Correlation of Vitamin D with Obesity Parameters in Patients of Cardiometabolic Syndrome

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ABSTRACT

Objective:
To find out the correlation between Vitamin D and obesity parameters in patients of cardiometabolic syndrome (CMS).

Methodology:
This case control study was carried out in Endocrinology Unit, Hayatabad Medical Complex from January to April 2012 on fifty (cases and controls each) adult patients of CMS using purposive sampling. Controls were gender and age matched relatives of patients. Lipid profile, fasting blood sugar, blood pressure, waist circumference, height and weight (to calculate Body Mass Index) were recorded. Serum levels of 25(OH) D were analysed by ELISA.

Results:
Mean values of cases for Body Mass Index (BMI), Waist Circumference (WC) and Waist Hip Ratio (WHR) were 30.30±4.60 kg/m^2, 103.48±4.27cm, 1 ± 2.28 whereas in controls, the mean values came out to be 22.77±1.85 kg/m^2, 81.56±7.77cm, 0.82±1.94 respectively. In cases and controls, Vitamin D_3 levels were 15.03±18.11 and 24.11±17.05 ng/ml respectively. A negative correlation of vitamin D with increased WC and WHR was found (p= <0.05). Statistically significant negative correlation was observed between Vitamin D level and WC and WHR which was r = -0.205 and r= -0.213respectively (p< 0.05).

Conclusion:
Our results suggest that high WC and WHR are likely to be inversely correlated with hypovitaminosis D.

Keywords:
Waist Circumference, 25(OH)D, Waist Hip Ratio, Cardiometabolic Syndrome, BMI

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INTRODUCTION

Vitamin D, the sunshine vitamin is not only important for strengthening bones[1] and homeostasis of calcium[2] but its deficiency has been found to be related with many disorders such as cardiovascular disease,[3] hypertension,[4] obesity,[5] diabetes mellitus type 2[6] and depression[7] etc.
There is a wide spread deficiency of Vitamin D globally.[8] According to Holick in 2007, the number of people suffering from Vitamin D insufficiency or deficiency rose to one billion.[8] Vitamin D_3 deficiency is prevalent in Pakistan.[9,10] A previous study reported 53.5% frequency of Vitamin D_3 deficiency in the Pakistani population.[11] Human adipocytes express receptor for vitamin D.[12] It not only plays a role in regulation of vitamin D but also gets regulated by vitamin D.13[14] Studies suggest that deficiency of vitamin D can result in increased parathyroid hormone level, enhanced influx of calcium into adipose cells promoting lipogenesis in adipose tissue.[15] However, in obesity, varying levels of 1,25$(OH)_2$D have been observed.[16,17] All round the world, cardiometabolic markers as hypertension, hyperglycaemia, and dyslipidaemia are getting more prevalent, resulting in a rise in mortality.[18,19] Pitta *set al.* also observed that hypovitaminosis D was associated with CMS.[20]

Issues of overweight and obesity are also growing.[21] According to a census by World Health Organization (WHO), the number of overweight adults is 1.9 billion.[22] It has been observed that this increase is independent of ethnicity.[23] Therefore, efforts are being put in to find out the risk factors for increase in weight and develop associated

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disturbances of metabolic health.[23] The common markers of obesity include waist circumference (WC) and body mass index (BMI).[24] According to a study, Pakistan is ranked 9th in the list of obesity in the world.–[25] In the current study we observed the correlation of vitamin D with waist circumference, waist hip ratio and BMI in patients of CMS.

METHODOLOGY

A case control study on hundred (fifty cases and fifty controls) adult patients of CMS was carried out at Endocrinology Unit, Hayatabad Medical Complex (HMC) from January 2012 to April 2012. CMS subjects were selected on the basis of (International Diabetes Federation) IDF criteria. The cut off values for the markers of CMS in this study are according to International Diabetes Federation (IDF), National Cholesterol Education Program Adult Treatment Panel III and the World Health Organization for CMS. These are as follows:[2627]

1.Waist circumference for Asian men is ≥ 90 cm and women is ≥ 80 cm according to IDF consensus.[27]

2. Elevated Triglycerides (TG) ≥ 150 mg/dl or being treated for dyslipidemia.

3. High density lipoproteins-cholesterol (HDL-C) < 40 mg/dl in males, < 50 mg/dl in females or taking anti-dyslipidemics.

4. Fasting glucose ≥ 100 mg/dl or taking drug treatment for elevated glucose.

5. Blood pressure Systolic: ≥ 130 mmHg or Diastolic: ≥ 85 mmHg or taking antihypertensive medicines for established hypertension.[27]

Cases (n=50) were selected by purposive sampling by considering two criteria for CMS, in addition to ethnic specific waist circumference. Age and gender matched controls (n=50), were selected among the attendants who were relatives of the CMS patients.

Subjects were kept in the fasting condition and 5 ml of blood was withdrawn. It was allowed to clot. Serum was obtained by centrifuging the sample for fifteen minutes at the speed of 2500 revolutions per minute within 30-45 minutes of drawing blood. These serum aliquots were labeled and stored at -18 to -20°C in pathology laboratory of HMC. Fresh blood samples were used for estimation of fasting blood sugar. The kit used was Glucose Liquicolor GOD-PAP (Glucose oxidase-phenol and 4 aminophenazone) having a catalogue number 10121 manufactured by Human (Germany). It was run on Roche/Hitachi 902 Automatic Analyzer with estimation done through enzymatic colorimetric test. For measuring lipid profile that included (HDL-C), serum TG and total serum cholesterol, enzymatic colorimetric method was used and analysis was performed on Roche/ Hitachi 902 Automatic Analyzer.[28] ELISA technique was used for measuring vitamin D [25(OH)D] concentration in serum run on fully automated ELISA processor (Germany), Euroimmun Analyzer 1 in HMC Pathology laboratory. Euroimmun 25-hydroxy vitamin D ELISA (Germany) kit was used and manufacturer's instructions were followed.[29] More than 30 ng/ml was considered normal Vitamin D level and < 20ng/ml as deficiency.[1] This study is part of the thesis of the primary author and the methodology for most part of this article has been published.[30]

To obtain body weight of subjects in kg, a digital weighing scale was used.[31] Height was calculated by stadiometer while the subject stood straight against a wall. [31] BMI was expressed in kg/m^2.[31] The cutoff values for normal, overweight and obese were 18.5 to 24.9, 25 to 29.9, ≥30 respectively.[32] Waist circumference in cm was assessed by an unstretchable measuring tape placed at the level of umbilicus with subjects wearing light clothes equidistant from lower border of ribs and the iliac crest at the instant of ending of normal expiration.[31] For finding WHR, the measurement of hip circumference was done at the widest area of gluteus maximus. The participant stood straight with feet approximately 12-15 cm apart with equal distribution of weight on each leg while breathing normally. Measurement was taken at the end of gentle expiration by an unstretchable measuring tape while holding it horizontally and firmly. Dividing waist circumference by hip circumference gave Waist Hip Ratio. In males, ≤ 0.90 and in females a value of <0.85 was interpreted as normal.[33]

a) Inclusion criteria:

Adult males and females from Khyber Pakhtunkhwa (KPK) admitted in HMC Endocrinology Unit, with cardiometabolic syndrome for uncontrolled hypertension or unhealed wounds, were selected according to IDF criteria as cited above.[34]

b) Exclusion criteria:

Participants were excluded from the study if they were suffering from heart failure, rheumatoid arthritis, renal failure, thyroid or parathyroid disorders, adrenal insufficiency, malignancies, skeletal and metabolic disorders. Subjects who were taking medications such as Vitamin D, calcium, steroids etc. were also excluded unless they had undergone a washout period of two weeks prior to the study.

Ethical approval was granted by institutional Review Board (IRB) of Peshawar Medical College dated 20-10-2011. A written well informed consent was given by the study participants. SPSS version 17 was used for data analysis. Anthropometric measurements of the study participants are given as mean ± SD in this study. Pearson's correlation between vitamin D level and BMI, WC and WHR was calculated.

RESULTS

A total number of 100 age and gender matched subjects' participated in this case control study. Among the total, 48 were males and 52 were females. Anthropometric variables of cases and controls are presented as mean ± SD in table I. Serum 25(OH)D levels were found to be low in cases 15.03±18.11ng/ml compared to control group 24.11±17.05 ng/ml [Table I]. BMI was higher in cases 30.30±4.60kg/m^{2}compared to controls 22.77± 1.85 kg/m^2.Similarly, waist circumference (WC)and waist hip ratio (WHR) were also reported higher in cases 103.48± 4.27cm and 1± 2.28 compared to controls 81.56± 7.77cm and 0.82± 1.94 respectively [Table I].

The number of study participants having increased BMI, increased WC and increased WHR are shown in Table II. Serum 25(OH)D level decreased with obesity, waist circumference (WC) and waist hip ratio (WHR). A statistically significant negative correlation was identified between vitamin D and waist circumference (r=-.205; p= 0.04) and vitamin D and waist hip ratio (r=-.213; p= 0.03). However, a negative correlation for BMI was not statistically significant (r= -.140; p= 0.16).

Characteristics	Cases (n=50) Mean (±SD)	Controls (n=50) Mean (±SD)
Age(years)	51.30±5.25	50.40± 4.84
Weight (kg)	75.40± 10.74	59.72±5.99
Height(cm)	158.2±6.71	161.42± 7.17
WC (cm)	103.48±4.27	81.56±7.77
BMI (kg/m^2)	30.30±4.60	22.77±1.85
WHR	1 ± 2.28	0.82±1.94
Vitamin D_3(ng/ml)	15.03±18.11	24.11±17.05

SD = standard deviation

Table I: Characteristics of study population

Vitamin D status	Waist circumference		Number of participants
	Increased WC	Normal WC	
Low	23(23%)	10(10%)	33(33%)
Normal	31(31%)	36(36%)	67(67%)
Total	54	46	100
Vitamin D status	**WHR**		
	Increased WHR	**Normal WHR**	
Low	21(21%)	12(12%)	33(33%)
Normal	20(20%)	47(47%)	67(67%)
Total	41	59	100
Vitamin D status	**BMI**		
	High BMI	**Normal BMI**	
Low	21(21%)	27(27%)	48(48%)
Normal	32(32%)	20(20%)	52(52%)
Total	53	47	100

Table II: Cross tabulation of Vitamin D3 and waist circumference, WHR, BMI

Values in table are n(%), Vitamin D level interpretation Normal range: >30ng/ml, Low: <20 ng/ml [35]. WC interpretation[27] Normal: less than 90cm in males and less than 80cm in females High: more than or equal to 90cm in males and more than or equal to 80cm in females

WHR interpretation[33] Males:≤ 0.90, Females:<0.85. BMI interpretation[32], Normal: 18.5 to 24.9, High: Overweight: 25 to 29.9, Obese: more than or equal to 30

DISCUSSION

Main relationship between obesity and hypovitaminosis D is due to insulin resistance leading to impaired glucose homeostasis and influence on adipogenesis.[36] One of the cause of increased adiposity is hypertrophy of adipocytes.[36] Vitamin D reduces adipogenesis through a mechanism that involves competition between Vitamin D receptor (VDR) and peroxisome proliferator-activated receptor gamma (PPAR).[37] Obesity also leads to decreased physical inactivity, which in turn may lead to hypovitaminosis D, worsening the condition.[38]

Our study showed a probable negative correlation between 25(OH)D levels and Body Mass Index, WC and WHR. However, vitamin D was significantly correlated with WC and WHR only. An insignificant correlation was noted between 25(OH) D levels and Body Mass Index. Snijder *et al.* have highlighted that BMI and WC had an inverse

association with 25(OH)D in older women aged 55-85 years which is same as observed in our study.[39] This can be attributed to the fact that vitamin D is either produced in skin or is available following oral ingestion; gets sequestered in adipocytes before reaching the liver to get converted into 25(OH)D.[40] Similarly, Arunabh *et al*. observed a strong significant inverse correlation of 25(OH) D with Body mass Index and weight.[41] In our study, BMI was also inversely related with Vitamin D, however, the relation was insignificant. Asoom *et al*. also had similar findings of inverse association of Vitamin D with Waist circumference and Waist hip ratio.[31] However, their study also showed a weak association with BMI, which is same as in our study.[31]In a large study done in Norway by Lagunova *et al*. a negative correlation between BMI and 25(OH)D level was found in relation to gender.[42] This may be due to the large sample size. In our study population, BMI had a non-significant association with Vitamin D level and may be due to small sample size as compared to their study.[42]

Kolokotroni *et al*. carried out a cross sectional study in Cypriot adolescents in which a Curvilinear relationship was viewed between Vitamin D and Body Mass Index.[43] However, ours was a matched case control study that showed an inverse correlation between BMI and 25(OH) D. A non significant correlation was found between BMI and Vitamin D level in a large European study (HELENA),carried out on adolescents in both genders.[44] Similarly, Kavarić*et al*. showed an inverse relation of vitamin D with Body Mass Index (r = -0.127, p = 0.048) and waist circumference (r = -0.165, p = 0.010)[45], compared to ours which depicted an inverse correlation of vitamin D with waist circumference and waist hip ratio.

Our study participants were in their fifties with lesser physical activity due to age related osteoarthritis or obesity. Spending more time indoors and darker skin complexion also adds to vitamin D deficiency.[38] However, comparison of vitamin D level with skin complexion in the subjects was not carried out.

In a study by Theuri *et al*. a negative correlation was found out between WC and vitamin D in males in study population of eastern Africans. (r = -0.347, p = 0.013) This was in accordance to our result which can be attributed to reduced bioavailability of vitamin D from fat stores of the body.[40] Their female study participants did not reveal any significant correlation between central adiposity and vitamin D level. We did not take gender differences into account in our study.46 However, Chen et al. did not find any evidence of reduced level of vitamin D in CMS patients which is in contrast to our study.[47] On the other hand, Mahmood et al had similar observation as in our study that their study participants with CMS had reduced 25(OH)D serum level.[48] The discussion concludes a probable correlation of hypovitaminosis D with central obesity in patients of CMS. This may be of some help in planning preventive measures for accumulation of central adiposity in our population thereby improving the health condition.

LIMITATIONS

Comparison of both genders and in various age groups was not done. Physical activity, sun exposure index, diet, complexion, was not evaluated. Sample size was small.

CONCLUSION

Serum Vitamin D levels show a probable inverse correlation with BMI, Waist hip ratio and Waist circumference.

GRANT SUPPORT & FINANCIAL DISCLOSURES

None

CONFLICT OF INTEREST

None

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