



Contents lists available at ScienceDirect

Journal of Steroid Biochemistry & Molecular Biology

journal homepage: www.elsevier.com/locate/jsbmb



Review

Vitamin D in Saudi Arabia: Prevalence, distribution and disease associations

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ARTICLE INFO

Article history:

Received 27 June 2016

Received in revised form 14 November 2016

Accepted 23 December 2016

Available online xxx

Keywords:

Vitamin D

Saudi Arabia

Vitamin D related-diseases

Prevalence

ABSTRACT

More than 33 years have passed since the first paper highlighting vitamin D deficiency as a public health concern in Saudi Arabia was published in 1983. Despite “early” detection, it wasn’t until the year 2010 where the interest in vitamin D research grew exponentially worldwide and was finally visible in Saudi clinical and academic areas. Since then, many landmark studies have been generated with regards to the physiologic functions of vitamin D, both skeletal and extra-skeletal. This review is limited to the prevalence, distribution. A systematic review on the prevalence studies done in KSA from 2011 to 2016 was done and revealed that the prevalence of vitamin D deficiency (<50 nmol/l) in Saudi Arabia among different populations (adults, children and adolescents, newborns and pregnant/lactating women) is 81.0% (Confidence Interval 95% 68.0–90.0), in line with most neighboring Gulf countries. Vitamin D deficiency in KSA has been mostly associated with bone and insulin-resistant diseases but limited data are available to prove causality. In conclusion, there is a need to develop local consensus guidelines that will identify candidates for screening, monitoring and treating those who are at most risk for vitamin D deficiency complications.

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Contents

1. Background	00
2. Methods	00
2.1. Meta-analysis	00
3. Results	00
4. Discussion	00
4.1. Vitamin D deficiency in KSA and in the middle east	00
4.2. Vitamin D deficiency has been associated with a wide range of diseases in the Saudi community	00
4.3. How do we move forward from vitamin D deficiency?	00
5. Conclusion	00
Competing interest	00
Acknowledgments	00
References	00

1. Background

During the last decade, no other micronutrient has gained and sustained massive interest in the fields of health and biomedical research community as much as vitamin D. Globally, vitamin D deficiency is widespread and is considered an epidemic [1]. The Middle East and North African (MENA) region in general has a very high prevalence of vitamin D deficiency [defined as 25(OH) D levels

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Table 1
Overview of Studies in Different Saudi Populations Highlighting the Prevalence of Vitamin D Deficiency Published in 2011–2016.

Author	Setting/Location	Sample Size	Method Used	Serum 25(OH)D Cut-Off Definition Used	Central Measure	Prevalence (%)
Adults						
Tuffaha et al. [10]	Multi-Center (National), April–June 2013	806 Males 1434 Females	ECL (Roche)	<28 ng/ml	Not mentioned	40.6 in Males 62.7 in Females
Al-Daghri et al. [11]	Multi-Center (KSU), Riyadh Feb–Oct 2013	368 Males 462 Females	ECL (Roche)	<25 nmol/l	40.9 ± 1.1 in Males 39.8 ± 1.4 in Females	17.7 in Males 36.8 in Females
BinSaeed AA et al. [12]	Single Center (KSU), Riyadh	255	ECL	<30 nmol/l	Not mentioned	75.2
Alfawaz et al. [13]	Single Center (KAMC), Riyadh Sept 2009–Dec 2010	756 Males 2719 Females	HPLC	<25 nmol/l	35.5 ± 30.6	36.1 in Males 48.8 in Females
Kanan et al. [14]	Single Center (KAMC), Riyadh Jun–Aug 2009 (Summer) Jan–March 2009 (Winter)	659 Females 897 Females	HPLC	<50 nmol/l	33.3 ± 1.65 (SE) 28.5 ± 1.16 (SE)	80.0 85.0
Ardawi et al. [15]	Multi-Center (Jeddah) Jan 2008–Dec 2009	834 Males	ECL (Roche)	<50 nmol/l	≥50 years 31.2 ± 17.5 <50 years 26.8 ± 15.0	87.8
Ardawi et al. [16]	Multi-Center (Jeddah) June 2008–June 2009	1172 Females	CLIA (Diasorin)	<50 nmol/l	Premenopausal 43.0 ± 30.5 Postmenopausal 33.3 ± 24.9	80.0
Children and adolescents						
Al-Daghri et al. [11]	Multi-Center (KSU), Riyadh February–October 2013	1187 Boys 1038 Girls	ECL (Roche)	<25 nmol/l	39.0 ± 0.6 in Boys 29.4 ± 0.6 in Girls	19.4 in Boys 47.0 in Girls
AlBuhairan et al. [17]	Multi-Center (National)	6444 Boys 6131 Girls	CMI (Abbott)	<50 nmol/l	Not mentioned	95.6
Mansour and Alhadidi [18]	Single Center (Jeddah) Oct–December 2010	220 Boys 290 Girls	CLIA (Diasorin)	<20 ng/ml	13.1 ± 7.8	58.8
Newborns						
Al-Faleh et al. [19]	Single Center (KSU) November–March 2013	200	ECL (Roche)	<25 nmol/l	21 (13)	59.5
Aly et al. [20]	Single Center, 2011	92	EIA (IDS)	<30 nmol/l	33.4 ± 18.3	Not mentioned
Pregnant/Lactating						
Al-Faris (2016) [21]	Single Center (KFMC), Riyadh March–May 2010	160	ECL (Roche)	<50 nmol/l	49.9 (28.0)	50.0
Al-Ajlan et al. [22]	Multi-Center (KSU) Riyadh	515	ECL (Roche)	<25 nmol/l	19.1 ± 15.1	68.0

Note: Central measures were presented as mean ± standard deviation, median (range) or mean ± standard error (SE).

lower than 50 nmol/l (20 ng/ml)] and is most prominent in women of varying ages [2]. The kingdom of Saudi Arabia (KSA), being part of the MENA region, therefore, is not spared from vitamin D deficiency, despite the year-round sunlight rich-environment. Even though local evidence is accumulating, the response at the national level remains is equally deficient. In this review, the local studies done on vitamin D deficiency are highlighted, with emphasis on epidemiology and associated diseases, with the hope that the evidence presented will compel the Saudi medical and scientific authorities to initiate tougher measures on early intervention and prevention of vitamin D deficiency in KSA.

2. Methods

A review of literature on the most recent epidemiology, clinical trials and reviews done in KSA with respect to vitamin D deficiency was conducted. The literature search was done in May 2016 using the MEDLINE/PubMed database. For epidemiology, the search was limited to studies conducted locally from 2011 to 2016 using the key words “Vitamin D deficiency”; “Saudi Arabia” and “observational study” which yielded 105 results. Reviews; case reports and studies with very small sample sizes; genetic studies; studies involving the prevalence of vitamin D deficiency in connection to other diseases (types 1 and 2 diabetes; osteoporosis; liver diseases; kidney diseases; autoimmune diseases and studies with vague diagnostic cut-offs used and technique); interventional studies and

animal studies were excluded. Studies including non-Saudis or not done in KSA were also excluded. Studies that involved other populations with common diseases associated with vitamin D deficiency in KSA were used in Table 2. A flowchart of study inclusion is presented in Fig. 1.

2.1. Meta-analysis

Studies included were assessed using an adjusted CASP tool [9]. Forest plot was generated using the comprehensive meta-analysis (CMA) software version 3.0 (<http://www.meta-analysis.com/index.php>).

3. Results

A total of 13 studies (N=24,399) were included and are summarized in Table 1 [10–22]. These studies include several apparently healthy subpopulations (adults, children and adolescents, newborns and pregnant/lactating women). A forest plot was generated and showed that the prevalence of vitamin D deficiency (<50 nmol/l) in Saudi Arabia among different populations (adults, children and adolescents, newborns and pregnant/lactating women) is 81.0% (Confidence Interval 95% 68.0–90.0) using the random-effect model (Fig. 2). Furthermore from the studies included it is apparent that there is no clear cut-off used for vitamin D deficiency as well as no uniformity in the methods for

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