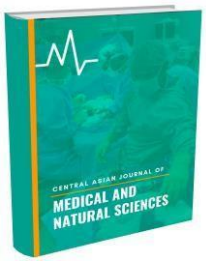

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Article

Association of some Biochemical Markers, Hepatitis B, and C Viruses with Type 2 Diabetes Mellitus in Kirkuk City/Iraq

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Abstract: Hepatitis B and C viruses could be found in diabetes patients and increase the severity of the disease. A major worldwide public health issue is vitamin D deficiency. It has a significant role in the development of type 2 diabetes. Objectives: To address the correlation of some biomarkers such as [Vitamin D3, S. Ferritin, and total serum bilirubin], HCV, and HBV with diabetes mellitus type 2 of patients from Kirkuk city, Iraq this study has been performed. The current study was case-control study, included 100 diabetic patients and 100 non-diabetic patients, which was achieved on patients with diabetes mellitus type II within age group [25-75] years, who showed up at Kirkuk General Hospital from the period of January 1st 2024 to January 15th 2025. HCV, HBV, Vit. D3, S. Ferritin, and TSB were evaluated for both the patients and control groups. The current study, displayed the greatest ratio 20 [40%] of diabetic male were within age group [66-75] years old, while the lowest proportion 3 [6%] of male with diabetes mellitus in age group [25-35] years old. There was lowering of vitamin D3 mean levels [14.50±3.42 ng/ml] within diabetic patients in comparison to the non-diabetic ones [48.83±10.89 ng/ml]. Seven diabetic patients out 100 had HCV infection in comparison to only 1 non-diabetic patient that had HCV infection, the variances were not-significant [P=0.065]. 10% of the diabetic patients had HBV infection in matching to 1% of the non-diabetic individuals had HBV infection and the variations were significant [P=0.033].: Diabetes mellitus are more prevalent among elderly patients. HCV and HBV infections could be associated with diabetes mellitus and male patients. Lowering of Vitamin D3 and S. Ferritin levels could be correlated with old-ages and diabetes mellitus.

Keywords: Type 2 Diabetes Mellitus, Vitamin D, Ferritin, HCV, HBV

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1. Introduction

Hyperglycemia is a symptom of diabetes mellitus [DM], a chronic metabolic disease. Certain organs and tissues experience long-term damage and diseases as a result of DM. Although there are two main types of diabetes mellitus [DM], genetic issues, toxicity, pregnancy, and insulin receptor defects can all contribute to the development of DM. Type-1 diabetes mellitus [T1DM], Type-2 diabetes mellitus [T2DM], gestational diabetes, and other less prevalent forms including monogenic diabetes are the primary categories of diabetes at the moment. The most prevalent kind of diabetes in this category, type 2 DM, which is a chronic illness marked by increased hepatic glucose synthesis that results in hyperglycemia, decreased glucose uptake, and altered glucose-induced insulin secretion [1].

Hepatitis B and C viruses could be found in diabetes patients and increase the severity of the disease, millions of people worldwide are afflicted with hepatitis B, a potentially fatal infection that targets the liver. The hepatitis B virus [HBV] can cause acute

and chronic liver disorders. Approximately 8% of people worldwide have had an HBV infection, and 5–6% are permanent carriers of the virus [2]. The Hepatitis C virus [HCV] likewise is an epidemic that affects millions of people worldwide each year. The World Health Organization [WHO] estimates that over 150 million people suffer from a chronic hepatitis C infection. Globally, the prevalence of HCV infection is estimated to be between 2.2% and 3.0% based on the data currently available. With the highest incidence of HCV infection reported in the African and Eastern Mediterranean regions, the overall picture remains comparable even though individual estimates from various regions or nations have changed somewhat since the WHO's initial estimates were released in 1997. The incidence rate is much higher in Africa and the Western Pacific than in the Americas and Europe. It is estimated that between 2 and 5 million people in Europe are infected with HCV [3].

According to a Chinese cohort study, those with type 2 diabetes had a 43% higher relative risk of contracting the Hepatitis B virus [HBV] than people without the disease [4]. In another study conducted in Brazil, type 2 diabetes had a prevalence of 1.7% viral Hepatitis C and 15.83% HBV infection [5]. Research on the link between diabetes and hepatitis B and C has frequently been cross-sectional in Africa [6]. In Morocco, individuals with type 2 diabetes had a 4.5% prevalence of viral hepatitis C [7]. Fat buildup is caused by type 2 diabetes, which is most frequently linked to dyslipidemia. A viral hepatitis infection damages the liver's integrity and function. Therefore, the chance of developing steatosis and liver fibrosis may be increased if diabetes and hepatitis coexist [8].

Furthermore lipid metabolism may be adversely affected by abnormal glycolysis. Human placental lactogen, prolactin, and estrogen are among the placental hormones that significantly contribute to maternal obesity and insulin resistance [IR], which in turn causes atherogenic dyslipidemia [AD] [9], [10].

It is believed that vitamin D increases the body's sensitivity to insulin, reducing the risk of insulin resistance. It is uncertain, meanwhile, how vitamin D levels relate to type 2 diabetes. A major worldwide public health issue is vitamin D deficiency. It has a significant role in the development of type 2 diabetes [11].

Since type 2 diabetes is one of the effects of having too much iron in the body, hepcidin may play a part in the aetiopathogenesis of the condition. Because of oxidative stress, too much systemic iron can harm pancreatic β cells and hepatocytes. To address the correlation of some biomarkers such as [Vitamin D3, S. Ferritin, and total serum bilirubin], HCV, and HBV with diabetes mellitus type 2 of patients from Kirkuk city, Iraq this study has been performed..

2. Materials and Methods

2.1 The study's design and setting

The current study was case-control study, included 100 diabetic patients and 100 non-diabetic patients, which was achieved on patients with diabetes mellitus type II within age group [25-75] years old, who showed up at Kirkuk General Hospital from the period of January 1st 2024 to January 15th 2025, the control group included non-diabetic individuals who were about the same age. A specialized questionnaire form was utilized to collect basic data from both the patients and control groups.

2.2 Biochemical tests:

The ichroma Vitamin D Neo technology, a fluorescence immunoassay for the quantitative measurement of total 25-OH Vitamin D was used to measure the quantity of Vitamin D3 in each participant [Ref No. CFPC-133, Bioditech Med INC, Korea]. The same technique was also used to measure serum Ferritin levels for all the participants [Ref No. CFPC-32, Bioditech Med INC, Korea]. Total Bilirubin was also estimated for all the participants by utilizing of colorimetric method [spectrophotometer] and using of a kit from Biolabo with Ref No. 80403.

2.3 Virological tests:

Enzyme linked immunosorbent assay [ELISA] technique used for detection of HCV through using of ELISA kit from [Campmedica group, Lot: HCV 2202-3, Romania], and HBsAg ELISA kit from [Fortress diagnostics, Lot: BS-2310-4, United kingdom]. The steps were followed firmly according to the manufacturer's directions.

2.4 Exclusion criteria:

Diabetic children and pregnant women, hemolyzed and fatty blood samples were excluded from the current study.

2.5 Ethical consideration:

The study protocol has been approved by the University of Kirkuk's College of Medicine's ethical council.

2.6 Analysis of statistics:

SPSS [Statistical Package for Scientific Services] version 26 was used for computerized statistical analysis. Data comparison [P value], categorical variable analysis, and probability [P] were all done using chi-square. The numerical variables were also compared using the unpaired t-test and one-way ANOVA test. A P value of less than 0.05 was considered statistically significant [S], a P value of less than 0.01 was considered highly significant [HS], and a P value of less than 0.05 was considered significant. P >0.05 was regarded as non-significant

3. Results and Discussion

The current study, displayed the greatest ratio 20 [40%] of diabetic male were within age group [66-75] years old, while the lowest proportion 3 [6%] of male with diabetes mellitus was in age group [25-35] years old. Table 1

For non-diabetic male participants, the highest rate 13 [26%] was among age group [46-55] years, whereas, the lowest percentage 6 [12%] were age between [25-35] years old. Table 1.

In respects to female diabetic patients, the greatest percentage 24 [48%] was noticed among patients who were aging between [66-75] years old and the lowest rate 1 [2%] was noted within age ranged [25-35] years, whereas the non-diabetic female individuals showed the greatest rate 20 [40%] among individuals aged [56-66] years old, Table 1.

Table 1. Age distribution between male and female diabetic and non-diabetic.

Age range	Male		Female	
	Diabetic No. [%]	Non-diabetic No. [%]	Diabetic No [%]	Non-diabetic No. [%]
25-35	3 [6]	6 [12]	1 [2]	5 [10]
36-45	5 [10]	10 [20]	4 [8]	9 [18]
46-55	7 [14]	13 [26]	5 [10]	11 [22]
56-65	15 [30]	10 [20]	16 [32]	20 [40]
66-75	20 [40]	11 [22]	24 [48]	5 [10]
Total	50 [100]	50 [100]	50 [100]	50 [100]

There was lowering of vitamin D3 mean levels [14.50±3.42 ng/ml] within diabetic patients in comparison to the non-diabetic ones [48.83±10.89 ng/ml] and the differences were highly significant [P<0.0001]. These were also applicable for the S. Ferritin levels within both diabetic and non-diabetic participants. Table 1.

Regarding the TSB mean levels, the lowest mean levels [0.67±0.23 mg/dl] was recorded among non-diabetic participants, while the highest mean levels [3.07±1.32 mg/dl] was denoted among diabetic patients and the results were extremely significant [P=0.005], as shown in table 2.

Seven diabetic patients out 100 had HCV infection in comparison to only 1 non-diabetic patient that had HCV infection, the variances were not-significant [P=0.065]. Table 2.

10% of the diabetic patients had HBV infection in matching to 1% of the non-diabetic individuals had HBV infection and the variations were significant [P=0.033], Table 2.

Table 2. Correlation between diabetes and non-diabetes in regards to biochemical parameters, HCV, and HBV.

Variables	Diabetes No. [%]	Non-diabetes No. [%]	P. Value
Mean±SD			
Vit. D3	14.50±3.42	48.83±10.89	<0.0001
S. Ferritin	49.72±37.73	161.41±20.02	<0.0001
TSB	3.07±1.32	0.67±0.23	0.005
HCV			
Positive No. [%]	7 [7]	1 [1]	0.065
Negative No. [%]	93 [93]	99 [99]	
HBV			
Positive No. [%]	10 [10]	2 [2]	0.033
Negative No. [%]	90 [90]	98 [98]	

In respect to the comparison between male and female on the basis of diabetes mellitus, biochemical parameters, HCV, and HBV, the present study exhibited lowering in the mean levels of Vit D3 among diabetic male and female patients respectively [15.12±3.59 VS 13.88±3.16 ng/ml] in comparing to [51.20±10.90 VS 48.46±1.47 ng/ml] for the non-diabetic male and female participants respectively. The results were highly significant [P<0.0001]. The different letters within the cells indicated significant differences between the groups, while the same letters within the groups stated no-differences. Table 3.

There was lowering of the S. Ferritin mean levels within the diabetic patients, female patients showed the lowest mean levels [34.58±24.52 ng/ml], while the greatest mean level [176.06±14.0 ng/ml] was seen in non-diabetic male participants. The differences were highly significant, as shown in table 3.

Regarding the TSB mean levels, Diabetic group and specifically male diabetic patients showed increment in the mean levels [3.68±1.64 mg/dl] in comparing to the rest of the groups, while the lowest concentrations of TSB [0.63±0.26 mg/dl] was documented among non-diabetic female patients. The variances within the groups were highly significant [P=0.005], as shown in table 3.

Moreover, our study detected 5 [10 %] of the diabetic male patients had HCV infection, though 2 [4 %] of the female diabetic patients had the virus. In addition to that 1 [2 %] of the male non-diabetic group had HCV. The differences within the groups between the positive and negative HCV were greatly significant [P less than 0.0001].

Furthermore, male diabetic male patients revealed the greatest ratio of HBV infection 7 [14 %] in comparison to female diabetic and non-diabetic groups. The different letters within the groups stated significant differences, Table 3.

Table 3. Comparison between male and female on the basis of diabetes mellitus, biochemical parameters, HCV, and HBV.

Variables	Male		Female		P. Value
	Diabetic	Non-Diabetic	Diabetic	Non-Diabetic	

	No. [%]	No. [%]	No. [%]	No. [%]	
Mean±SD					
Vit. D3	15.12±3.59[a]	51.20±10.90[b]	13.88±3.16[a]	48.46±1.47[c]	<0.0001
S. Ferritin	64.86±33.09[a]	176.06±14.0[b]	34.58±24.52[c]	146.76±13.29[d]	<0.0001
TSB	3.68±1.64[a]	0.70±0.20[b]	2.46±0.28[c]	0.63±0.26[d]	0.005
HCV					
+	5 [10]	1 [2]	2 [4]	-	<0.0001
-	45 [90]	49 [98]	48 [96]	50 [100]	
HBV					<0.0001
+	7 [14]	2 [4]	3 [6]	-	
-	43 [86]	48 [96]	47 [94]	50 [100]	

Figure 1, illustrated the correlation between age and Vit. D3 mean levels, here we noticed that Vit. D3 mean levels decrease among old ages diabetic patients.

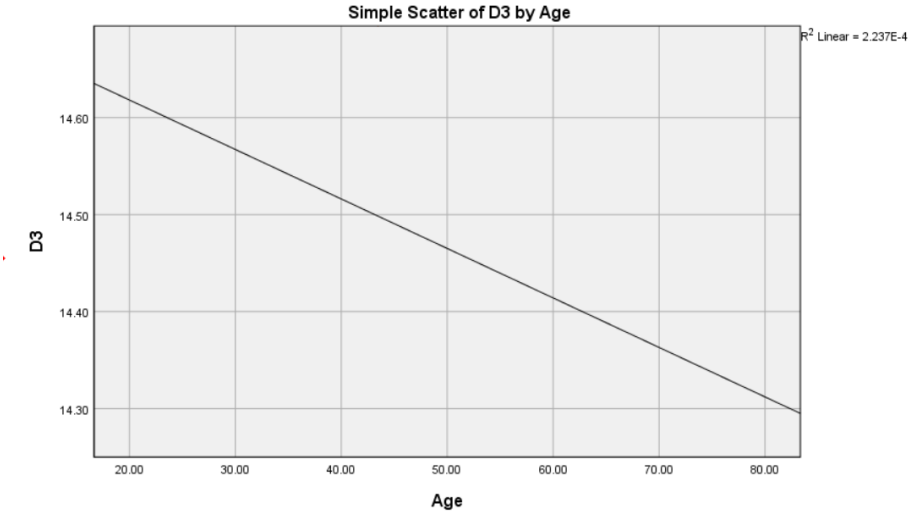

Figure 1. Correlation between Age and Vitamin D3 levels among Diabetes Mellitus patients.

Pearson correlation=-0.015 negative correlation [i.e. with increasing age, the vitamin D3 levels decrease among diabetic patients]

Significant [2 tailed]=0.883

In figure 2, here we noted that old age diabetes patients revealed lower levels of S. Ferritin.

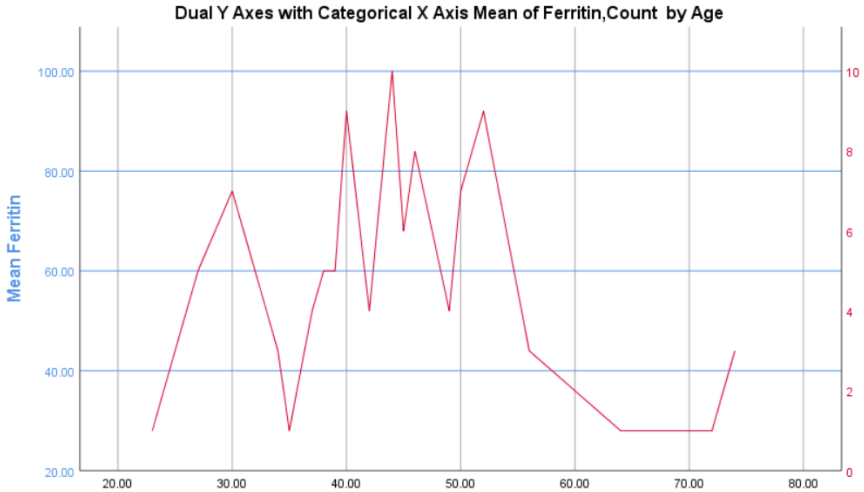

Figure 2. Correlation between Age and Ferritin levels among diabetic patients.

Pearson correlation: 0.086.

Sig [2-tailed]=0.393 non-significant correlation between Age and Ferritin levels.
The levels of S. Ferritin decrease among old age diabetic patients.

4. Discussion

A metabolic disease of great public health significance is diabetes mellitus. The disease is thought to affect 425 million individuals today, and by 2045, that number is predicted to increase to 629 million. Furthermore, 318 million persons are thought to have impaired glucose tolerance and are at risk of getting the condition in the future. However, the data on chronic liver illnesses brought on by hepatitis C or B infections are just as alarming. Hepatitis B and C viruses infect over 325 million individuals worldwide, and 350,000 of those patients pass away from cirrhosis or hepatocellular cancer [12].

According to the current study, the largest percentage of diabetic patients were in the age range of 66–75 years, these were near to a study done in South Korea, where they noticed that patents aged 65 years and more were more susceptible to get diabetes mellitus than younger individuals [13], likewise our study was in line with another study done in China [14].

Moreover, there was lowering of vitamin D3 and S. Ferritin mean levels within diabetic patients in comparison to the non-diabetic ones, while the TSB mean levels was higher in diabetes patients in matching to non-diabetes ones, these were agreed with a study conducted in Iraq where they found that Vit. D3 levels decreased significantly among diabetic patients in matching to non-diabetes ones [15]. In another study done in Hilla city, Iraq [16] where they detected lower vitamin D3 levels among diabetes patients and higher levels of TSB among the diabetes patients, which were in line with our findings. Another study from Baghdad, Iraq revealed lower Ferritin levels within diabetes patients in comparison to non-diabetes ones which were agreed with our research [17]. Our study disagreed with a study done by Bayih A et al., who detected higher levels of S. Ferritin levels in diabetic patients in comparison to non-diabetic individuals, and these differences may be due to the variances in the study design where our study is case-control while this study is cross-sectional study, or the sample size differences in addition to the life style of the patients in regards to consuming of Iron-rich diet or not [18]. There is growing evidence linking iron metabolism to type 2 diabetes. It was thought that there might be a reciprocal relationship in which glucose metabolism influences iron metabolism and vice versa. Additionally, it was proposed that decreased iron activity may impact insulin secretion, and hence aid in managing type 2 diabetes [19].

There was significant decreasing in the Vit. D3 and S. Ferritin levels among diabetes female faster than male patients, these were close to Ciftel S et al., findings who detected low Vit. D3 and S. Ferritin among female patients [20].

Regarding the TSB mean levels, Diabetic group and specifically male diabetic patients showed increment in the mean levels, these were in line with a study conducted in Ramadi city, Iraq, where they found that men with diabetes mellitus and hypertension showed elevation in their TSB levels [21].

Moreover, our study detected 5 [10 %] of the diabetic male patients had HCV infection, though 2 [4 %] of the female diabetic patients had the virus. These were close to Farshadpour F et al., findings who stated that diabetes mellitus could be a risk factor to contract HCV of male patients [22]. Our results were also in line with another study achieved by Ndako JA et al., who found that the prevalence of HCV among male patients was 11.3% [23].

Furthermore, male diabetic male patients revealed the greatest ratio of HBV infection 7 [14 %] in comparison to female diabetic and non-diabetic groups, which was disagreed with a Chinese study which stated the opposite, these variances might be due to the variations in the demographic distribution between our study and this study [24].

Our study also revealed that with increasing of ages the levels of Vit. D3 and S. Ferritin levels decrease non-significantly, these were close to what was reported earlier by Ciftel S et al., who detected that malnutrition is becoming more common in this demographic;

according to statistics, 46.2% of older persons suffer from malnutrition leading to low vitamin D3 and S. Ferritin levels.

5. Conclusion

1. Diabetes mellitus are more prevalent among elderly patients.
2. HCV and HBV infections could be associated with diabetes mellitus and male patients.
3. Lowering of Vitamin D3 and S. Ferritin levels could be correlated with old-ages and diabetes mellitus.

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