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Vitamin D status in Middle East and Africa

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Despite ample sunshine, the Middle East (15°-36°N) and Africa (35°S-37°N), register the highest rates of rickets worldwide. This is in large part explained by limited sun exposure due to cultural practices and prolonged breast feeding without vitamin D supplementation in the Middle East [1], and by dark skin colour and calcium deficiency, rather than vitamin D deficiency, in several countries in Africa [2]. Both regions also have a high prevalence for hypovitaminosis D, the latency disease for osteoporosis, and the main focus of this discussion.

Hypovitaminosis D is very common in this region and does not spare the paediatric age [3, 4] (see Table 1). A large proportion of adolescent girls, up to 70% in Iran [5] and 80% in Saudi Arabia [6] had 25(OH)D levels below 25nmol/L. The reported proportions were 32% in Lebanese girls and between 9-12% in Lebanese adolescent boys [7, 8]. Diarrhoea and maternal vitamin D status in infants [9, 10] and gender, clothing style, season, and socioeconomic status in older children were independent risk factors for 25(OH)D levels [5-7, 11] (see Table 1). Several were also predictors for calcium and vitamin D intake [12].

The first study in adults from the region was conducted in university students and elderly from Saudi Arabia, and revealed a mean 25(OH)D level ranging between 10-30nmol/L [13]. The mean 25(OH)D level was near 25nmol/L in Lebanese, Saudi, Emirati and Iranian women [14-17]. A similar mean was recorded in elderly Lebanese [18]. The proportion of subjects with vitamin D levels below specific cut-offs varied. It was 35% for a vitamin D level below 25nmol/L in a study of elderly subjects from a geriatric hospital in Israel [19] and between 60-65% in Lebanon, Jordan and Iran [14, 20, 21]; and was 48% for a

cut-off less than 37.5nmol/L in subjects from Tunisia [22]. In the elderly Lebanese, 37% of men and 56% of women had vitamin D levels below 25nmol/L; the corresponding proportions were 8% for men and 14% for elderly subjects participating in the Longitudinal Aging Study Amsterdam [23]. In the similar international study conducted in women with osteoporosis, the highest proportion of hypovitaminosis D was noted in the Middle East [24]. In a study of hip fracture patients and elderly from Israel, up to 80% of subjects had hypovitaminosis D [25, 26]. Inadequate vitamin D intake, urban dwelling, female gender, wearing the veil, winter season, age and high parity were independent predictors of low vitamin D levels [15, 20-22, 27, 28] (see Table 2).

Neonates born to mothers with low D levels have lower cord vitamin D levels, and may be at risk for rickets and other complications [3, 29]. Studies from Saudi Arabia, Kuweit, United Arab Emirates and Iran reveal that 10-60% of mothers and 40-80% of their neonates had undetectable to low vitamin D levels (0-25nmol/L) at delivery [30-33] (see Table 3). Neonatal outcomes were not detailed in most studies. Higher socioeconomic status, antenatal care, and vitamin D intake were associated with higher vitamin D levels [33].

The negative impact of low vitamin D on mineral metabolism is illustrated in the inverse relationship between vitamin D and PTH levels noted in Lebanese of all age groups, and in Emirati and Iranian women (R= -0.2-0.25) [17, 34, 35]. A positive correlation between 25(OH)D and spine, but not hip BMD (Z-score) was noted in postmenopausal Iranian women [36]. Similar correlations were noted in elderly Lebanese with spine, hip, and forearm BMD (R=0.13-0.3), but were not present after adjustment for age, height, lean mass and PTH levels [18]; consistent with findings in Iranian women [34]. Neonatal size or bone mass may be affected by maternal vitamin D status [3]. No effect of maternal vitamin D levels on neonatal birth weight was detected in a sample of 50 mothers-neonates from Iran after adjusting for maternal height, age, and parity [30]. Conversely, in a larger sample of 449 women and their newborns from Tehran, neonates of mothers with adequate calcium and vitamin D intake, were 0.9 cm taller and had a better Apgar at birth [37]. Vitamin D supplementation for one year increased lean mass, bone area, and bone mass in a randomised controlled trial in Lebanese adolescent girls [8].

In summary, vitamin D levels are quite low across age groups in this region. Consistent predictors of low levels are older age, female gender, multi-parity, the winter season, conservative clothing style, low socioeconomic status and urban living. The negative impact of low vitamin D levels on indices of mineral bone metabolism and the positive effect of replacement in adolescents is consistent with observations worldwide and supports recommendations to optimise vitamin D status.

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For further information, the reader is referred to:

A. Mithal, D.A. Wahl, J-P. Bonjour et al. on behalf of the IOF Committee of Scientific Advisors (CSA) Nutrition Working Group. Global vitamin D status and determinants of hypovitaminosis D (2009) *Osteoporosis International, in press*

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Table 1 Prevalence of hypovitaminosis D by country in children in the Middle East and North Africa

								25-OHD (ng/ml)				
	Author	Year	Country - City	Latitude	N	Gender	Age (yrs) Mean±SD range	Mean± SD	% < 10-12	% between 10-20	Predictors	Comments
Children	El-Hajj Fuleihan	2001	Lebanon-Beirut	33°N	346	81 boys 88 girls	13.3 ± 1.6	Boys: 19±7 Girls: 15±8 All: 17±8	Boys: 9% Girls: 32% All: 21%	Boys: 46% Girls: 42% All: 44%	Gender Season SES Clothing	Children selected 3 schools of different SES
						83 boys 94 girls	13.3 ± 1.7	Boys: 24±6 Girls: 19±7 All: 22±7	Boys: 0% Girls: 8% All: 4%	Boys: 25% Girls: 46% All: 36%		
	Bahijri	2001	Saudi Arabia-Jeddah	21 °N	935	-	4-72 months	• 4-6mon: 26.2±14.1 • 6-12mon: 24.9±14.1 • 12-24mon: 24.6±14 • 24-36mon: 6.7±11.3 • 36-72mon: 4.2±11.5	**Between 5-10 ng/ml** • 4-6mon: 14% • 6-12mon: 13% • 12-24mon: 14% • 24-36mon: 4% • 36-72mon: 8%		Episodes of diarrhea Dietary intake of vitamin D Sun exposure	Random selection covering all districts and all SES
	Moussavi	2005	Iran-Isfahan	32° N	318	153 boys 165 girls	14-18	Boys: 37.3±18.8 Girls: 16.8±8.4	**< 20 ng/ml** Boys: 18% Girls: 72%		Gender Sun exposure	Cross-sectional, multistage random selection from schools
	Dahifar	2006	Iran-Tehran	35° N	414	Girls	11-15	All: 30	All: 3.6%	-	Ca intake Sun exposure	Cross-sectional, random selection from schools
	El-Hajj Fuleihan	2006	Lebanon-Beirut	33° N	363	184 boys 179 girls	10-17	All: 16±9	Boys: 12% Girls: 33%	Boys: 66% Girls: 51%	Gender Winter	Convenience sample, from 4 schools, balanced geographical and socioeconomic presentation
	Siddiqui	2007	Saudi Arabia-Jeddah	21° N	433	Girls	12-15	-	All: 81%	-	Family income Sun exposure Intake of dairy products	Randomly selected from different schools

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	Author	Year	Country - City	Latitude	N	Gender	Age (yrs) Mean±SD range	Mean± SD	% < 10-12	% between 10-20	Predictors	Comments
Adults	El-Sonbaty	1996	Kuwait-Kuwait city	29° N	72	Women: 50 veiled 22 unveiled	14-45	Veiled: 5.8±2 Unveiled: 12±3.3	**<8 ng/ml** Veiled: 86%		Veiling	Case-control study, convenience sampling
	El-Hajj Fuleihan	1999	Lebanon-Beirut	33° N	465	Women	15-60	All: 11±14	All: 60%	All: 35%	Veiling	Random sample from a village in central Lebanon
	Ghannam	1999	Saudi Arabia-Riyadh	24° N	321	Women	10 ->50	All: 10 ±8	All: 52%	-	Lactation Parity	Cohort, convenience sampling through advertisements
	Gannage	2000	Lebanon-Beirut	33° N	310	99 men 217 women	30-50	Men: 14.3±7.5 Women: 7.6±5.8 All: 9.7±7.1	**<12 ng/ml** Men: 48% Women: 84% **<5 ng/ml** Men: 41% Veiled: 62%		Vitamin D intake Urban dwelling Veiling High parity	Convenience sampling, from different rural and urban centers
	Mishal	2001	Jordan-Amman	31° N	146	22 men 124 women	18-45	**Summer** Men: 43.8±5.2 Women by dress style: • Western: 36.7±6.1 • Hijab: 28.3±4.5 • Niqab: 24.3±5.8 **Winter** Men: 34.7±4.2 Women by dress style: • Western: 30.9±4.6 • Hijab: 24.4±3.9 • Niqab: 22.7±3.0	**5- 12 ng/ml** **Summer** Men: 18% Women by dress style: • Western: 31% • Hijab: 55% • Niqab: 75% **Winter** Men: 46% Women by dress style: • Western: 75% • Hijab: 71% • Niqab: 82%		Dress style Winter	Convenience sampling

Table 2 Prevalence of hypovitaminosis D by country in adults in the Middle East and North Africa

								25-OHD (ng/ml)			
	Author	Year	Country - City	Latitude	N	Gender	Age (yrs) Mean±SD range	Mean± SD	% < 10-12	% between 10-20	Predictors	Comments
Adults	El-Sonbaty	1996	Kuwait-Kuwait city	29° N	72	Women: 50 veiled 22 unveiled	14-45	Veiled: 5.8±2 Unveiled: 12±3.3	**<8 ng/ml** Veiled: 86%		Veiling	Case-control study, convenience sampling
	El-Hajj Fuleihan	1999	Lebanon-Beirut	33° N	465	Women	15-60	All: 11±14	All: 60%	All: 35%	Veiling	Random sample from a village in central Lebanon
	Ghannam	1999	Saudi Arabia-Riyadh	24° N	321	Women	10 ->50	All: 10 ±8	All: 52%	-	Lactation Parity	Cohort, convenience sampling through advertisements
	Gannage	2000	Lebanon-Beirut	33° N	310	99 men 217 women	30-50	Men: 14.3±7.5 Women: 7.6±5.8 All: 9.7±7.1	**<12 ng/ml** Men: 48% Women: 84% **<5 ng/ml** Men: 41% Veiled: 62%		Vitamin D intake Urban dwelling Veiling High parity	Convenience sampling, from different rural and urban centers
	Mishal	2001	Jordan-Amman	31° N	146	22 men 124 women	18-45	**Summer** Men: 43.8±5.2 Women by dress style: • Western: 36.7±6.1 • Hijab: 28.3±4.5 • Niqab: 24.3±5.8 **Winter** Men: 34.7±4.2 Women by dress style: • Western: 30.9±4.6 • Hijab: 24.4±3.9 • Niqab: 22.7±3.0	**5- 12 ng/ml** **Summer** Men: 18% Women by dress style: • Western: 31% • Hijab: 55% • Niqab: 75% **Winter** Men: 46% Women by dress style: • Western: 75% • Hijab: 71% • Niqab: 82%		Dress style Winter	Convenience sampling

Table 2 Prevalence of hypovitaminosis D by country in adults in the Middle East and North Africa

								25-OHD (ng/ml)				
	Author	Year	Country - City	Latitude	N	Gender	Age (yrs) Mean±SD range	Mean± SD	% < 10-12	% between 10-20	Predictors	Comments
Adults	Mirsaeid	2004	Iran-Tehran	35° N	1172	682 men 490 women	3-69	Men: 35±26 Women: 21±22	**< 20 ng/ml** Men: 35% Women: 69%		Season	Cluster random sample. More variation than the women
	Meddeb	2005	Tunisia-Tunis	36° N	389	128 men 261 women	20-60	Veiled: 14 Non-veiled: 17	**< 15 ng/ml** All: 47% Veiled: 70% Non-veiled: 50%		Age Veiling Parity Menopause Winter	Transverse descriptive inquiry
	Hashemipour	2006	Iran - Tehran	35° N	1210	495 men 715 women	20-69	All: 13±16.5	**< 5ng/ml** All: 9% **5-10 ng/ml** All: 56%		Gender Season	Randomized clustered sampling from the Tehran population
	Saadi	2006	UAE- Al Ain	24° N	259	Women	20-85	All: 10.1±4.3	**<8ng/ml** Premenopausal: 39%		Season (low in summer due to avoidance of heat)	Subjects recruited through advertisements. All had low vitamin D levels
	Arabi	2006	Lebanon-Beirut	33° N	443	157 men 286 women	65-85	**Median** Men: 11.3 Women: 9.6	Men: 37% Women: 56%	Men: 57% Women: 39%	Gender	Randomly recruited based on geographical maps
	Hosseinpanah	2008	Iran-Tehran	35° N	245	PM women	40-80	All: 29.2±24.9	All: 5%	All: 38%	Menopause	Cross-sectional, random sampling

Table 3 Prevalence of hypovitaminosis D by country in pregnant women and infants in the Middle East and North Africa

								25-OHD (ng/ml)				
	Author	Year	Country - City	Latitude	N	Gender	Age (yrs) Mean±SD range	Mean± SD	% < 10-12	% between 10-20	Predictors	Comments
Pregnancy / Neonates	Serenius	1984	Saudi Arabia-Riyadh	24° N	119	Women at term and their newborns	-	**Median** All: 5.7	**Undetected levels** Mothers: 9% Cord blood: 42% **< 4 ng/ml** Mothers: 16% Cord blood: 26%		High SES Antenatal care Vitamin D supplement	Survey, 75% of subjects selected randomly from hospital
	Bassir	2001	Iran-Tehran	35° N	50	Women at term and their newborns	16-40	Mothers: 5.1±10.4 New born: 2±3.8	Mothers: 80% New born: 82%	-	Sun exposure	Pilot study, convenience sample from hospital
	Molla	2005	Kuwait-Kuwait city	29° N	214	Women at term and their neonates	27.5±4.2	Mothers: 14.6±10.7 Newborn: 8.2±6.7	**< 10ng/ml** Mothers: 38-41% New born: 60-70%		Maternal education	Mothers selected from two hospitals
	Ainy	2006	Iran-Tehran	35° N	95	Women: 48 Pregnant 47 control	26.2±5.0	1st term: 20.6±12 2nd term: 25.7±16.7 3rd term: 24.5±12.8 Control: 23.0±12.9	1st term: 20% 2nd term: 10% 3rd term: 3% Control: 15%	1st term: 40% 2nd term: 38% 3rd term: 44% Control: 25%	Pregnancy trimester	Cohort study, randomly selected from care centers