Endokrynologia Polska/Polish Journal of Endocrinology
Tom/Volume 63; Numer/Number 1/2012
ISSN 0423–104X

Association of body mass index and serum vitamin D level in healthy Iranian adolescents

Związek wskaźnika masy ciała ze stężeniem witaminy D w surowicy u zdrowych Irańczyków

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Abstract

Introduction: In studies of obese adolescents in various countries, vitamin D deficiency has been correlated with greater weight and elevated BMI. However, there is insufficient data on the relation between vitamin D status and body fat indexes in adolescence. The aim of this study was to investigate the association of serum (25[OH]D) concentrations with body mass index of healthy Iranian subjects to understand whether specific data on the relation between vitamin D status and body mass index is common in all populations.

Material and methods: Data was collected from 259 ambulant medical staff adults, students and other subjects who met the inclusion criteria of the study. Body mass index and fasting 25-Hydroxy vitamin D level were measured. Vitamin D deficiency was defined as having a 25(OH)D concentration < 25 nmol/L.

Results: Participants were aged 20–64 years, mean age 34 ± 9 years, and about 57.5% of the participants were women. The mean (± SD) body mass index (kg/m^2) was 24.2 ± 3.8 kg/m^2 (median = 23.7 kg/m^2), the mean (± SD) vitamin D level of the participants was 29 ± 16 nmol/L (median = 26 nmol/L), and 48% of the participants had vitamin D deficiency. In this study, there was no significant association between vitamin D level and BMI (r = 0.064; p = 0.307) (age adjusted). Moreover, there was no association between vitamin D level and sex of the participants. In addition, no association between BMI and sex of the adolescents was seen (p; NS), but a significant association between age and vitamin D level was found (r = 0.002).

Conclusion: Our data suggests that various mechanisms could potentially contribute to the robust association of vitamin D with adiposity; in normal or near normal BMI, vitamin D status may not be correlated with age. **(Pol J Endocrinol 2012; 63 (1): 29–33)**

Key words: *vitamin D deficiency, body mass index, obesity*

Streszczenie

Wstęp: W badaniach nad otyłymi nastolatkami w różnych krajach stwierdzono korelację między niedoborem witaminy D a zwiększoną masą ciała i podwyższonym wskaźnikiem masy ciała (BMI). Nie ma jednak wystarczających danych dotyczących zależności między stężeniem witaminy D a zawartością tkanki tłuszczowej w organizmie osób dorosłych. Celem niniejszego badania była analiza związku stężeń witaminy 25(OH)D w surowicy ze wskaźnikami tkanki tłuszczowej u zdrowych dorosłych Irańczyków w celu ustalenia, czy podobne zależności, jak u młodzieży, występują w populacji ogólnej.

Materiał i metody: Zgromadzono dane 259 pracowników służby zdrowia, studentów i innych dorosłych osób spełniających kryteria włączenia do badania. Wyliczono BMI i zmierzono stężenia witaminy 25-hydroksy-D na czczo. Niedobór witaminy D definiowano jako stężenie 25(OH)D < 25 nmol/l.

Wyniki: Uczestnikami badania były osoby w wieku 20–64 lat (średnia wieku 34 ± 9 lat); około 57,5% badanej grupy stanowiły kobiety. Średnia wartość (± SD) BMI (kg/m^2) wynosiła 24,2 ± 3,8 kg/m^2 (mediana = 23,7 kg/m^2), a średnie stężenie (± SD) witaminy D — 29 ± 16 nmol/l (mediana = 26 nmol/l). Niedobór witaminy D stwierdzono u 48% uczestników. W niniejszym badaniu nie wykazano istotnych związków między stężeniem witaminy D i BMI (r = 0,064; p = 0,307) (po skorygowaniu względem wieku). Nie stwierdzono również zależności między stężeniem witaminy D a płcią uczestników badania. Nie stwierdzono zależności między BMI a płcią (p nieistotne statystycznie), odnotowano natomiast istotny związek wieku ze stężeniem witaminy D (r = 0.002).

Wnioski: Dane sugerują, że u podłoża silnego związku między niedoborem witaminy D i otyłością mogą leżeć różne mechanizmy. U osób z BMI w zakresie wartości prawidłowych lub zbliżonym do prawidłowego nie ma zależności między stężeniem witaminy D a wiekiem. **(Endokrynol Pol 2012; 63 (1): 29–33)**

Słowa kluczowe: *niedobór witaminy D, wskaźnik masy ciała, otyłość*

Introduction

Vitamin D (25[OH]D) is essential for normal growth and development. Vitamin D deficiency compromises long-term health and increases the risk of chronic disease [1, 2]. Recently, there has been a resurgence of hypovitaminosis D_3 in many populations [3–6]. Vitamin D deficiency is prevalent in as many as one half of

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middle-aged to elderly subjects in developed countries [2]. In addition to its musculoskeletal effects, evidence suggests that individuals with vitamin D deficiency are at increased risk of cardiovascular morbidity and mortality [7, 8].

Thus, understanding the characteristics that promote vitamin D deficiency in the general population has important clinical implications. Studies of obese adolescents in various countries have shown that vitamin D deficiency has been correlated with greater weight and elevated BMI [9, 10]. However, there is insufficient data on the relation between vitamin D status and body fat indexes in adolescence.

The aim of this study was to investigate the association of serum (25[OH]D) concentrations with the body mass index of healthy Iranian subjects to understand whether specific data on the relation between vitamin D status and body mass index is common in all populations. The study also aimed to determine in subjects with normal or near normal BMI whether there was vitamin D insufficiency, assessed by serum 25-hydroxyvitamin D.

Material and methods

Study subjects and design

Data from 259 ambulant medical staff adults, students and other subjects who met the inclusion criteria of the study were collected for this study. The study was carried out in 2010. All subjects (aged 20–64 years) were of Iranian origin and from a central province of the country. They had no organic disease (i.e. liver or kidney disease or diabetes mellitus) and were not on any medication which could affect calcium homeostasis. Other inclusion criteria were absence of pregnancy or lactation, and no presence of convulsions or its history. Participants currently taking calcium, vitamin D or any other supplements, or using weight loss agents, or participating in commercial weight loss programmes, or who expressed a desire to lose weight were also excluded from the study. Weight, height, waist and blood pressure were measured using standard methods and analysed for the study stages. Weight was measured while the subjects were wearing light clothing and no shoes. BMI was calculated as the mean weight (kg) divided by the mean height squared (m^2).

Laboratory assays

Measurements

A fasting blood sample (10 ml) was drawn from each participant. The samples were centrifuged and serums were extracted. Serum samples were obtained in the morning after an overnight fast, and were frozen at –80°C. Analyses of the samples were done in one laboratory. The EIA Kits (Immunodiagnostic Systems plc, Boldon, UK) technique was used in order to determine 25-Hydroxy vitamin D levels. The tests were done with a Stat Fax 2100 (Awareness Technology, Palm City, FL, USA). For the present analysis, vitamin D deficiency was defined as having a 25(OH)D concentration < 25 nmol/L [11].

Ethical approval

Information sheets and consent forms were distributed among the participants, and all the subjects signed consent forms. The research study was approved by the ethics committee of Shahrekord University of Medical Sciences, Iran.

Statistical analysis

Statistical analysis was performed by SPSS, version 11.0, software (SPSS, Chicago, IL, USA). Statistical correlations were performed using Pearson correlation coefficients to assess simple associations between continuous variables. In addition, partial correlation test was used to exclude confounding factors. The independent *t*-test was used to compare vitamin D and BMI for male and female. $p \leq 0.05$ was considered statistically significant.

Results

Participants were aged 20 to 64 years, with mean (± SD) age of 34 ± 9 years; 57.5% of the participants were women. The mean (± SD) body mass index (in kg/m^2) was 24.2 ± 3.8 kg/m^2 (median = 23.7 kg/m^2), and the mean (± SD) vitamin D level of the participants was 29 ± 16 nmol/L (median = 26 nmol/L). The characteristics of the study sample are set out in Table I. About 48% of the participants had vitamin D deficiency (serum 25(OH)D concentrations below 25 nmol/L). Table II sets out the distribution of body mass index between the subjects. Table III sets out the distribution of age between four groups of BMI in the subjects. Figure 1 shows the distribution of 25(OH)D concentrations in all subjects.

In this study, there was no significant association between vitamin D level and BMI ($r = 0.064$; $p = 0.307$) (age adjusted). In addition, there was no association between vitamin D level and the sex of the participants, nor was there a significant association between BMI and the sex of the participants (p; NS). However, a significant association between age and vitamin D level was seen ($r = 0.002$) (Figure 2).

Discussion

In the present study, we found that 48% of our participants had vitamin D deficiency. There was no significant association between the vitamin D level and the BMI or

Table I. *Demographic characteristics of subjects*
Tabela I. *Charakterystyka demograficzna badanych*

Participant characteristics	Mean ± SD	Minimum	Maximum
BMI [kg/m²]	24.2 ± 3.8	14.8	38.7
Vitamin D level [nmol/L]	29.0 ± 16.0	8.0	96.0
Age (years)	34.0 ± 9.0	20.0	64.0
Weight [kg]	68.8 ± 12.0	43.0	120.0
Waist [cm]	83.0 ± 10.0	60.0	128.0

Table II. *Distribution of body mass index between subjects*
Tabela II. *Rozkład wartości wskaźnika masy ciała w badanej grupie*

Participants	BMI [kg/m²]			
	Up to 18.4	18.5 to 24.9	25 to 29.9	> 30
Female (149)	17.7 ± 0.5	22.3 ± 1.6	27.4 ± 1.5	32.0 ± 2.0
Male (110)	16.7 ± 1.5	22.0 ± 1.5	26.6 ± 1.1	32.7 ± 3.2
Total (259)	17.3 ± 1.1	22.3 ± 1.5	27.0 ± 1.3	32.2 ± 2.5

Table III. *Distribution of age between four groups of BMI in subjects*
Tabela III. *Wiek uczestników w czterech grupach wydzielonych na podstawie wartości BMI*

Participants' age	BMI [kg/m²]			
	Up to 18.4	18.5 to 24.9	25 to 29.9	> 30
Female (149)	29.1 ± 6.4	30.0 ± 6.8	39.4 ± 1.5	32.0 ± 0.1
Male (110)	31.0 ± 1.0	32.0 ± 8.2	38.0 ± 8.9	38 ± 6.9
Total (259)	30.0 ± 8.0	30.1 ± 7.5	37.6 ± 9.5	38.4 ± 7.4

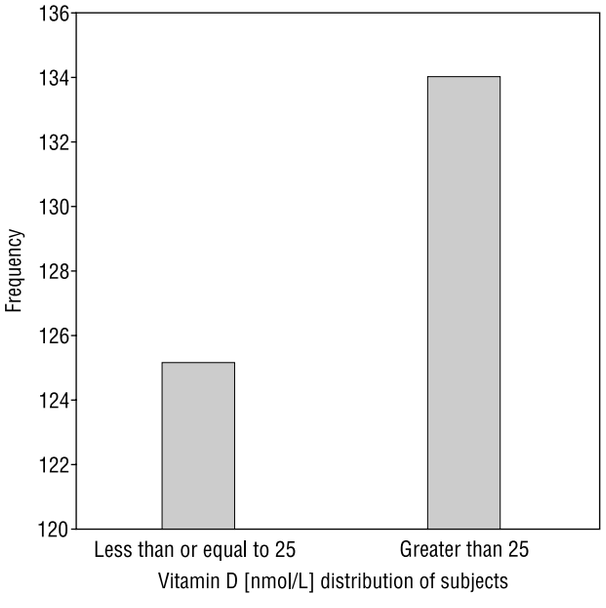

Figure 1. *Vitamin D status in participants*
Rycina 1. *Stężenia witaminy D u uczestników badania*

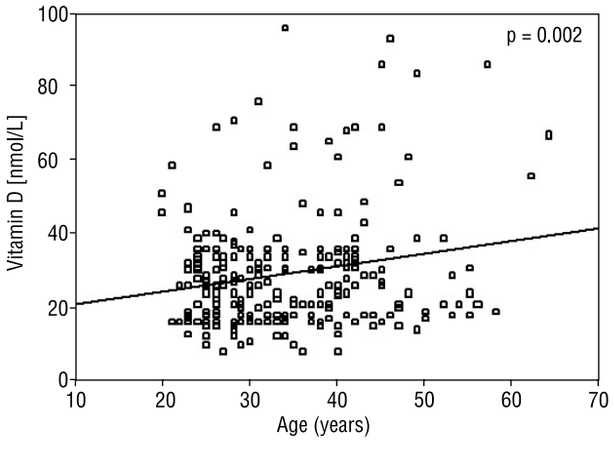

Figure 2. *Significant association of age with vitamin D level*
Rycina 2. *Istotne zależności między wiekiem a stężeniem witaminy D*

sex of the participants. In addition, we observed no association between the BMI and the sex of the participants, but there was a significant association between age and vitamin D level. Studies in adults have shown evidence of an association between body fat and deficiency of vitamin D [1, 12]. Vitamin D deficiency has been reported as a risk factor for various diseases such as osteoporosis, autoimmune diseases, various types of cancer, and cardiovascular diseases [13–16]. In a study on 530 healthy children aged 6 to 7 years in central Iran, Ardestani et al. found that 26% of the subjects had a serum 25-OHD level below 33 ng/mL [17]. To understand the difference between vitamin D deficiency prevalence in the summer compared to the winter, a study was conducted in a city with high humidity and a sultry climate in the north of Iran by Kashi et al. The study was carried out on 351 subjects (66.4% women and 33.6% men) aged 11 to 69 years (mean age 37.1 ± 12.6). They found that the mean 25-(OH)D concentrations in summer and winter were 13.4 ± 13 and 11.7 ± 11 respectively, and that their difference was statistically significant. In addition, the prevalence of 25-OHvitamin D deficiency was 87.5% in winter and 78.6% in summer. They concluded that while their area has a high humidity climate, seasonal variation of vitamin D is statistically significant and the prevalence of vitamin D insufficiency is as high in summer as in winter [18].

Parikh et al. compared 154 obese subjects [body mass index (BMI) 37.3 ± 5.8 kg/m^2] with 148 non-obese (BMI 25.6 ± 2.9 kg/m^2) age, race, and sex-matched participants. In this study, serum 25hydroxy vitamin D was negatively correlated with BMI and serum 1,25-vit D was also negatively correlated with BMI. They found that lower 25-OH-vit D and 1,25-vit D concentrations in obese adults were independent of age, sex, or race [19].

Al-Sultan et al. [20] conducted a study on a group of age- and gender-matched obese young (18–25 years) Saudi adults (n = 76) and lean controls (n = 84) with a body mass index of ≥ 30. They found vitamin D levels were significantly higher in the lean controls, and showed a significant decline in relation to classes of obesity. Hypovitaminosis D was found in 30% (38.2% obese vs. 22.7% in lean) and deficiency in 17.5% of the subjects (19% vs. obese 15.8%) even though their country has a great deal of sunlight. However, study results showed that vitamin D level among young obese adult Saudis is negatively associated with body mass index and classes of obesity [20].

In the present study, a significant association of age with 25-OH-vit D level was observed. To assess the vitamin D endocrine system, and its relation to age and body mass index (BMI), Bischof et al. conducted a study on the samples of 483 adults. They found a positive correlation between age and 25-OH-vit D [21].

In accordance with our findings, Masoumpour et al. found that serum level of 25-hydroxyvitamin D did not decline with age. Their study, which was carried out in Shiraz, a neighbouring province to the venue of our study, consisted of 520 men with a mean ± SD age of 45 ± 15 years and a mean ± SD 25-hydroxyvitamin D level of 35 ± 17 nmol/L. They found that more than 33.9% of men in Shiraz had a low level of 25-hydroxyvitamin D (≤ 25 nmol/L) [22].

In contrast to this finding, Smotkin-Tangorra et al. concluded that vitamin D insufficiency is associated with increased age. In their study, 217 obese subjects were tested and severely low vitamin D levels were observed in 21.6% of the patients [23]. These contradictory results may be due to the BMI and age of the participants: in their study, mean BMI and mean age of subjects were 32.2 ± 6.4 kg/m^2 and 12.92 ± 5.5 years, respectively, while in our study mean BMI and age were 24.2 ± 3.8 kg/m^2 and 34 ± 9 years, respectively.

It would seem that for evaluation of 25-OH-vit D status, both age and BMI should be taken into account. Taken together, our data suggests that various mechanisms could potentially contribute to the robust association of vitamin D with adiposity.

In conclusion, in cases of normal or near normal BMI, vitamin D status may not be correlated with age.

Acknowledgment

This study was supported by a grant from Shahrekord University of Medical Sciences, Iran.

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