List of Contents

List of Abbreviations

$1,25(OH)_2D$ .....1, 25-dihydroxyvitamin D

25(OH)D .....25-hydroxyvitamin D

AIDS .....Acquired immune deficiency syndrome

BBMI .....brush border myosin I

BMD .....bone mineral density

CaBP.....calbindin

CaM .....calmodulin

CaSR .....calcium sensing receptor

CaT1.....calcium transport channel

CD .....Cluster of differentiation

CDC.....Centers for Disease Control and Prevention

CDK.....cyclin-dependent kinases

CHF .....Congestive heart failure

CI.....confidence interval

Creat .....Creatinine

CVD .....Cardio vascular disease

CVS .....Cerebrovascular stroke

CYP.....Cytochrome P

CYP24A1 .....Cytochrome P450, family 24, subfamily A, polypeptide1

CYP27B1 .....cytochrome P450, family 27, subfamily B, polypeptide 1

CYP2R1 .....Cytochrome P450, Family 2, Subfamily R, Member 1

DBP .....vitamin D binding protein

DC .....dendritic cells

DNA .....Deoxyribonucleic acid

List of Abbreviations

FGF23 .....Fibroblast growth factor 23

GC .....Glucocorticoids

GH .....Growth hormone

GHRH .....Growth hormone releasing hormone

Hb.....Hemoglobin

HCl .....Hydrogen chloride

HIV .....Human immunodeficiency virus

HPT .....hypothalamus-pituitary-thyroid

IFN .....interferon

IGF .....Insulin growth factor

IL.....Interleukin

IU.....International unit

MARRS.....membrane-associated rapid response steroid binding protein

m-CSF .....macrophage colony-stimulating factor

MHC .....Major histocompatibility complex

MS .....Multiple sclerosis

NaPi-IIb .....sodium-phosphate cotransporter type IIb

NCX1 .....sodium/calcium exchanger

OR .....Odds ratio

PCOS .....polycystic ovary syndrome

PD1A3 .....protein disulfide isomerase associated protein 3

PHEX.....phosphate regulating endopeptidases X-linked

PO4 .....Serum Phosphorous

PTH .....Parathyroid hormone

List of Abbreviations

r.....Pearson correlation coefficient

RANK.....Receptor activator of NF-κB

RANKL.....Receptor activator of NF-κB ligand

RAS .....Renin-angiotensin system

RCT .....Randomized controlled trial

RDA.....Recommended Dietary Allowance

RNA.....Ribonucleic acid

RR.....relative risk

RTIs .....respiratory tract infections

RXR.....Retinoic acid X receptor

SD.....Standard deviation

SE.....sun exposure

SES.....Socio-economic status

SHOX gene.....Short stature HOmeoboX-containing gene

Sig.....Significant

t.....Student t

T1DM .....Type 1 diabetes mellitus

T2DM .....Type 2 diabetes mellitus

T3 .....triiodothyronine

TH .....Thyroid hormone

TNF .....Tumor-necrosis factor

TRPV6.....Transient Receptor Potential Cation Channel Subfamily V Member 6

UK.....United Kingdom

US.....United States

UVB.....Ultraviolet B rays

VDD.....Vitamin D deficiency

List of Abbreviations

VDDR.....Vitamin D deficiency rickets

VDR.....Vitamin D receptor

VDREs.....Vitamin D response elements

WHO.....World Health Organization

List of Tables

List of Tables

List of Tables

List of Figures

List of Figures

List of Figures

Abstract

Background/objectives

Vitamin D deficiency is a worldwide health problem. High prevalence of vitamin D insufficiency in healthy children and adolescents has been reported worldwide (e.g. India, Turkey, France, Italy, etc.) in the past few years. Vitamin D deficiency during periods of growth can have a negative influence on bone development, causing not only rickets, but also interfering with attainment of genetically programmed height.

Materials and methods

Our study conducted on 180 healthy adolescent males and females aged 10-19 years, randomly selected from Ain Shams University Hospitals. Outpatients with minor intercurrent illness or companions of inpatients were invited to participate in the study after explaining the objective of the study. Samples collected from participants from January 2017 to May 2017.

Results

Sufficient group: 38/180 subjects (21.11%) with vitamin D level above > 30 ng/ml. Mild deficiency group: 48/180 subjects (26.67%) with vitamin D level between 21-29 ng/ml. Moderate deficiency group: 88/180 subjects (48.89%) with vitamin D level between 10-20 ng/ml. Severe deficiency group: 6/180 subjects (3.33%) with vitamin D level below < 10 ng/ml.

Our results showed a ***significant positive*** correlation between vitamin D level and stature for age percentile (r=0.174) (p=0.019).

Conclusion

Subclinical vitamin D insufficiency and deficiency are common problems in apparently healthy Egyptian adolescents with negative impact on height percentile.

Keywords: Vitamin D, adolescents, height, Egypt.

INTRODUCTION

Vitamin D deficiency is a worldwide health problem ***(Hossein-Nezhad and Holick, 2013),*** spanning many continents and including all ages, genders and racial groups ***(Lappe, 2011).*** It is currently estimated that over a billion people worldwide are vitamin D deficient or insufficient ***(Holick, 2011).***

Vitamin D deficiency during periods of growth can have a negative influence on bone development, causing not only rickets, but also interfering with attainment of genetically programmed height ***(Bueno and Czepielewski, 2008)*** as there is a positive correlation between circulating 25(OH)D and height ***(Kremer et al., 2009).*** Vitamin D deficiency increases the risk of many chronic diseases, including autoimmune diseases, diabetes mellitus, heart disease and hypertension, and infectious diseases ***(Sabetta et al., 2010).*** Vitamin D deficiency may even contribute to the development of cancers, especially breast, prostate and colon cancers ***(Wacker and Holick, 2013).***

High prevalence of vitamin D insufficiency in healthy children and adolescents has been reported worldwide in the past few years. Studies in India found that hypovitaminosis D was seen in 95% of apparently healthy adolescents. Other studies reported prevalence of vitamin D deficiency as 59.4% in Turkey, 78% in France, 42.5% in Beijing, 47% in Greece ***(Dhore and Wasnik, 2013).***

The prevalence of vitamin D deficiency in a study among adolescent girls from four European countries, ranged from 26% to 51%, while over 90% of the adolescents had suboptimal vitamin D levels ***(Tylavsky et al., 2006).*** American data showed that the prevalence of vitamin D deficiency is adjusted to 28% - 40% during the period of 2001 to 2006, and vitamin D insufficiency were 70% - 80% of cases for the same time period ***(Saintonge et al., 2009).***

Despite the abundance of sunshine in the Middle East allowing vitamin D synthesis all year round, the region registers some of the lowest levels of vitamin D and the highest rates of hypovitaminosis D worldwide. Several studies in Iran, Jordan, Lebanon, Saudi Arabia, United Arab Emirates and Qatar revealed that is 30-75% of apparently healthy children and adolescents suffer from vitamin D deficiency ***(Bassil et al., 2013).***

In a recent study conducted on 90 healthy Egyptian adults aged 20-60 years, the prevalence of vitamin D deficiency with level of 25(OH) D <20 ng/ml was 77%, while prevalence of vitamin D insufficiency with level of 25(OH) D between 20-29 ng/ml was 20% ***(Boutros et al., 2016).***

However the status of vitamin D among adolescents in Egypt and its relation to growth has not been addressed yet.

Aim of the Work

Vitamin D deficiency is endemic in Egyptian city population and we aimed to study its relation with height percentile in teenagers (age 10-19 years) in both genders.