

## Research Article

# Association of obesity with vitamin D deficiency and the clinical implications

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### ABSTRACT

**Background:** Obesity is a complex disorder which leads to health problems like diabetes, hypertension and hypercholesterolemia. It has been reported that obesity is associated with vitamin D insufficiency due to decreased bio-availability. The aim of the present study is to investigate whether vitamin D deficiency can be a causative factor for obesity in Saudi women above 40 years.

**Methods:** 100 Saudi female patients above 40 years who came to the outpatient department of Arar central hospital were selected for the study. Patients who were on immunosuppressive drugs, with hormonal disorders and with impaired renal function were excluded from the study. The data was collected using a questionnaire which included the socio demographic details, height, weight and medical history and the serum vitamin D levels were assessed.

**Results:** 69% of the Saudi women were obese (BMI >30). 84% (n=58) of the obese women had vitamin D deficiency (<50 nmols/l) while 69.6% of the overweight women had vitamin D deficiency. 43.5% (n = 30) of obese women had diabetes, 44.9% (n=31) of obese women had hypertension. The association between obesity and vitamin D deficiency was not significant.

**Conclusions:** No significant association was found between obesity and vitamin D deficiency indicating that vitamin D deficiency has no significant role in causing obesity in Saudi women above 40 years.

**Keywords:** Vitamin D deficiency, Obesity, Saudi women

### INTRODUCTION

Obesity is considered as a global epidemic and is associated with hypertension, insulin resistance and metabolic syndromes.<sup>1-2</sup> Obesity and the related issues contribute significantly to modern healthcare costs, morbidity and mortality.<sup>3</sup> Although several studies have been done to find out the relationship between obesity and Vitamin D deficiency, there is no consensus regarding the opinion that vitamin D deficiency causes obesity. Although researchers have reported that serum vitamin D levels can be a good predictor of obesity the role of vitamin D in lowering body weight is yet to be

established.<sup>4-11</sup> In a study done in the eastern province of Saudi Arabia, the researchers found that the overall prevalence of obesity was 43.8%, and the peak prevalence was in the age group 50-59 years. Obesity was found higher among women than men and significantly higher in housewives, and among the less educated than others.<sup>12</sup> Diabetes, hypercholesterolemia, and hypertension were found to be strongly associated with obesity in a study done in Saudi Arabia.<sup>13</sup> Another study done in Saudi women to find out the factors associated with osteoporosis in the Northern part of Saudi Arabia showed that 82 out of 100 women had vitamin D deficiency.<sup>14</sup> This study is therefore aimed to find out

whether vitamin D deficiency can be the major causative factor for obesity in Saudi women above 40 years of age.

**METHODS**

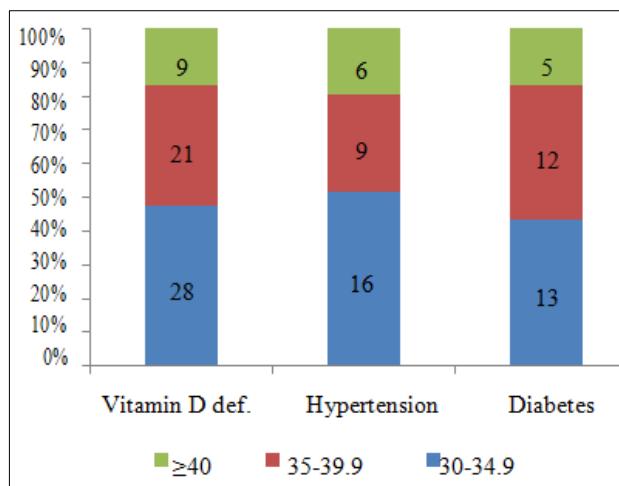
After formal approval to conduct the experiments described has been obtained from the human subjects ethical committee of the institution and after taking informed consent, 100 Saudi women above 40 years were selected from the outpatient department of Arar central hospital. The study was done over a period of four months. Women who were on immunosuppressive drugs, who had hormonal disorders and who had renal damage were excluded from the study. A comprehensive questionnaire was given which included the socio-demographic data, height, weight, medical history and drug intake. After completing the questionnaire serum vitamin D level was measured in nmols/l using Elecsys 2010 vitamin D Assay (Roche) in the Arar Central Hospital laboratory. Serum vitamin D level below 20 ngms/ml (50 nmols/l) was considered as vitamin D deficiency.<sup>15</sup> The serum vitamin D levels were repeated in another laboratory to validate the results. Vitamin D level  $\leq 12.5$  nmols/l was classified as severe vitamin D deficiency, 12.5-25 nmols/l was classified as moderate Vitamin deficiency and  $>25$  nmols/l was classified as mild vitamin D deficiency.<sup>16</sup> After measuring the height in cm and weight in kg, Body Mass Index (BMI) was calculated. The weight was measured with light clothing and no shoes.

The formula used for calculating BMI was Mass (Kilograms)/Height (Meters)<sup>2</sup>. Women having BMI in the range of 18.5-24.9 was considered as normal weight BMI in the range of 25-29.9 was considered as overweight,  $>30$  was considered obese.<sup>17</sup> Women having BMI below 18.5 were considered underweight. Obese women were divided into three groups, Class I (BMI=30-34.9), Class II (BMI=35-39.9) and class III (BMI $\geq 40.0$ ) according to WHO classification.<sup>18</sup> Logistic regression analysis was used to find out the association between vitamin D deficiency and obesity, hypertension and obesity and diabetes and obesity.

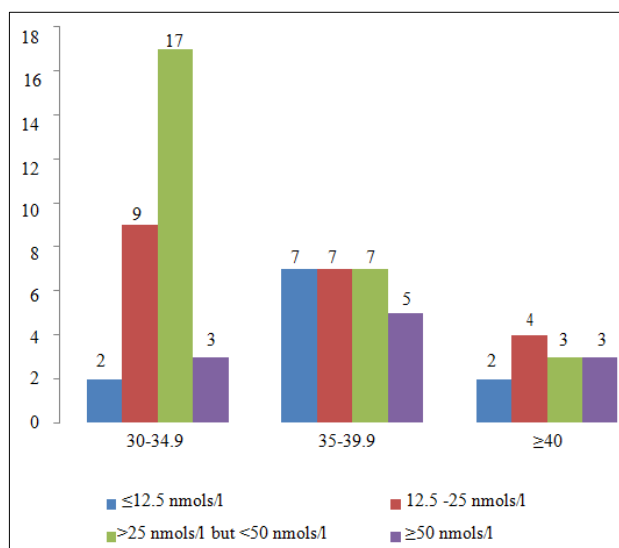
**RESULTS**

Out of the 100 Saudi women who were selected for the study, 69 Saudi women (69%) had obesity (BMI $>30$ ), 23% were overweight (BMI between 25 and 29.9) and 8% had normal body weight (BMI between 18.5 and 24.9). 84% (n=58) of the obese women had vitamin D deficiency ( $<50$  nmols/l), 43.5% (n=30) of obese women had diabetes, 44.9% (n=31) of obese women had hypertension (Figure 1).

11 of the obese women had severe vitamin D deficiency ( $\leq 12.5$  nmols /l), 20 had moderate vitamin D deficiency (12.5-25 nmols/l), 27 had mild vitamin D deficiency ( $>25$  nmols/l and  $<50$  nmols/l) while 11 had vitamin D level  $>50$  nmols/l (Figure 2).



**Figure 1: BMI range with vitamin D deficiency, hypertension and diabetes.**



**Figure 2: BMI range and vitamin D levels.**

Statistical analysis was done using SPSS software. Logistic regression analysis was done to find out the association between vitamin D and obesity, hypertension and obesity and diabetes and obesity. The results showed that there was no significant association between vitamin D deficiency and obesity, hypertension and obesity and diabetes and obesity. The p values were all more than 0.05 indicating that the variables have no significant role in explaining obesity (Table 1).

**Table 1: Association between obesity and predictors (Vitamin D deficiency, diabetes and hypertension).**

Variables	Coefficient	p value	Odds ratio	95% CI for odds ratio
Vit. D def.	0.679	0.255	1.972	(0.612,6.34)
Diabetes	1.477	0.086	4.381	(0.810,23.70)
Hypertension	0.464	0.488	1.590	(0.428,5.90)

## DISCUSSION

The prevalence of common obesity has become a public health concern in many countries as phenomenological approaches to the understanding of obesity have failed to achieve any long term effect on prevention or treatment.<sup>19</sup> Based on, for example, the wide organ distribution of the vitamin D receptor, it is becoming increasingly clear that vitamin D metabolites are not only important in (bone) Ca homeostasis, but also for adequate functioning of many other systems.<sup>20</sup> In addition to its well-known role in osteogenesis, the vitamin D receptor and its ligand impact on lipid accumulation and gene expression in adipose tissue. The vitamin D receptor is expressed in both white and brown adipocytes, and vitamin D and its metabolites are stored in adipose tissue.<sup>21</sup> Other recent studies demonstrated that the 1,25(OH)2D3 regulated, secreted bone protein osteocalcin mediates effects on adipose tissue,  $\beta$ -cells, and energy metabolism.<sup>22</sup>

Researchers have reported that vitamin D3 supplementation during weight loss did not increase weight loss or associated factors compared with placebo; however, women who became replete experienced greater improvements.<sup>23</sup> It has been suggested that controlled studies should assess the impact of optimal vitamin D supplementation, with or without added calcium in ethnic groups that are at high risk for insulin resistance and obesity.<sup>24</sup>

Vitamin D insufficiency has been shown to be associated with increased risk of developing type 2 diabetes mellitus and cardiovascular disease (CVD), as well as with cardiovascular risk factors such as hypertension and obesity.<sup>25</sup> Contrary to existing evidence, the reports of some researchers did not show significant associations among individual metabolic risk factors such as fasting blood glucose, triglycerides, HDL cholesterol and blood pressure with vitamin D status.<sup>26</sup>

There is evidence of aberrations in vitamin D-endocrine system in obese subjects.<sup>27</sup> Recent researches have shown that vitamin D may have a role in obesity. The best form of vitamin D for use in the obese individuals is calcitriol because it is the active form of the vitamin D3 metabolite, its receptors are present in adipocytes, and modulates inflammatory cytokine expression.<sup>28</sup> To date, there is not enough scientific evidence to support the use of vitamin D as a pathway to prevent and/or treat obesity.<sup>29</sup>

The results of the present study show that 84% of the obese Saudi women had vitamin D deficiency. These Saudi women were not taking oral vitamin D supplementation due to the lack of awareness. The results have showed the p values more than 0.05 indicating that the variables like vitamin D deficiency, diabetes and hypertension have no significant role in explaining obesity.

There are plausible mechanisms and some in vitro evidence supporting a role for vitamin D in weight reduction, with the proviso that it may be difficult to determine which effects are due to vitamin D itself and which are mediated via calcium. Clinical trials have not been conclusive, at least in part due to variable quality of study design. Some studies showing no effect of vitamin D supplementation on weight included participants who were vitamin D replete, and may thus have shown that giving supplemental vitamin D to those who are replete has no additional effect. There is a clear need for adequately-powered, prospective interventions which include baseline measurement of 25D concentrations and involve adequate doses of supplemental vitamin D. The role of vitamin D supplementation in obesity prevention remains still uncertain.<sup>30</sup>

## CONCLUSION

There was no significant association found between vitamin D deficiency and obesity in Saudi women in our study which suggests that vitamin D deficiency may not be a causative factor for obesity in Saudi women above 40 years of age.

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## REFERENCES

1. Kayaniyil S, Vieth R, Harris SB, Retnakaran R, Knight JA, Gerstein HC, et al. Association of 25(OH)D and PTH with metabolic syndrome and its traditional and nontraditional components. *J Clin Endocrinol Metab.* 2011;96:168-75.
2. Botella-Carretero JI, Alvarez-Blasco F, Villafruela JJ, Balsa JA, Vazquez C, Escobar-Morreale HF. Vitamin D deficiency is associated with the metabolic syndrome in morbid obesity. *Clin Nutr.* 2007;26:573-80.
3. Earthman CP, Beckman LM, Masodkar K, Sibley SD. The link between obesity and low circulating 25-hydroxyvitamin D concentrations: considerations and implications. *Int J Obes.* 2012;36:387-96.
4. Lagunova Z, Porojnicu AC, Vieth R, Lindberg FA, Hexeberg S, Moan J. Serum 25-hydroxyvitamin D is a predictor of serum 1,25-dihydroxyvitamin D in

- overweight and obese patients. *J Nutr.* 2011;141:112-7.
5. Lagunova Z, Porojnicu AC, Lindberg F, Hexeberg S, Moan J. The dependency of vitamin D status on body mass index, gender, age and season. *Anticancer Res.* 2009;29:3713-20.
  6. Parikh SJ, Edelman M, Uwaifo GI, Freedman RJ, Semega-Janneh M, Reynolds J, et al. The relationship between obesity and serum 1,25-dihydroxy vitamin D concentrations in healthy adults. *J Clin Endocrinol Metab.* 2004;89:1196-9.
  7. Konradsen S, Ag H, Lindberg F, Hexeberg S, Jorde R. Serum 1,25-dihydroxy vitamin D is inversely associated with body mass index. *Eur J Nutr.* 2008;47:87-91.
  8. Garanty-Bogacka B, Syrenicz M, Goral J, Krupa B, Syrenicz J, Walczak M, et al. Serum 25-hydroxyvitamin D (25-OH-D) in obese adolescents. *Endokrynol Pol.* 2011;62:506-11.
  9. Tamer G, Mesci B, Tamer I, Kilic D, Arik S. Is vitamin D deficiency an independent risk factor for obesity and abdominal obesity in women? *Endokrynol Pol.* 2012;63:196-201.
  10. Lee SH, Kim SM, Park HS, Choi KM, Cho GJ, Ko BJ, et al. Serum 25-hydroxyvitamin D levels, obesity and the metabolic syndrome among Korean children. *Nutr Metab Cardiovasc Dis.* 2012;22:1-7.
  11. Vashi PG, Lammersfeld CA, Braun DP, Gupta D. Serum 25-hydroxyvitamin D is inversely associated with body mass index in cancer. *Nutr J.* 2011;10:51.
  12. Al-Baghli NA, Al-Ghamdi AJ, Al-Turki KA, El-Zubaier AG, Al-Ameer MM, Al-Baghli FA. Overweight and obesity in the Eastern province of Saudi Arabia. *Saudi Med J.* 2008;29(9):1319-25.
  13. Memish ZA, El Bcheraoui C, Tuffaha M, Robinson M, Daoud F, Jaber S, et al. Obesity and associated factors - Kingdom of Saudi Arabia, 2013. *Prev Chronic Dis.* 2014;11:140236.
  14. Oommen A, AlZahrani I. Prevalence of osteoporosis and factors associated with osteoporosis in women above 40 years in the Northern part of Saudi Arabia. *Int J Res Med Sci.* 2014;2:274-8.
  15. Gallagher JC, Sai AJ. Vitamin D Insufficiency, deficiency, and bone health. *J Clin Endocrinol Metab.* 2010;95:2630-3.
  16. Hashemipour S, Larijani B, Sedaghat HAM, Mohammad MP, Bastan-Hagh H, A Javadi ASE, et al. The status of biochemical parameters in varying degrees of vitamin D deficiency. *J Bone Miner Metab.* 2006;24:213-8.
  17. Khorvash F, Mottaghi T, Askari G, Maracy MR, Ghiasvand R, Maghsoudi Z, et al. the association between serum vitamin D levels with general and abdominal obesity among patients with migraine. *Int J Prev Med.* 2013;4n:S313-7.
  18. Wagner B, Klinitzke G, Braehler E, Kersting A. Extreme obesity is associated with suicidal behavior and suicide attempts in adults: results of a population-based representative sample. *Depress Anxiety.* 2013;10:975-81.
  19. Foss YJ. Vitamin D deficiency is the cause of common obesity. *Med Hypotheses.* 2009;3:314-21.
  20. Reichel H, Koeffler HP, Norman AW. the role of the vitamin D endocrine system in health and disease. *N Engl J Med.* 1989;320:980-91.
  21. Narvaez CJ, Matthews D, Broun E, Chan M, Welsh JE. Lean phenotype and resistance to diet-induced obesity in vitamin D receptor knockout mice correlates with induction of uncoupling protein-1 in white adipose tissue. *Endocrinology.* 2009;150(2):651-61.
  22. Ferron M, Hinoi E, Karsenty G, Ducy P. Osteocalcin differentially regulates  $\beta$  cell and adipocyte gene expression and affects the development of metabolic diseases in wild-type mice. *Proc Natl Acad Sci.* 2008;105:5266-70.
  23. Mason C, Xiao L, Imayama I, Duggan C, Wang CY, Korde L. Vitamin D3 supplementation during weight loss: a double-blind randomized controlled trial. *Am J Clin Nutr.* 2014 May; 99(5):1015-25.
  24. McCarty MF. Poor vitamin D status may contribute to high risk for insulin resistance, obesity, and cardiovascular disease in Asian Indians. *Med Hypotheses.* 2009;72:647-51.
  25. Baz-Hecht M, Goldfine AB. The impact of vitamin D deficiency on diabetes and cardiovascular risk. *Curr Opin Endocrinol Diabetes Obes.* 2010;17:113-9.
  26. Moy FM, Bulgiba A. High prevalence of vitamin D insufficiency and its association with obesity and metabolic syndrome among Malay adults in Kuala Lumpur, Malaysia. *BMC Public Health.* 2011;11:735.
  27. Bell NH, Epstein S, Greene A, Shary J, Oexmann MJ, Shaw S. Evidence for alteration of the vitamin D-endocrine system in obese subjects. *J Clin Invest.* 1985;76:370-3.
  28. Luong KVQ, Nguyễn LTH. The beneficial role of vitamin D in obesity: possible genetic and cell signaling mechanisms. *Nutr J.* 2013;12:89.
  29. Cândido FG, Bressan J. Vitamin D: link between osteoporosis, obesity, and diabetes? *Int J Mol Sci.* 2014;15(4):6569-91.
  30. Vanlint S. Vitamin D and obesity. *Nutrients.* 2013;5(3):949-56.

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