Comparison of vitamin-D status with body mass index and their relation with lipid parameters

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Abstract:

Vitamin D deficiency is a common health problem especially among women and those of younger ages. Vitamin D is thought to increase the risk of various severe non-skeletal chronic diseases, including autoimmune disorders, cardiovascular disease, and several malignancies.BMI has been linked to lower vitamin D concentrations and have shown a connection between higher BMI. Therefore, present study aimed to evaluate the role of vitamin D status among the participant with different BMI.Study included 150 participants with different BMI status and vitamin D, blood pressure, biochemical parameters and was evaluated. It was observed that males had low HDL ($p=0.01$), high TG ($p<0.0001$) and higher VLDL ($p=0.02$) comparatively. It was observed that the BMI 25-30kg/m^2, >30 kg/m^2 had higher systolic (152.11mmHg, 151.41mmHg) and diastolic blood pressure (101.0mmHg, 196.09mmHg) compared to BMI <25kg/m^2 respectively. The level of HDL among the participants with BMI 25-30kg/m^2, >30 kg/m^2 had 41.20mg/dl and 35.81mg/dl while <25 kg/m^2 BMI had 44.89mg/dl. It was also observed that the BMI 25-30kg/m^2, >30 kg/m^2 showed higher TG (277.24mg/dl, 301.85mg/dl) compared to <25 kg/m^2 BMI (231.31mg/dl). Participants having BMI, >30 kg/m^2 had 18.59mg/dl vitamin-D level while BMI <25 kg/m^2, and 25-30 kg/m^2 had 32.24mg/dl and 30.13mg/dl vitamin-D level and differences among them was found to be statistically significant ($p<0.0001$). It suggested a negative correlation between vitamin D status and BMI of the participants ($r=-0.41$, $p<0.0001$). Our study concluded that BMI or obesity is linked with altered systolic and diastolic blood pressure, HDL and TG as well as altered vitamin D level among the general population which may lead to other metabolic disorders in future.

Keywords: Body mass index, Vitamin-D, Lipid profile.

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INTRODUCTION:

A widespread health issue, vitamin D insufficiency is mostly brought on by insufficient exposure to sunlight. A crucial nutrient, vitamin D has a significant impact on many bodily processes [1]. Most vitamins don't work like hormones, but vitamin D does, and every cell in the body has a receptor for it and which is also found in some foods including fatty fish and fortified dairy products [2]. Around the world, about 1 billion people experience vitamin D deficiency or insufficiency, and the elderly are particularly susceptible to this condition [3], Middle Eastern women and girls [4]. Darker skin tone, staying indoors,

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the sunlight is the primary source of vitamin D, being overweight or obese, being elderly, consuming little fish or milk and milk products, and having kidney or liver illness are all risk factors that are frequently linked to vitamin D insufficiency [2]. However, Saudi males are not exposed to enough sunshine because of their traditional dress, which almost completely encloses their entire body, as well as the majority of their daytime activities, which are indoors. Consequently, vitamin D deficiency is a common health problem among Saudi adults, especially among women and those of younger ages [5]. Lack of vitamin D is thought to increase the risk of various severe non-skeletal chronic diseases, including autoimmune disorders, cardiovascular disease, and several malignancies [6]. In addition to a high correlation between low vitamin D levels and obesity and visceral fat, studies on adolescents have indicated an inverse link between vitamin D levels, hypertension, and fasting hyperglycemia [7]. Additionally, higher BMI has been linked to lower vitamin D concentrations [8] and studies have shown a connection between higher BMI and lower vitamin D levels [9]. Vitamin D appears to be stored in enlarged adipocytes, which sequesters this fat-soluble vitamin [10]. On the other hand, some scientists think that a vitamin D shortage may exacerbate obesity. The active form of vitamin D (1,25 dihydroxyvitamin D) can cause lipolysis, control adipocyte death, and decrease fat mass because adipocytes have receptors for the vitamin [10]. Therefore, present study aimed to evaluate the vitamin-D status among obese and non-obese individual and their association with biochemical parameters.

Materials and method:

Study design and subjects: Present case-control study included total 150 participants from Saudi Arabia. Blood samples were collected in serum vials and centrifuged to separate the serum for biochemical investigations. Research study was performed after the ethical approval by the research ethics committee, Ministry of Health, Saudi Arabia, Approval No/reg. no: 607–43-1478. Written informed consent was obtained from all the participants.

Biochemical and vitamin-D Level Assessment: Stored serum of participants at −80°C were thawed and further biochemical parameters such as HDL, LDL, TG, cholesterol, VLDL and vitamin-D levels were assessed by the electrochemiluminescence immunoassay (Cobas e411, Roche, Basel, Switzerland). Serum 25 (OH) D levels ≤20ng/mL was considered as Vitamin-D deficiency, <30 ng/mL considered as insufficiency and 30ng/mL or above considered as sufficiency.Vitamin B12 deficiency was defined as <148 pmol/L in serum and above was considered as normal range.

Statistical Analysis:

Data analysis was performed using Graph Pad Prism software version 6.05 and SPSS 21.0. The Mann–Whitney U-test (2 groups), Kruskal–Wallis post hoc Dunn test (>2 groups) was used to analyze the significant differences among the groups. $p< 0.05$ was considered significant.

Demographics: Present study included 73% male participants and 27%female participants, 43% were≤45 years and 57% were with >45 years of age. Smoking status were recorded and observed that 71% were smokers and 29% were nonsmokers. Among them 29% were vitamin-D deficient, 42% were insufficient and 29% were sufficient (table 1).

Variables	Number (%)
Gender	
Males	109 (73)
Females	41 (27)
Age	
≤45 years	64 (43)
>45 years	86 (57)
Smoking status	
Smokers	107 (71)
Nonsmokers	43 (29)
Vitamin D status	
Deficient	43 (29)
Insufficient	64 (42)
Sufficient	43 (2)

Table 1: Demographic and clinical characteristic of participants.

Association of gender with biochemical parameters: We compared the biochemical parameters with respect to gender (table 2) and significant difference was observed in HDL, TG, VLDL between males and females. It was observed that the females had 42.05mg/dl HDL while males had 36.14 mg/dl HDL (p=0.01). Among the females, TG was 230.96 mg/dl while males had 287.58 mg/dl TG (<0.0001) and VLDL among the females was 32.65 mg/dl while males had 34.81 mg/dl VLDL (0.02).

Gender		Systolic	Diastolic	HDL	LDL	TG	Cholesterol	VLDL
Female	Mean	143.07	97.29	42.05	199.70	230.96	250.74	32.65
	SD	15.77	12.95	13.43	20.45	99.42	13.86	5.22
Male	Mean	146.03	99.13	36.14	201.32	287.58	249.58	34.81
	SD	14.32	14.11	14.11	22.55	68.39	17.18	3.49
P value		0.34	0.62	0.01	0.70	<0.0001	0.88	0.02

Table 2: Comparison of blood pressure and biochemical parameters between males and females participants.

Association of age and smoking status with biochemical parameters: No as such significant association was observed between age groups and smoking status with biochemical parameters (table 3).

Age (in years)		Systolic	Diastolic	HDL	LDL	TG	Cholesterol	VLDL
≤45	Mean	145.26	96.48	39.23	201.51	261.49	250.23	33.60
	SD	148.05	13.89	12.40	26.00	70.17	19.60	4.48
>45	Mean	145.21	100.26	41.38	200.40	280.44	249.64	32.96
	SD	142.77	13.57	14.81	18.47	88.78	13.46	5.21
P value		0.98	0.14	0.47	0.70	0.24	0.42	0.81
Smoking status		**Systolic**	**Diastolic**	**HDL**	**LDL**	**TG**	**Cholesterol**	**VLDL**
Nonsmokers	Mean	141.00	98.34	41.00	200.45	267.38	252.44	33.55
	SD	14.51	12.73	13.95	26.34	95.70	20.03	4.33
Smokers	Mean	146.96	98.76	40.23	201.06	274.30	248.85	33.11
	SD	14.53	14.25	13.83	20.04	75.55	14.53	5.13
P value		0.06	0.93	0.94	0.85	0.26	0.36	0.47

Table 3: Comparison of blood pressure and biochemical parameters with respect to age groups and smoking status.

Comparison of blood pressure and biochemical parameters among different BMI category participants: Based on BMI, 3 categories were made (<25, 25 -30 and >30kg/m²) and blood pressure and biochemical parameters were analyzed (table 3, figure 1). We observed significant differences in systolic blood pressure (p<0.0001), diastolic blood pressure (p<0.0001), HDL level (p=0.01), and TG level (p=0.003). It was observed that the BMI 25-30kg/m², >30 kg/m² had higher systolic (152.11mmHg, 151.41mmHg) and diastolic blood pressure (101.0mmHg, 196.09mmHg) compared to BMI <25kg/m² respectively. The level of HDL among the participants with BMI 25-30kg/m², >30 kg/m² had 41.20mg/dl and 35.81mg/dl while <25 kg/m² BMI had 44.89mg/dl. It was also observed that the BMI 25-30kg/m², >30 kg/m² showed higher TG (277.24mg/dl, 301.85mg/dl) compared to <25 kg/m² BMI (231.31mg/dl).

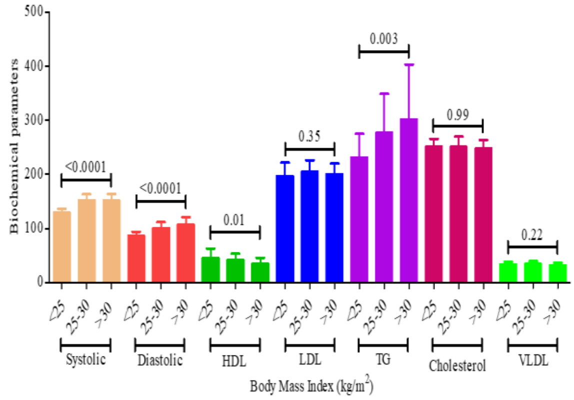

Figure 1: Illustration of blood pressure and biochemical parameters comparison among different <25, 25-30 and >30 kg/m² BMI.

Body Mass Index (kg/m²)		Systolic	Diastolic	HDL	LDL	TG	Cholesterol	VLDL
<25	Mean	129.21	86.89	44.89	197.17	231.31	251.06	33.68
	SD	7.56	6.73	17.80	24.79	43.85	14.61	4.89
25-30	Mean	152.11	101.00	41.81	204.32	277.24	250.91	34.18
	SD	10.81	10.57	11.60	21.72	71.20	18.47	5.04
>30	Mean	151.41	106.09	35.20	200.29	301.85	247.79	31.82
	SD	12.45	14.96	10.39	19.47	101.69	15.36	4.54

Table 4: Comparison of biochemical parameters between different BMI status (<25, 25-30 and >30kg/m²) of participants.

Comparison of vitamin-D status with BMI status: The level of vitamin-D was analyzed with respect to BMI of participants (figure 2). It was observed that the participants having BMI, >30 kg/m² had 18.59mg/dl vitamin-D level while BMI <25 kg/m², and 25-30 kg/m² had 32.24mg/dl and 30.13mg/dl vitamin-D level and differences among them was found to be statistically significant (p<0.0001).

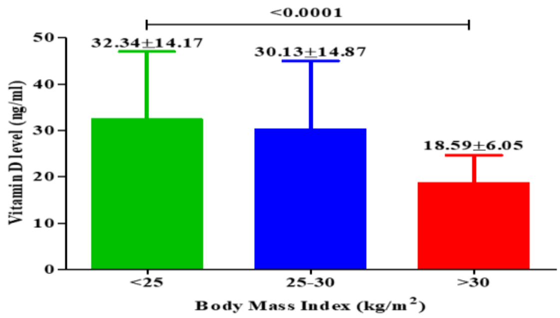

Figure 2: Level of vitamin D among the participants with respect to BMI.

Correlation of BMI with vitamin-D status: Quantitative data of BMI were correlated with vitamin D level and observed a negative association (figure 3). It is suggested that the increase in BMI may lead the decrease in vitamin D level (r=-0.41, p<0.0001) vice versa.

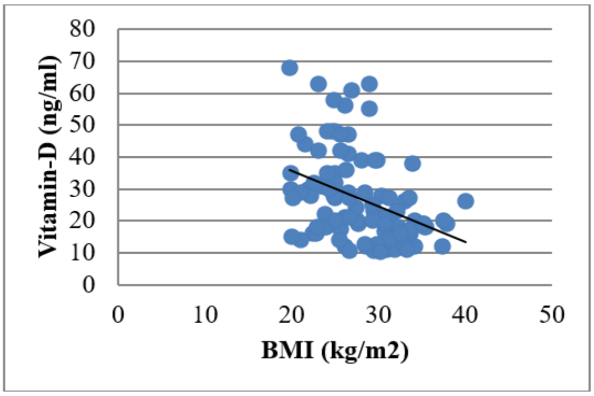

Figure 3: Correlation of different BMI with vitamin D level among the participants.

Discussion: Vitamin D, originally known for its effects on bone metabolism [11], has been recently associated with several chronic diseases [12], including obesity, metabolic syndrome, hypertension, and type 2 diabetes mellitus [13]. The World Health Organization (WHO) considers obesity the greatest current threat to public health [14].Changes in lifestyle such as alterations in eating habits and the adoption of a sedentary lifestyle, have contributed substantially to the epidemic growing of chronic diseases such as obesity, diabetes mellitus and hypertension, conditions that frequently occurs with lipid abnormalities, hypercoagulability and increased risk of cardiovascular disease (CVD) [15]. In the present study we observedlow HDL, higher TG and higher VLDL among the males compared to females. In the same way a study by Leao SC in 2016 observed low HDL, higher TG and higher VLDL among males compared to females [16]. Studies also show that HDL has a protective role in the development of atherogenesis [17]; and the increase of its levels would be directly associated with reduced cardiovascular risk [18].

It has been said that BMI seems to be a better predictor for hypertension and suggested that the participants with higher BMI seemed to be more likely to be hypertensive in all age-groups [19]. In the same way we observed higher systolic and diastolic blood pressure with BMI 25-30 and >30(kg/m^2). A study by Sagaro GGin 2021 revealed that the rise in BMI parallel increases the mean blood pressure levels [20].In adult population higher BMI is associated with hypertension [21] and higher BP [22].Elevated triglycerides and reduced HDL-C levels in the general population has been observed to be associated with overweight and obesity [23]. Increase risk of metabolic disorder, cardiovascular disease is associated with visceral obesity and waist circumference could also help to identify the metabolic risks and indicator of body fat distribution [24]. He Y et al 2007 revealed that BMI could be the better predictive index of prevalent diabetes, hypertension, and cardiac related disorder [25]. Hou X et al 2013 suggested that higher risk of having hypertension or having hypertension plus dyslipidemia linked with BMI [26] and closely related to blood pressure [26]. In 2016, Zhu Y reported that BMI played a stronger role in predicting the prevalence of dyslipidemia in childhood obesity [27]. We observed higher systolic, diastolic blood pressure, lower HDL, higher TG among the participant with BMI 25-30kg/m^2, >30 kg/m^2 respectively. It was also observed that the BMI with 25-30 and >30 kg/m^2 had reduced vitamin-D level among the participants.

It has been claimed that inflammation and vitamin D deficiency frequently co-occur [28]. Immunomodulatory effects of vitamin D are mediated through the vitamin D receptor [29], making it a potential mediator in the relationship between inflammation and obesity [30].It has been hypothesized that the level of serum 25(OH)D in people who are overweight and obese may modify their inflammatory profile [31].Wortsman J et al revealed that obese subjects had significantly lower basal 25-hydroxyvitamin D concentrations [32]. Ruiz-Ojeda FJ et al suggested that low serum 25(OH)-D is positively associated with obesity or BMI in adults and children [33]. High BMI coupled with vitamin D deficit or sufficiency has also been linked to paraspinal muscle atrophy and pain intensity in postmenopausal women [34].Women who are obese and have low 25(OH)D levels in the early stages of pregnancy are especially susceptible to continuing to have low 25(OH)D levels throughout pregnancy and giving birth to children with inadequate 25(OH)D levels [35].

Conclusion: Study concluded that BMI or obesity could be associated with altered systolic and diastolic blood pressure, HDL and TG. Obesity could be associated with reduced vitamin D level among the general population and lead to other metabolic disoders.

Disclosure

The authors declare no conflicts of interest in this work.

Data Sharing Statement

The corresponding author can provide the datasets that were used and/or analyzed during this study upon request.

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