

Sexual health status and vitamin D in primary care patients from the Middle East and Sweden

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Abstract

Background

Low vitamin D is more common in Middle Eastern-born patients (Middle Easterners) than in Swedish-born patients of northern European descent (Swedes), and the condition might affect sexual health. The present study (*i*) investigated primary care (PC) patients (*ii*) compared self-reported sexual health in Swedes and Middle Easterners; (*iii*) analysed differences within and between the groups and (*iv*) analysed differences in vitamin D levels between the groups.

Methods

522 PC patients responded to a health questionnaire that included items on sexual health. All provided blood samples: 225 Middle Easterners from Iran, Iraq, and Turkey and 297 Swedes. Logistic regression was used to calculate the odds ratio (OR).

Results

Middle Easterners reported less sexual dysfunction than Swedes; 75.8% of Middle Easterners and 18.9% of Swedes presented a 25(OH)D of < 50 nmol/L. The crude OR for reporting sexual dysfunction was 70% higher in Swedes compared to Middle Easterners (OR 1.50, 95% CI 0.92–3.23). This OR remained significant after adjustment for age, gender, waist circumference, and reported sexual desire. But the significance disappeared after additional adjustment for vitamin D. In both groups, more females than males reported insufficient sexual desire. More female Middle Easterners reported sex life dissatisfaction. More female Swedes reported sexual dysfunction. Covariate inclusions could not explain the association between gender and insufficient sexual desire. Vitamin D could explain association between gender and sex life dissatisfaction in Middle Easterners, and age could explain association between gender and sexual dysfunction in Swedes. Age, waist circumference, and vitamin D levels were significant covariates in the logistic regression models.

Conclusions

Results from the present study suggest that vitamin D variation partly explains differences in sexual dysfunction between the groups and between genders within the groups. Vitamin D therapy should be investigated to determine if these results are clinically useful. That said, perceptions about sex life and mental health (rather the physiological pathology) might explain the results. And further investigation into female Middle Easterners and female Swedes is warranted.

Background

Sexuality is an essential part of being human and is important for quality of life (1). Impaired sexual function is a clinical condition (1–3). Loss of sexual desire is a primary disorder (1–3), and is not caused by other problems such as erectile dysfunction, dyspareunia or other diseases. Hormonal changes in females and males due to aging (2) and psychosocial factors (3) may play a role in loss of sexual desire. Sexual disorders occur as a consequence of obesity in males of all ages (4).

Prevalence of specific, sexual dysfunction manifestations varies considerably (5–7) for females and males. Epidemiological studies of male sexual dysfunction consistently indicated that dysfunction increases with age. Sexual dysfunction increases 10% in males aged 40 to 49 and 100% in males aged 70 to 89 (4, 5). Additionally, male sexual desire decreases in advanced age (8, 9). Female sexual dysfunction also increases in advanced age. And female sexual dysfunction varied up to 50% (6–8, 10–12).

Studies of sexual dysfunction in the UK reported a higher prevalence of the disorder in males of south Asian descent than in males of European descent in the UK (13). Similarly, another study in London concluded that those, who sought care for dysfunction, came mainly from Asia, the Middle East, or North Africa (14). A Swedish study of patients with type-2 diabetes found no differences in sexual dysfunction prevalence. That said, the study reported higher prevalence of decreased sexual desire (self-reported) in Assyrians than in Swedes (15).

Some evidence suggests that vitamin D can affect sexual health. A recent clinical trial found that vitamin D treatment in males with vitamin D deficiency could increase testosterone levels and improve erectile function (16). But the study included males aged 35 to 64 with normal testosterone levels at baseline. A pilot study of young females found a correlation between vitamin D deficiency and lower self-rated sexual health as evaluated by the *Female Sexual Function Index* – particularly in the areas of sexual desire, orgasm dysfunction, and sexual satisfaction (17).

Vitamin D deficiency prevalence varies between immigrants to Europe and native-born Europeans. A German study reported that 74% of Turkish immigrants (male and female) had a vitamin D deficiency – compared to 33% of native Germans (defined as 25(OH)D of < 30 nmol/L). Deficiency prevalence was somewhat higher in Turkish females, who wore ethnic skin-covering clothing, than females who wore western clothing (86% vs. 69%) (18).

While vitamin D variation between native Europeans and Middle Eastern immigrants was found, no data or analyses indicate whether this variation is associated with differences in sexual health. If this association exists, it might imply that immigrants seeking care for sexual dysfunction should be tested, and when appropriate, treated for vitamin D deficiency. So the aims of this study were to (*i*) determine if a difference in sexual health exists between Swedes and Middle Easterners (self-reporting, primary care patients) and (*ii*) determine if any existing differences are associated with vitamin D variation, age, sex, body mass index (BMI), and waist circumference.

Methods

Study population

Data used in the present study came from: (i) "Screening and treatment of prediabetes in primary health care: a pilot study" and (ii) "Health problems and vitamin D status in primary health care patients from different ethnic groups". The former (4-D diabetes study; 2013 – 2015) was done at the Flemingsberg and Jakobsberg Primary Health Care Centres in Stockholm (PHCC). The latter (vitamin D study; 2015 – 2016) was done at the Flemingsberg PHCC.

Inclusion criteria for both studies were (i) being born in Sweden (persons born in Sweden whose parents were also born in Sweden and are of northern European descent) and (ii) being born in the Middle East, Africa, or Asia (an immigrant in Sweden). The 4-D study excluded patients with a diabetes diagnosis.

All patients, who consecutively sought primary care during the relevant periods and met the inclusion criteria, received a verbal invitation to participate in the studies. In total, 929 patients were recruited to both studies at the Flemingsberg PHCC (n=394 in the 4-D study and n=99 in the vitamin D study) and at the Jakobsberg PHCC (n=436 in 4-D study). Patients (n=23), who participated in both studies at the Flemingsberg PHCC, were only counted once. So in total, 903 patients participated in both studies. Firstly, the patients responded to a questionnaire about their health, and then they provided blood samples drawn at the Karolinska University Hospital.

The present study included patients of northern European descent who were born in Sweden and whose parents also were born in Sweden (n=297) and patients of Middle Eastern descent born in Turkey, Iran, or Iraq (n=225), namely, 522 patients in total.

Independent variable

Origin categorized as Swedes and Middle Easterners; see above.

Dependent variables

Overall *self-reported sexual health* and:

- *sexual function* based on "Can you complete the act of intercourse?" – item defined as ability to have intercourse (yes/no);
- *sexual desire* based on "Do you have any sexual desire?" – item dichotomised as either present or absent (yes/no); and
- *sex life dissatisfaction*: "How satisfied are you with your sex life?" – item responses on a five-point scale: very satisfied, somewhat satisfied, neutral, somewhat dissatisfied, very dissatisfied.

Covariates

The present study included these covariates: age, sex, birthplace, BMI, waist circumference, and vitamin D levels (25(OH)D in nmol/L). *Age* was a continuous variable. *BMI* was continuous and calculated as weight divided by height squared (kg/m^2) and grouped as: normal ($\text{BMI} < 25$); overweight ($\text{BMI} \geq 25$ and < 30); and obese ($\text{BMI} \geq 30$). *Waist circumference* was a continuous variable. Vitamin D *levels* categorized as: normal ($25(\text{OH})\text{D} \geq 50 \text{ nmol/L}$); inadequate ($25(\text{OH})\text{D} \geq 25 \text{ and } < 50 \text{ nmol/L}$); and deficient ($25(\text{OH})\text{D} < 25 \text{ nmol/L}$) (15).

The present study selected 25(OH)D because (i) it is the metabolite of vitamin D that is used for determining a person's vitamin D status; (ii) it has a long half-life, and (iii) its production by the liver is not significantly regulated – versus production of 1,25(OH₂)D by the kidneys (19, 20).

Statistical methods

Differences in normally distributed variables between Swedes and Middle Easterners were determined with a Student's t-test. Differences in variables that were *not* normally distributed were determined with a Mann-Whitney U-test. Categorical variables were gender, sexual function, sexual desire, and sex life satisfaction. Statistical significance – of differences in these variables between Swedes and Middle Easterners – was determined with a chi-square test. Logistic regression revealed the odds ratios between Swedes and Middle Easterners and separately, between females and males in each group. Stepwise adjustment for each explanatory variable was presented in models; each model was added stepwise to the previous model. A p-value of less than 0.05 was considered statistically significant. STATA 14 software (StataCorp LP, Texas) was used for all statistical analyses.

Results

Demographic characteristics

The present study had 522 patients 297 Swedes (56.9%) and 225 Middle Easterners (43.1%); see Table 1. Females were in the majority among Swedes (58.3%) and Middle Easterners (59.6%). Middle Easterners were significantly younger with than Swedes with (mean ages 45.3 and 55.0, respectively). Statistically significant differences between the two groups were found in median 25(OH)D levels of 67.4 nmol/L in the Swedes and 37.0 nmol/L in the Middle Easterners. Reporting of sexual dysfunction was significantly higher among Swedes.

No statistically significant differences occurred regarding sexual satisfaction and sexual desire between the groups. The most striking difference was in vitamin D level: 227 Swedes (81.6%) and 66 Middle Easterners (35.5%) had a normal 25(OH)D level of $\geq 50 \text{ nmol/L}$ ($p < 0.0001$).

Table 2 presents gender differences regarding sexual health. Significant gender differences occurred regarding (i) insufficient sexual desire and sexual dysfunction in Swedes and (ii) sex life dissatisfaction in Middle Easterners. Compared to male Swedes, female Swedes more frequently reported insufficient sexual desire (52.3% versus 47.7%) and sexual dysfunction (60.4% versus 39.6%), which is significant.

Female Middle Easterners reported significantly more sex life dissatisfaction than male Middle Easterners (67.0% versus 33.0%, respectively).

Logistic regression

Table 3 displays difference in sexual dysfunction in Swedes (with Middle Easterners as reference). The crude OR of reporting sexual dysfunction in Swedes patients was 1.70 (95% CI 1.15–2.50). The adjustment for age and sex increased the odds ratios to 2.14. Stepwise inclusion in the logistic regressions models of waist circumference and sexual desire slightly change the odds ratios (2.17 and 2.11). In the final model with inclusion of the vitamin D level covariate, the odds ratios changed to non-significant, OR=1.50 (95% CI 0.92-3.23). Age, waist circumference, and vitamin D levels were significant covariates. Patients who had adequate vitamin D levels had 19 times higher odds of reporting sexual dysfunction than those with vitamin D levels under 25 nmol/L (OR=19.35, 95% CI 8.50-43.90).

Because gender differences occurred regarding insufficient sexual desire, more statistical analyses were done to explore possible covariant influences. Table 4 displays the crude odds ratio for female Swedes (with male Swedes as reference). Female Swedes had a crude odds ratio of 1.71 for insufficient sexual desire; it rose to 1.87 after adjustment for age. So females had the probability of reporting insufficient sexual desire 87% more times than male Swedes.

Adjustment for differences in age and waist circumference and sexual function increased the odds ratios from 1.87 to 2.40. In the final model, with inclusion of vitamin D levels, the odds ratios was almost the same (2.17) and still significant.

Results of logistic regression analyses of differences in reporting sexual dysfunction between female Swedes with male Swedes showed that in the crude model, male Swedes had 57% higher odds for having sexual desire – compared to female Swedes. In the age-adjusted model, the odds ratios decreased to nonsignificant levels (not shown in table).

Table 5 displays results of the logistic regression analyses for reporting sex life dissatisfaction among female Middle Easterners – compared to male Middle Easterners. The odds ratio for females was more than twice that for males in the crude model (OR=2.07). When differences in vitamin D levels were accounted for in the final model, the odds ratio for reporting sex life dissatisfaction in females decreased and was no longer significant. So differences in vitamin D levels could explain gender differences in reporting sex life dissatisfaction. The sexual desire covariate was the only significant one: regardless of gender, those who reported insufficient sexual desire had 5 times higher odds for reporting sex life dissatisfaction than those who did *not* report insufficient sexual desire.

Discussion

The present study investigated primary care patients (Swedes and Middle Easterners). It analysed differences within and between the groups regarding (*i*) sexual health factors and (*ii*) differences in

vitamin D levels.

One-third of all patients reported sexual dysfunction. Compared to Swedes, Middle Easterners had significantly *lower* sexual dysfunction prevalence and odds of having sexual dysfunction. After adjustment for all covariates (including vitamin D), differences between the groups changed to nonsignificant. This suggests that vitamin D status might help explain the observed difference in probability regarding sexual dysfunction. No significant differences existed between Swedes and Middle Easterners regarding self-reported sexual desire or sex life satisfaction.

Results of the present study were unexpected regarding reporting worsen sexual life in Swedish-born than in Middle Eastern-born patients and not aligned with the results of other studies. Malavige et al reported no significant difference in erectile dysfunction (ED) prevalence between south Asians and Europeans. And premature ejaculation was significantly more common in south Asian males. That said, the present study and this study may not be comparable due to differences in population and methods (13). Another study of males from the Middle East and south Asia reported that most patients who sought care at a clinic in London were of north African, Middle Eastern, or south Asian descent (14). Both studies involved males only, which is not similar to the present study that included males and females.

But a Swedish study with a sample comparable to the present study reported findings that were not aligned with findings in the present study either. That particular Swedish study found a higher prevalence of decreased sexual desire in Assyrians than in Swedes – and no differences in sexual function. Although the study was methodologically similar to the present study, it only included patients with type-2 diabetes (15).

Other studies reported higher prevalence of vitamin D deficiency in Middle Easterners living in Europe than in native Europeans (18, 21), and the present study confirmed this finding. This isn't surprising because evidence in this area is strong. Skin colour is one (but not the only potential cause of this difference).

Moreno-Reyes et al reported that Moroccans and Turks residing in Brussels had higher vitamin D levels than residents from the Congo – even though the Congolese had darker skin colour (21). These researchers suggested that it might be due to factors such as socio-economic status and UVB light exposure rather than differences in diet, because few food items contain significant amounts of vitamin D. The present study only included Middle Easterners. So no vitamin D deficiency comparison could occur between Middle Easterners and other immigrant groups.

Another study with 1231 participants reported higher vitamin D deficiency prevalence in Turkish immigrants than in ethnic Germans – and even higher prevalence in Turkish females who totally covered their bodies (18). This finding suggests that limiting the amount of sunlight that reaches the skin (with clothing) can affect vitamin D levels (18). And while the present study did not investigate clothing, the populations are comparable, and the present study yielded similar result.

The present study also found significant gender differences regarding insufficient sexual desire and sexual function among Swedes. Age explained differences between genders (Swedish) in those who reported sexual dysfunction. Covariates could not explain gender differences regarding insufficient sexual desire among Swedes nor could they explain the probability of reporting insufficient sexual desire.

The aforementioned discrepancies call for further investigation. Explanations could be found in deeper investigation of hormonal disturbances or mental health. But among Middle Easterners, those with lower vitamin D levels had significantly lower risk for reporting insufficient sexual desire than those with normal vitamin D levels. This was unexpected but might be explained by perceptions about sex life and mental health rather the physiological pathology. Further, deeper investigations of the sexual desire among Middle Easterners are also warranted.

A growing number of studies reported age-related increases in sexual dysfunction in males – largely attributable to performance disturbances due to atherosclerosis (8, 9, 22). Consequently in the present study, age was expected to be a significant covariate.

Multimorbidity and polypharmacy in older persons might explain this – as might psychological issues. In addition, the present study's population had risks for developing type-2 diabetes – a disease associated with fatigue, depression, and other health conditions that affect sex life.

Strengths and limitations

The material used in the present study consists of data that was the first of its kind to be gathered in Sweden. The aforementioned *4-D diabetes* and *vitamin D* studies were the first to compare sexual health factors among Swedes and Middle Easterners. Covering so many factors can be a strength – if a general overview of health is the aim. But it may also be a weakness, because the questionnaire only briefly dealt with sexual health.

Results from the present study imply that greater prevalence of low vitamin D levels among Middle Easterners could be associated with higher risk for sex life dissatisfaction. A Deleskog et al study suggested that vitamin D levels can trigger sex life dissatisfaction – a common complaint among patients with type-2 diabetes. Not unlike patients in the Deleskog study, patients in the present study had higher risk for developing type-2 diabetes. And this suggests that they should be tested for vitamin D levels – as a proxy for type-2 diabetes within 10 years – and be subscribed vitamin D for type-2 diabetes prevention, which the Deleskog study recommended (23). The Deleskog study included non-immigrant population resettled in Stockholm and the results were that those with prediabetes had lower vitamin D levels and higher diabetes risk as measured after 10 years. However, because this was a cross-sectional study, it was not possible to determine causality, i.e., whether the difference in vitamin D levels caused the difference in reporting declined sexual health, in general, and sex life dissatisfaction, in particular. Instead, causes not included in the statistical analysis, such as differences in diet, health conditions, amount of exercise, or measurement of vitamin D levels during different seasons (winter or summer) may explain the findings.

The previously published studies of patients on haemodialysis concluded that treatment with vitamin D did not improve sexual function in patients with vitamin D deficiency (24, 25). But this could be because of the patients' other medical condition. One study investigated treatment of 102 healthy middle-aged males with vitamin D deficiency and ED with high dosage of ergocalciferol, a form of vitamin D, over at least 12 months. The men's ED improved, their testosterone increased, and their HbA1c decreased (17). The researchers also observed a small decrease in the men's BMI (16). Clearly, knowledge of this area is insufficient and further studies on effects of treatment with different forms of vitamin D are highly needed.

Another limitation of the present study was type of questions asked. Because of the nature of the two studies from which the data for this study were collected (they were general overviews of the participants' health), the questionnaire only briefly touched on sexual health with three issues: ability, desire, and satisfaction. For example, impaired sexual function consist of one single yes/no question without detailed categorization into its specific aetiologies (e.g., ED, dyspareunia). Fuller investigation of the topic would require additional questions.

The present study included patients from the countries of origin of large immigrant groups in Sweden. This makes results of the study readily applicable to a large part of the Swedish immigrant population. But the study sample may not be representative of immigrants who came to Sweden very recently – many of whom come from Syria and Afghanistan. Although it may be plausible to assume that results of the present study may be applicable to immigrants from Syria (because of geographic proximity of Syria to countries included in the present study), it is less likely that they are applicable to immigrants from Afghanistan, due to geographic distance and perhaps cultural and religious differences.

The skewed sex distribution in the present study's population (58.8% female) may make the results more applicable to females than males. It also makes it harder to compare the present study's results to those of other studies, because many previous studies investigated ED and vitamin D. That said, gender distribution of the Swedes and the immigrants did not vary significantly in present study; consequently, the skewed distribution did not affect comparison between these two groups – as seen when gender was add in the logistic regression.

Some factors may render the present study's population as not representative of the entire population of Sweden because it is based on primary care patients. The present study lacks information regarding patients who *refused to participate* in the aforementioned *4-D diabetes* and *vitamin D* studies. Only patients seeking care at a primary care centre were included, which means that people who were healthy or for some other reason did not seek primary health care were not included in the studies. So compared to the general population, the present study's population may contain a larger proportion of people with chronic health conditions that can affect sexual health. Recruitment occurred in two areas outside Stockholm with high immigrant populations, which might make the results more difficult to apply to the population of other areas in Sweden. Recruitment at multiple geographic locations – and not limited to patients – is warranted for future studies.

Although the results of the present study may not be applied clinically because the study did not establish any kind of causality, it provides ideas for future clinical studies that could investigate possible vitamin D treatment effects. The present study lacked data on whether or not participants in the 4-D diabetes study were treated with vitamin D supplements. If found effective in such studies, the vitamin D supplementation could possibly contribute to treatment for sexual health problems. It might also have positive effects on other aspects of health, because other symptoms are linked to vitamin D deficiency (26, 27).

Conclusions

The present study achieved its objectives to investigate primary care patients (Swedes and Middle Easterners), compare their self-reported sexual health status, analyse differences within and between the groups, and analyse differences in vitamin D levels between the groups. The study revealed that vitamin D variation partly explains differences in sexual dysfunction between the groups and between genders within the groups. But the study cannot establish causality. Investigations of vitamin D treatment should be done to determine whether these results are clinically useful. The present study's findings might be explained by perceptions about sex life and mental health – rather than physiological pathology. More extensive investigation of sex life for female Swedes and Middle Easterners are warranted.

Abbreviations

BMI Body Mass Index

ED Erectile Dysfunction

SD Standard Deviation

OR Odds Ratio

PHCC Primary Health Care Centre

UK United Kingdom

UVB Type B Ultraviolet

Declarations

Ethical approval and consent to participate

Ethical permits for the 4D-study (diarienr 2014/3:2) and vitamin D study (diarienr 2009/422 – 31/4 with the amendment 2015/680 – 32/4) were approved by Ethical Review Board in Stockholm. All participant

received written informed consent and have consented to be a part of the 4D and vitamin D studies both verbally and by participation in testing of blood samples and other tests in the studies.

Consent for publication

Not applicable.

Availability of data and materials

Either data or materials are publicly available as the sharing of the data with other researchers was not included in patient's written informed consent. However data are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Author's contribution

MT was a major contributor in writing the manuscript and performed statistical analyses, KS participate in designing of the 4D study and participated in data collection, CGÖ participated in design of the study, interpretation of the results and critically editing of the manuscript, HS participated in design of the study and critically edit the manuscript. All authors read and approved the final version of the manuscript.

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Tables

Table 1. Study sample characteristics with test of statistically significant differences.

	All patients	Swedes	Middle Easterners	p-value
Total (%)	522 (100%)	297 (56.9)	225 (43.1)	
Age (years)				
Mean (SD)	50.8 (0.63)	55.0 (0.87)	45.3 (0.78)	<0.0001 ^a
Waist circumference				
Mean (SD)	98.0 (0.64)	99.6 (0.86)	95.3 (0.93)	0.0037 ^a
25(OH)D (nmol/L)				
Mean	53.7 (1.5)	67.4 (1.9)	37.0 (1.6)	<0.0001 ^a
25(OH)D (nmol/L)				
<25	69 (13.2)	8 (2.7)	61 (27.1)	
25-49.9	135 (25.9)	48 (16.2)	87 (38.7)	
≥50	318 (60.9)	241 (81.1)	77 (34.2)	<0.0001 ^a
Gender				
Male n (%)	215 (41.2)	124 (41.8)	91 (40.4)	
Female n (%)	307 (58.8)	173 (58.3)	134 (59.6)	0.764 ^b
Sexual function				
Yes (%)	145 (28.8)	69 (24.1)	76 (35.0)	
No (%)	358 (71.2)	217 (75.9)	141 (65.05)	0.008 ^b
Sexual desire				
Yes (%)	125 (38.7)	109 (38.0)	86 (39.6)	
No (%)	209 (61.3)	178 (62.0)	131 (60.4)	0.706 ^b
Sex life satisfaction				
Yes (%)	240 (52.2)	133 (53.2)	107 (51.0)	
No (%)	220 (47.8)	117 (46.8)	103 (49.0)	0.631 ^b

a: Student's t-test.

b: Chi-square

Table 2. Prevalence of sexual health by gender among Swedes and Middle Easterners

Covariates	Swedes			Middle Easterners		
	Females	Males	Chi ² test	Females	Males	Chi ² test
Total population, (%)	134 (59.6)	91 (40.4)		173 (58.3)	124 (41.7)	
Self-reported sexual desire, n (%)	93 (52.3)	85 (47.7)	0.032	70 (53.4)	61 (46.6)	0.060
Self-reported sexual function, n (%)	131 (60.4)	86 (39.6)	0.041	83 (58.9)	58 (41.1)	0.890
Self-reported sex life satisfaction, n (%)	63 (53.9)	54 (46.1)	0.601	69 (67.0)	34 (33.0)	0.010

Table 3. Associations between sexual dysfunction and covariates variables in Swedes with Middle Easterners as reference. Significant odds ratios in bold.

Variable	Crude OR OR (95% CI)	Model 1: +age, sex OR (95% CI)	Model 2: waist circumference OR (95% CI)	Model 3: + sexual desire OR (95% CI)	Model 3: +25(OH)D OR (95% CI)
Group					
Middle Easterners	Reference	Reference	Reference	Reference	Reference
Swedes	1.70 (1.15-2.50)	2.14 (1.00-2.40)	2.17 (1.15-2.50)	2.11 (1.15-2.50)	1.50 (0.92-3.23)
Age		1.01 (1.04-1.07)	1.01 (1.04-1.07)	1.05 (1.04-1.07)	1.04 (0.98-1.01)
Gender					
Female	Reference	Reference	Reference	Reference	Reference
Male	1.01 (1.04-1.07)	1.01 (1.03-1.07)	0.81 (0.53-1.23)	0.91 (0.55-1.52)	
Waist	1.01	1.01	1.01	1.01	1.03
circumference		(1.00-1.03)	(1.00-1.03)	(1.00-1.02)	(1.00-1.04)
Sexual desire					
Yes				Reference	Reference
No				1.06 (0.67-1.68)	1.40 (0.81-2.40)
25(OH)D					
<25 nmol/L					Reference
25–49.9 nmol/L					3.30 (1.41-7.80)
≥50 nmol/L					19.35 (8.50-43.90)

Table 4. Associations between insufficient sexual desire and covariates in female Swedes with male Swedes as reference. Crude model (OR=1.71, 95% CI (1.04-2.80)). Significant odds ratios in bold.

Variable	Model 1: +age OR (95% CI)	Model 2: waist circumference OR (95% CI)	Model 3: + sexual function OR (95% CI)	Model 4: + sexual dissatisfaction OR (95% CI)	Model 3: +25(OH)D OR (95% CI)
Group					
Middle Easterners	Reference	Reference	Reference	Reference	Reference
Swedes	1.87 (1.13- 3.10)	1.83 (1.08-3.11)	2.40 (1.32-4.30)	2.18 (1.20-4.02)	2.17 (1.05- 3.95)
Age	1.02 (1.00- 1.03)	1.01 (1.00-1.03)	1.01 (1.00-1.03)	1.02 (1.00-1.04)	1.01 (1.00- 1.02)
Waist		1.05 (1.03-1.07)	1.05 (1.03-1.07)	1.05 (1.03-1.07)	1.05 (1.02- 1.07)
Sexual function					
Yes			Reference	Reference	Reference
No			2.43 (1.25-4.71)	1.78 (0.88-3.62)	1.62 (0.74- 3.60)
Sexual dissatisfaction					
No				Reference	Reference
Yes				1.05 (0.60-1.85)	0.80 (0.42- 1.50)
25(OH)D					1.00 (0.98- 1.00)

Table 5. Associations between sex life dissatisfaction and covariates in female Middle Easterners with male Middle Easterners as reference. Significant odds ratios in bold.

Variable	Crude OR	Model 1: +age OR (95% CI)	Model 2: + sexual function OR (95% CI)	Model 3: + sexual desire OR (95% CI)	Model 3: +25(OH)D OR (95% CI)
Group					
Males	Reference	Reference	Reference	Reference	Reference
Females	2.07 (1.18-3.61)	2.09 (1.20-3.70)	2.09 (1.20-3.70)	2.10 (1.20-3.80)	1.77 (0.90-3.00)
Age					
		1.00 (0.98-1.03)	1.00 (0.98-1.03)	1.01 (0.99-1.04)	1.02 (0.99-1.06)
Sexual function					
Yes			Reference	Reference	Reference
No			0.90 (0.50-1.62)	0.50 (0.24-1.06)	0.57 (0.22-1.46)
Sexual desire					
Yes				Reference	Reference
No				2.81 (1.32-6.00)	5.30 (2.06-13.60)
25(OH)D status					
≥50 nmol/L					Reference
25–49.9 nmol/L					1.10 (0.51-2.34)
<25 nmol/L					0.85 (0.35-2.10)