Vitamin D status and relationship between vitamin D and risk factors of metabolic syndrome: A study in Taiyuan City in China

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Abstract

Background

Vitamin D deficiency is widespread, and the residents in Taiyuan City in China seem to be at high risk of vitamin D deficiency. The situation might be because the city is located in north China and air pollution in the city is heavy. Meanwhile, emerging evidence suggests that vitamin D deficiency may be associated with prevalence of metabolic syndrome (MetS), which usually progress to diabetes and increases the risk of cardiovascular disease. MetS has been becoming much more common in China, and even affects younger people.

Objectives

This study investigated the vitamin D status of non-manual workers living in Taiyuan City; and explored the relationship between vitamin D status and markers of MetS in 200 participants attending the Health 100 Check-up Center in Taiyuan City for their usual health check.

Methods

In this cross-sectional study; 200 non-manual workers aged 20-80 years old, living in Taiyuan City were recruited. The participants had their serum vitamin D levels measured and were asked questions about their lifestyle, including daily exercise, alcohol use and smoking. The Check-up Center provided data relating to MetS of the participants. These data included anthropometrics (height, weight and body circumferences), biochemical data (lipid profiles and fasting glucose from blood samples taken for the check-up) and blood pressure.

Results

Seventy eight percent of participants had vitamin D values less than 50 nmol/L. The women's serum 25-hydroxyvitamin D (25(OH)D) status (median; 32.70 nmol/L (upper and lower quartile; 25.80, 43.80)) was significantly lower than that of the men (44.00 nmol/L (32.30, 55.40)) (p<0.01). In females aged younger than 40 years vitamin D status (29.25 nmol/L (24.05, 40.85)) was significantly lower than older

participants (age>65). In the present study, multiple linear regressions showed the determinants of the vitamin D status were female gender, smoking, and increased fasting glucose (p<0.05). The prevalence of MetS, or abdominal obesity between the groups with and without vitamin D insufficiency were not significantly different (p=0.08; p=0.07). Multiple logistic regression analysis showed that vitamin D status was not associated with MetS.

Conclusions

Vitamin D insufficiency was highly prevalent in non-manual workers in Taiyuan City in China during the winter season. Vitamin D status in the women was lower than the men. Among the females, younger women had worse vitamin D status than the older women. So, in the present study, female gender, increased fasting glucose, and smoking were significant determinants for vitamin D insufficiency. Vitamin D insufficiency was not associated with the risk factors for MetS in the present study. However, female gender, increased waist circumference (WC), and raised serum triglycerides were associated with higher risk of MetS.

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List of abbreviations

$1,25(OH)_2D$	1,25-dihydroxyvitamin D
7-DHC	7-Dehydrocholesterol
25(OH)D	25-hydroxyvitamin D
25(OH)-epi-D	Epimer of 25-hydroxyvitamin D
ATP	National Cholesterol Education Program
BMI	Body mass index
BP	Blood pressure
CDS	Chinese Diabetes Society
CPBA	Competitive protein binding assay
CVD	Cardiovascular disease
DBP	Vitamin D binding protein
DBS	Dried blood spot
DEQAS	Vitamin D External Quality Assessment Scheme
DM	Diabetes mellitus
EIA	Enzyme immunoassay
FINS	Fasting insulin
FM	Fat mass
FPG	Fasting plasma glucose
Glu	Glucose
HC	Hip circumference
HDL-C	High density lipoprotein cholesterol
HOMA	Homeostasis model assessment
HPLC	High performance liquid chromatography
IDF	International Diabetes Federation
IFG	Impaired fasting glucose
IGT	Impaired glucose tolerance
IR	Insulin resistance
IS	Insulin sensitivity
LC-MS/MS	Liquid chromatography-tandem mass spectrometry
LDL-C	Low density lipoprotein cholesterol

MetS	Metabolic syndrome
MUHEC	Massey University Human Ethics Committee
mVDR	Membrane vitamin D receptor
NCEP	National Cholesterol Education Program
NA-CLPBA	Nichols advantage-automated protein binding assay
nVDR	Nuclear vitamin D receptor
PD	Peritoneal dialysis
PTAD	4-phenyl-1,2,4-triazoline-3,5-dione
PTH	Parathyroid hormone
OR	Odds ratio
RAS	Renin-angiotensin system
RCT	Randomized controlled trial
RMP	Reference measurement procedure
SMD	Standardized mean difference
SPF	Sun protect factor
RIA	Radioimmunoassay
T2DM	Type 2 Diabetes mellitus
TC	Total cholesterol
TG	Triglycerides
TNF-α	Tumor necrosis factor- α
UV	Ultraviolet
VDR	Vitamin D receptor
WC	Waist circumference
WHO	World Health Organization
WHR	Waist circumference/hip circumference ratio