes. The study's findings contribute to our understanding of how dietary choices impact glycemic control and insulin sensitivity, with potential implications for developing effective dietary interventions to manage type 2 diabetes. Moreover, the gender-based analysis of lipid profiles add an additional layer of complexity to the investigation, suggesting that gender-specific considerations may play a role in diabetes risk and management strategies. Further research is warranted to validate and expand upon these findings, ultimately paving the way for more personalized and effective approaches to diabetes care and management.

Abbreviations

LDL Low-density lipoproteins.

HDL High-density lipoproteins.

AGEs Advanced glycation end products.

FBS Fasting blood sugar test.

SPSS Statistical Package for the Social Sciences.

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