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Correlation Between HbA1c and Body Mass Index Among Patients with High Lipid Profile Attending Johns Hopkins Aramco Healthcare Hospital in Saudi Arabia

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Abstract

Background and Objectives: Dyslipidemia is a modifiable risk factor for cardiovascular diseases, diabetes, and stroke. The primary objective of this study was to examine the relationship between HbA1C and body mass index (BMI) among patients with high lipid profiles.

Methods: This retrospective, cross-sectional, hospital-based study was conducted at Johns Hopkins Aramco Healthcare Facilities. Data were extracted from medical health records and included demographics, lipid profiles, and HBA1c measurements. The study included 2368 participants, and DATAtab was used to analyse the data.

Results: The participants were 57.05% male and 78.42% Saudi. The mean age was 41.48±12.1 years, and the mean body mass index (BMI) was 28.44±5.53. There was a statistically significant relationship between the use of dyslipidaemia medicine and HbA1c ($P<0.001$). There was a very weak positive but statistically significant relationship between HbA1c and BMI ($r = 0.18$, $P<0.001$). HbA1c and systolic blood pressure appeared to have a statistically significant positive association ($r = 0.16$, $P< 0.001$). There was no correlation between HbA1c and low-density lipoprotein cholesterol (LDL-C), total cholesterol (TC), or diastolic blood pressure. There was an inverse correlation between HbA1c and high-density lipoprotein cholesterol (HDL-C) ($r = -0.11$, $P< 0.001$).

Conclusion: The results indicated that HbA1c is linked to BMI, age, systolic blood pressure, triglycerides, and HDL-C levels. There was no correlation between HbA1c and LDL-C, TC, and diastolic blood pressure.

Keywords: Lipid Profile, HbA1c, BMI, Cross-sectional, Triglyceride.

Introduction

Elevated levels of total cholesterol (TC), triglycerides (TG), low-density lipoprotein cholesterol (LDL-C), and/or reduced levels of high-density lipoprotein cholesterol (HDL-C) are characteristics of the metabolic abnormality known as dyslipidaemia, which affects plasma lipids and lipoproteins. It is the main independent modifiable risk for cardiovascular disease (CVD), diabetes, and stroke and a leading source of morbidity and mortality [1][2][3][4][5]. Dyslipidemia causes 54% of the population's direct risk for myocardial infarction [6][7]. According to a study by the World Health Organization (WHO), high cholesterol levels cause 4.5% of worldwide deaths and 2% of disability-adjusted life years (DALYs) in people aged 18 years and over [8]. In a 2005 cross-sectional survey of the Saudi population aged 15-64 years, the prevalence of elevated total cholesterol was 20%, and the prevalence of dyslipidaemia ranged between 20 and 40% [9]. A study on the prevalence of dyslipidaemia among young people in all 13 districts of Saudi Arabia discovered that one in every four Saudi adolescents has dyslipidaemia [10].

In patients with diabetes mellitus (DM), HbA1c predicts the likelihood of developing diabetic complications[11]. Elevated HbA1c is a risk factor for CVD and is distinct from conventional risk factors like dyslipidaemia. According to estimates, the chance of CVD increases by 18% in the diabetic population for every 1% increase in absolute HbA1c levels. Even within the normal range of HbA1c, non-diabetic cases have shown this positive association between HbA1c and CVD [11][12]. Therefore, the main aim of this study was to identify the correlation between HbA1c and body mass index (BMI) among patients with dyslipidaemia, as well as to evaluate the importance of HbA1c as an indicator. This study will could in decision making, provide a baseline for evaluation, and help to develop a plan for recruiting patients for prevention and lifestyle-management programs.

Materials and Methods

Study Design, Settings, and Participants

This retrospective, cross-sectional, hospital-based study was conducted at Johns Hopkins Aramco Healthcare Facilities. This facility treats approximately 153,000 employees of ARAMCO and JHAH and their dependents. The majority of the study population lived in the Eastern region of Saudi Arabia in Dhahran, Al-Hasa, Ras Tanura, Abqaiq, and Udhailiyah. Eligible participants were greater than 18 years old and had to meet one of the following requirements (all unit are in mg/dl): TC ≥200, HDL-C <40 for men and <50 for women, LDL-C ≥ 100, TG ≥ 150, or age 20 years and over. Participants were excluded if they had diabetes, hypertension, asthma, or any chronic disease or if they were taking medication other than dyslipidaemia medications.

Data Extraction and Statistical Analysis

Data were extracted from medical health records. A data dictionary was used, and the following variables were included: HBA1c, age, sex, nationality, location, BMI, LDL-C, HDL-C, TC, TG, medication, and blood pressure (BP). The data were validated by selecting 10% of the data randomly and comparing it with medical health records.

All incomplete or missing data were excluded from the analysis, and the remaining data were exported into a DATAtab

(Graz, Austria).. Descriptive analysis was carried out by computing frequencies and percentages for categorical variables and the mean and standard deviation for continuous variables. An independent t-test was used as appropriate to assess differences between groups. Pearson's correlation tests were performed to examine various correlations with the continuous outcome variable.

Ethical Considerations

Ethical clearance was obtained from the JHAH Institutional Review Board as specified by the World Medical Association and Declaration of Helsinki.

Results

The study included 2368 participants. The participants were 57.05% male and 78.42%. Furthermore, 68.62% of the study population were treated in Dharan, and 92.69% were not in a dyslipidaemia medications Table 1. The mean age was 41.48±12.1 years, and the mean BMI was 28.44±5.53. The lipid profile and blood pressure are shown in Table 2.

Table 1. Data distribution according to gender, nationality, treatment location and medication

Variable	Subgroup	Frequency	Percentage
Gender	*Male*	*1351*	*57.05%*
	Female	*1017*	*42.95%*
Country of Nationality	*Saudi*	*1857*	*78.42%*
	non-Saudi	*511*	*21.58%*
Treatment Location	*Dharan*	*1625*	*68.62%*
	RT	*246*	*10.39%*
	Abgig	*218*	*9.21%*
	Alhasa	*184*	*7.77%*
	UD	*95*	*4.01%*
Is on Dyslipidemia Medications	*No*	*2195*	*92.69%*
	Yes	*173*	*7.31%*

Table 2 data distribution according to age, BMI, Hba1c and lipid profile.

Variable	N	Mean	Std. Deviation
AGE	*2368*	*41.48*	*12.11*
Body Mass Index	*2368*	*28.44*	*5.53*
HbA1c	*2368*	*5.37*	*0.61*
LDL	*2368*	*127.46*	*27.86*
HDL	*2368*	*52.5*	*14.5*
Total Cholesterol	*2368*	*201.87*	*33.01*
Triglycerides	*2368*	*109.33*	*56.87*
BP(Systolic)	*2368*	*121.54*	*13*
BP(Diastolic)	*2368*	*76.89*	*8.09*

The participant's country of origin and sex had no statistically significant relationship with HbA1c. There was a statistically significant relationship between the use of dyslipidaemia medication and HbA1c (P<0.001) (Table 3). HbA1c and BMI had a very weak positive relationship that was statistically significant (r=0.18, P<0.001). HbA1c and systolic blood pressure showed a statistically significant positive connection (r=0.16, P< 0.001) Table 4.

Table 3. relationship between HbA1c and country of origin, gender and dyslipidemia medication.

	variables	Sub-variable	M± SD	P- Value
HbA1c	Country of origin	Saudi (1857)	5.37± 0.63	>0.667
		non-Saudi(511)	5.37± 0.63	
	Gender	Male (1351)	5.39**± 0.53**	> 0.53
		Female (1017)	5.34**± 0.7**	
	Dyslipidemia Medication	Yes (173)	5.77**± 0.87**	<0.001
		No(2195)	5.34 **± 0.57**	

There was no correlation between HbA1c and LDL-C, TC, diastolic blood pressure, and LDL-C. There was an inverse correlation between HbA1c and HDL-C (r = -0.11, P< 0.001). There was a slight positive relationship between age and HbA1c, which was statistically significant (r= 0.26, P<0.001). Also, there was a weak but statistically significant positive relationship between HbA1c and TG (r=0.2, P<0.001) (Table 4).

Table 4. Correlation between HbA1c and age, BMI, LDL, HDL, TC, TG

Variables	Correlation Coefficient	P- value
HbA1c and Age	0.26	<0.001
HbA1c and BMI	0.18	<0.001
HbA1c and LDL	0.03	>0.091
HbA1c and HDL	-0.11	<0.001
HbA1c and Total Cholesterol	0.05	<0.02
HbA1c and Triglycerides	0.2	<0.001
HbA1c and BP(S)	0.16	<0.001
HbA1c and Last BP(D)	0.09	<0.001

Discussion

There was a significant correlation between HbA1c and age, which is consistent with a previous study conducted by Alzahrani et al. [13]. Our results showed a significant positive relationship between HbA1c and TG, which is also in agreement with previous studies [13][14][15]. Hussain et al. provided support for our finding of an inverse connection between HbA1C and HDL-C [16].

However, our findings showed no correlation between HbA1c, LDL-C, and TC, which is in disagreement with previous studies that showed a significant correlation with HbA1c [11][17][18]. This difference could be due to the fact that the previous studies included patients with DM, whereas in this study, such patients were excluded. However, one other study stated that HbA1c had no significant correlation with the LDL-C and TC, which agrees with our results [13]. HbA1c has been linked to elevated TG levels, suggesting that it may predict CVD and is a risk factor in type 2 DM [13].

There was no significant relationship between HbA1c and sex. However, previous studies showed that females had significantly higher HbA1c compared to males [13][19][20]. There was a very slight positive relationship between the HbA1c and the BMI, which may indicate that high levels of HbA1c are related to a high BMI, leading to a higher risk of developing DM, CVD, and hypertension. This finding is supported by another study that also found that elevated levels of HbA1c and BMI are correlated and pose a risk of developing chronic diseases [21]. A Japanese study found a linear increase in HbA1c levels with increasing BMI [22]. In general, research has indicated that being overweight or obese increases the chances of being unable to achieve glycaemic control [23].

A prior study discovered that dyslipidaemia can cause obesity and that people with dyslipidaemia are more likely to have hypertension [24][25]. Additionally, previous Saudi studies on adolescents found a significant frequency of unhealthy diets and sedentary lifestyles, which are likely to have an adverse effect on their health and wellbeing [26]. There was a very weak positive correlation between systolic and HbA1c. This means that higher levels of HbA1c could indicate higher levels of systolic blood pressure, which in turn increases the risk of hypertension.

Another study had similar results where high levels of systolic and diastolic blood pressure were associated with high levels of HbA1c [27]. Our study showed that individuals who are taking lipid-lowering therapy had lower HbA1c, which agrees with a previous study [28]. Our results also suggested that controlling the level of HbA1c will lower TG levels and increase HDL.

The key to preventing dyslipidaemia is to promote moderate exercise and a healthy diet[29]. A health education and promotion campaign would be very suitable for people with slightly HbA1c levels that are higher than normal. In addition, secondary prevention programs could be applied, such as screening for people aged 20 years and above, as well as high risk groups [30].

One of the limitations of this study was that it was a retrospective study. Furthermore, the results cannot be generalized for the population of Saudi Arabia. There was also no information on dietary choices, lifestyle behaviours, smoking, or duration of regular physical exercise. However, the sample size was relatively large, and we eliminated selection and recall bias by retrieving information from medical records.

Conclusion

Dyslipidemia is a risk factor for many diseases, including CVD and diabetes. This study found a correlation between BMI, systolic blood pressure, age, and TG. The results also showed that as HDL-C increases, HbA1c decreases. In addition, patients who were taking dyslipidaemia medication had significantly lower levels of HbA1c than those who were not taking it. Therefore, health promotion campaigns and secondary prevention programs to lower HbA1c levels are essential to reduce the risk of multiple morbidities associated with high levels of HbA1c.

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