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Lower serum vitamin D in obese children relative to children with normal body weights in Saudi Arabia

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ABSTRACT

Obesity is increasing in prevalence worldwide and represents a major international health burden. Pediatric obesity has increased during the prior two decades. Vitamin D plays important roles in promoting bone homeostasis and protecting against cardiovascular events. Several studies have linked vitamin D deficiency and obesity in adult populations. We sought to assess the relationship between serum vitamin D and obesity in children in Saudi Arabia. Pediatric outpatients who were 5-14 years of age were included in this study. Body mass index (BMI) was used to classify patients as follows: BMI<85th percentile was regarded as normal body weight; BMI between the 85th and 94th percentile was regarded as overweight; and BMI 295th percentile was regarded as obese. Serum vitamin D was measured in all patients. Vitamin D deficiency was defined to be a vitamin D level<30 ng/ml. Among the 65 patients included in this study, there were 24 patients with normal body weights and 41 overweight or obese patients. With respect to gender, there were 33 males and 32 female patients. Vitamin D deficiency was more common among overweight and obese patients than among patients with normal body weights; in particular, this deficiency was detected in 26 of the former patients and only 13 of the latter patients. Mean serum vitamin D (in nmol/l) was significantly greater for male patients (27.56 ± 10.80) than for female patients (21.99 ± 11.31) ; t(63)=-2.031; p=0.046). In addition, mean serum vitamin D (in nmol/l) was significantly greater in the Normal group (50th to 85th percentile in BMI; 29.33±13.97) than in the Overweight+ Obese group (\geq 85th percentile in BMI; 22.17±8.58; t=2.272; p=0.030). Obesity is associated with a significantly lower serum vitamin D level. Additional studies are needed to confirm this finding.

Keywords: Vitamin D, pediatric, obesity

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INTRODUCTION

Obesity, which is a global burden worldwide, represents a risk factor for major health problems, including hypertension, diabetes mellitus and musculoskeletal diseases¹. The incidence of obesity has increased during the prior decade; this phenomenon relates to major changes in dietary habits and lifestyles ². An increasing incidence of obesity has also been observed in the pediatric age group in particular; this increase represents an alarming sign that indicates the need to implement major health education initiatives regarding the importance of healthy diet and exercise programs ³.

Vitamin D3 is known for its major roles in maintaining hemostasis in bone metabolism and regulating serum calcium and phosphorus. Sun exposure and daily intake are both important sources of vitamin D. Recent research has indicated that vitamin D deficiency is associated with the development of insulin resistance, glucose intolerance and type 2 diabetes mellitus ^{4,5}. Associations between vitamin D deficiency and defects in insulin secretion have been demonstrated in numerous studies⁶. A recent investigation reported that the oral supplementation of vitamin D for 3 months is associated with a reduction in diastolic blood pressure, indicating a possible role for vitamin D in blood pressure regulation ⁷.

Vitamin D deficiency is common among healthy populations in various countries ^{8,9}. A prior study that examined 3475 subjects in Saudi Arabia demonstrated that the prevalence of low vitamin D was 78% among females and 72% among males; this finding suggested that hypovitaminosis is a major health issue in Saudi society ^{10.}

In this study, we seek to reveal the correlation between serum vitamin D and obesity in a pediatric population.

MATERIALS AND METHOD

This investigation is a cross-sectional study conducted in an outpatient clinic at King Abdulaziz University Hospital between June 2014 and August 2014. The study proposal and consent form were approved by the ethical research unit of King Abdulaziz University. Healthy pediatric subjects of 5-14 years of age were eligible for inclusion. We excluded patients who were known to suffer from chronic medical illness. Informed consent was given by participants (or next of kin/caregiver in the case of children) for their clinical records to be used in this study. The consent was documented by the principal investigator and kept in patients file and a copy of the consent kept with principal investigator. The data recorded in electronic sheet and saved in an electronic folder that is not accessible to others. Ethical committee approved the consent procedure The following epidemiological data were obtained: age, gender, weight, height, and body mass index (BMI). BMI was used to classify patients as follows: BMI<85th percentile was regarded as normal body weight; BMI between

the 85th and 94th percentile was regarded as overweight; and BMI≥95th percentile was regarded as obese. A trained nurse obtained 3 ml of blood from each patient for serum vitamin D measurement; in particular, 25-(OH) vitamin D was measured by enzyme-linked immunosorbent assay (ELISA) (I.D.S., Tyne & Wear, UK). Vitamin D deficiency was defined to be a vitamin D level < 30 ng/ml.

In the present study, statistical analyses using IBM SPSS Statistics, ver. 20.0, were conducted to evaluate and test hypotheses.

An independent t-test was used to compare the mean serum vitamin D (in nmol/l) of the Normal group (50th to 85th percentile in BMI) and the Overweight + Obese group (\geq 85th percentile in BMI) and assess whether these vitamin D levels statistically differed.

RESULTS AND DISUCSSION

This study included a total of 65 patients, 24 of whom had normal body weights and 41 of whom were overweight or obese. With respect to gender, the examined patients included 33 males and 32 females. Vitamin D deficiency was observed in 26 (63%) of the overweight or obese patients and was more common among these patients than among patients of normal weight, 13 (54%) of whom exhibited this deficiency.

Mean serum vitamin D (in nmol/l) was significantly greater for males (27.56 ± 10.80) than for females $(21.99\pm11.31; t(63)=-2.031; p=0.046;$ see Figure 1).

Mean serum vitamin D (in nmol/l) was significantly greater in the Normal group (50th to 85th percentile in BMI; 29.33 ± 13.97) than in the Overweight + Obese group (\geq 85th percentile in BMI; 22.17 ± 8.58 ; t=2.272; p=0.030; see Figure 2).



Figure 1: Mean serum vitamin D (in nmol/l) was significantly greater among males (27.56±10.80) than among females (21.99±11.31; t(63)=-2.031; p=0.046).



Figure 2. Mean serum vitamin D (in nmol/l) was significantly greater in the Normal group (50th to 85th percentile in BMI; 29.33±13.97) than in the Overweight + Obese group (≥85th percentile in BMI; 22.17±8.58; t=2.272; p=0.030).

In this study, we demonstrated that vitamin D deficiency is common in the pediatric age group in Saudi Arabia despite this country's relatively high year-round sun exposure. This finding is similar to the results of a Thai study that reported a prevalence of vitamin D deficiency of 79.2% ¹¹. In addition, an Indian study indicated that vitamin D deficiency is quite common among adolescent girls and pregnant women, with prevalences of 88% and 74%, respectively, in these two groups¹². India and Thailand are both situated at low altitudes and receive abundant sunshine, which is considered to be a major source of vitamin D. The results of the aforementioned studies raise questions regarding the importance of sun exposure for serum vitamin D. A Saudi Arabian study revealed that during the summer, the conversion of sunlight into vitamin D began at 8 AM and ended at 4 PM, with peak conversion between 10 AM and 12 PM. In winter, peak conversion continued to occur between 10 AM and 12 PM. In winter, peak conversion continued to accur the to a the summer of the animortant factor that negatively influences vitamin D level. Interestingly, another Saudi Arabian study reported

that increased sun exposure not only improves vitamin D profiles but also enhances glycemic control in patients with diabetes mellitus¹⁴

In our study, we demonstrate that an elevated BMI is associated with lower serum vitamin D. This finding is consistent with the results of other clinical studies. For example, a recent Korean study involving 2880 adolescents and children of 10-18 years of age reported a higher prevalence of metabolic syndrome among subjects with low vitamin D levels than among subjects with normal vitamin D levels; there was a clear positive correlation between low vitamin D levels and increased insulin resistance (p<0.001)¹⁵. Similar results were reported by Kelly et al, who concluded that a low serum vitamin D level was associated with elevated insulin resistance, as measured by homeostasis model assessment. In the same study, low serum vitamin D was associated with elevated fasting glucose and insulin levels¹⁶.

Insulin resistance is known to be a key moderator in the development of metabolic syndrome. Vitamin D can improve cellular sensitivity to insulin by enhancing glucose transport. A mouse study demonstrated that vitamin D deficiency is related to impaired glucose metabolism and insulin secretion; this finding suggested that vitamin D supplementation might be beneficial for protecting against the development of diabetes mellitus and metabolic syndrome ¹⁸. Another proposed mechanism for the role of vitamin D in insulin resistance is that vitamin D deficiency is associated with secondary elevations of serum parathyroid hormone, which lead to the accumulation of intracellular calcium and can thereby impair cellular glucose transport mechanisms.

Several studies have demonstrated that vitamin D supplementation is beneficial for improving blood pressure measurements and glucose metabolism in patients with metabolic syndrome. Based on a randomized controlled trial involving 281 subjects, Froeman et al concluded that vitamin D supplementation for three months is associated with significant improvements in blood pressure measurements relative to a placebo group ²⁰. This finding is similar to the results of another study involving 148 elderly women in which daily supplementation with 800 IU of vitamin D and 1200 mg of calcium was associated with a decrease in systolic blood pressure measurements relative to a control group ²¹.

In diabetic patients, vitamin D supplementation has been associated with improved control of serum glucose and glycosylated hemoglobin levels. A study conducted in 92 adults demonstrated that daily supplementation with 2000 IU of vitamin D or 800 mg of calcium was associated with a greater increase in insulin secretion and decreased serum glycosylated hemoglobin levels relative to a control group 22

To the best of our knowledge, the current investigation is the first Saudi Arabian study to demonstrate that serum vitamin D is linked to elevated BMI in pediatric subjects.

Our study had several limitations: 1) this investigation was a single-center study involving a relatively small number of patients; 2) we did not collect evidence relevant to metabolic syndrome, such as serum lipid profiles, fasting glucose measurements or determinations of serum insulin, which could have helped to clarify the relationship between vitamin D levels and metabolic syndrome; 3) no other factors that contribute to vitamin D deficiency, such as dietary intake or physical activity, were investigated; and 4) our investigation is a cross-sectional study that cannot be used to determine causation.

CONCLUSION

Vitamin D deficiency is common among Saudi children. Overweight and obesity are linked to decreased serum levels of vitamin D. Other studies have demonstrated that decreased vitamin D levels are associated with the development of insulin resistance and metabolic syndrome; therefore, we can conclude that the overweight and obese patients who we examined are at risk for metabolic syndrome and cardiovascular complications. However, multicenter studies involving larger sample sizes are needed to confirm the relationship between vitamin D and metabolic syndrome in Saudi children and to explore the effects of vitamin D supplementation on cardiovascular complications in obese children.

REFERENCES

- Hevener AL, Febbraio MA, Stock Conference Working Group. The 2009.stock conference report: inflammation, obesity and metabolic disease. Obes Rev 2010;11:635-44.
- World Health Organization. Obesity: preventing and managing the global epidemic. Report of a WHO consultation. WHO Technical Report Series. No. 894. Geneva: World Health Organization; 2000.
- Wang Y, Lobstein T. Worldwide trends in childhood overweight and obesity. Int J Pediatr Obes 2006;1:11-25.
- 4. Heshmat R, Malazy OT, Ahranjani SA, et al. Effect of vitamin D on insulin resistance and anthropometric parameters in type 2 diabetes; a randomized double-blind clinical trial. Daru 2012;20:10.
- 5. Talaei A, Mohamadi M, Adgi Z. The effect of vitamin D on insulin resistance in patients with type 2 diabetes. Diabetol Metab Syndr 2013;5:8.
- 6. Chiu KC, Chu A, Go VL, et al. Hypovitaminosis D is associated with insulin resistance and beta cell function. Am J Clin Nutr 2004;79:820-5.
- Al-Zahrani MK, Elnasieh AM, Alenezi FM, et al. A 3-month oral vitamin D supplementation marginally improves diastolic blood pressure in Saudi patients with type 2 diabetes mellitus. Int J Clin Exp Med 2014;7:5421-8.

- 8. Rucker D, Allan JA, Fick GH, et al. Vitamin D insufficiency in a population of healthy western Canadians. CMAJ 2002;166:1517-24.
- 9. Hashemipour S, Larijani B, Adibi H, et al. Vitamin D deficiency and causative factors in the population of Tehran. BMC Public Health 2004;4:38.
- Alfawaz H, Tamim H, Alharbi S, et al. Vitamin D status among patients visiting a tertiary care center in Riyadh, Saudi Arabia: a retrospective review of 3475 cases. BMC Public Health 2014;14:159.
- 11. Reesukumal K, Manonukul K, Jirapongsananuruk O, et al. Hypovitaminosis D in healthy children in Central Thailand: prevalence and risk factors. BMC Public Health 2015;15:248.
- Sahu M, Bhatia V, Aggarwal A, et al. Vitamin D deficiency in rural girls and pregnant women despite abundant sunshine in northern India. Clin Endocrinol (Oxf) 2009;70:680-4.
- Alshahrani FM, Almalki MH, Aljohani N, et al. Vitamin D: light side and best time of sunshine in Riyadh, Saudi Arabia. Dermatoendocrinol 2013;5:177-80.
- 14. Al-Daghri NM, Alfawaz H, Aljohani NJ, et al. A 6-month "self-monitoring" lifestyle modification with increased sunlight exposure modestly improves vitamin D status, lipid profile and glycemic status in overweight and obese Saudi adults with varying glycemic levels. Lipids Health Dis 2014;13:87.
- Lee DY, Kwon AR, Ahn JM, et al. Relationship between serum 25-hydroxyvitamin D concentration and risks of metabolic syndrome in children and adolescents from Korean National Health and Nutrition Examination survey 2008-2010. Ann Pediatr Endocrinol Metab 2015;20:46-52.
- 16. Kelly A, Brooks LJ, Dougherty S, et al. A cross-sectional study of vitamin D and insulin resistance in children. Arch Dis Child 2011;96:447-52.
- Maestro B, Campion J, Davila N, et al. Stimulation by1,25-dihydroxyvitamin D3 of insulin receptor expressionand insulin responsiveness for glucose transport in U-937human promonocytic cells. Endocr J 2000;47:383-91.
- Chiu KC, Chu A, Go VL, et al. Hypovitaminosis D is associated with insulin resistance and beta cell dysfunction. Am J Clin Nutr 2004; 79:820-5.
- Resnick LM. Calcium metabolism in hypertension and allied metabolic disorders. Diabetes Care 1991;14:505-20.
- 20. Forman JP, Scott JB, Ng K, et al. Effect of vitamin D supplementation on blood pressure in blacks. Hypertension 2013;61:779-85.

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- 21. Pfeifer M, Begerow B, Minne HW, et al. Effects of a short-term vitamin D(3) and calcium supplementation on blood pressure and parathyroid hormone levels in elderly women. J Clin Endocrinol Metab 2001;86:1633-7.
- 22. Mitri J, Dawson-Hughes B, Hu FB, et al. Effects of vitamin D and calcium supplementation on pancreatic β cell function, insulin sensitivity, and glycemia in adults at high risk of diabetes: the Calcium and Vitamin D for Diabetes Mellitus (CaDDM) randomized controlled trial. Am J Clin Nutr 2011;94:486-94.

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