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Association of Serum Vitamins with Eczema in US Adults (NHANES 2005–2006)

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Keywords

Eczema · Vitamins · NHANES

Dear editor,

Eczema is one of the most common dermatological issue, with dermatitis being the highest contributor of disability-adjusted life years (DALYs) to global skin disease morbidity and mortality [1]. We hypothesize that vitamins may be involved in the etiology of eczema, through their influence on the epidermis or the immune system. We tested our hypothesis cross-sectionally in the general population of the USA.

We used the US National Health and Nutrition Examination Survey (NHANES) conducted in 2005–2006. NHANES is a series of national, population-based, cross-sectional surveys conducted by the National Center for Health Statistics. The NHANES study sample was selected to represent the general non-institutionalized US population [2]. We included adults 20 years and older. Ever-report of eczema was assessed through the question “Has a doctor or other health professional ever told you that you have eczema?” Serum concentrations of vitamin D (25-hydroxyvitamin D), vitamin A (retinol), vitamin E (α and γ -tocopherol), vitamin B₆ (pyridoxal 5'-phosphate), and vitamin B₁₂ were measured. The association between eczema and tertiles of serum vitamin levels was estimated using multivariate logistic regression models adjusted for patient demographic variables (age, sex, season, race, education, income), lifestyle variables (BMI, smoking, drinking), stress variables (depression, sleep), and medical co-morbidities (asthma, hay fever, IgE). A sample weight was assigned to each individual representative of the US Census population, which is a measure of the number of people in the population represented by that sample person. We used SAS version 9.4 for regression models to estimate ORs with 95% CI. The ORs represented the odds of report of eczema versus no report of eczema. Results were considered significant at a level of $p < 0.05$.

A total of 3,925 adults were included in the analysis. The prevalence of ever-report of eczema was 7.9% (Table 1). Comparing the

lowest with the highest tertile (reference category) of vitamin concentrations, we did not see a relationship of vitamin A (OR 1.26, 95% CI 0.86–1.83), vitamin E (OR 1.34, 95% CI 0.81–2.20), vitamin B₆ (OR 1.07, 95% CI 0.72–1.60), or vitamin B₁₂ (OR 1.25, 95% CI 0.74–2.10) with risk of eczema. We saw a protective effect of vitamin D, with the lowest (range 13.2–47.1 nmol/L) and middle (range 49.5–66.5 nmol/L) tertiles of vitamin D showing higher risk of eczema (OR 1.70, 95% CI 1.05–2.74; OR 1.45, 95% CI 0.99–2.11) when compared to the highest tertile (range 68.9–195 nmol/L; Table 2).

A previous study in Korea reported that low vitamin D level was associated with eczema in an adult population [3]. A randomized, double-blinded, placebo-controlled study of atopic dermatitis patients found that vitamin D supplementation resulted in significant improvements in atopic dermatitis severity [4]. However, a UK Biobank study found no association between genetically lowered vitamin D levels and atopic dermatitis [5]. The relationship between vitamin D and eczema is still unclear. Our study found a relationship between vitamin D (serum 25-hydroxyvitamin D) level and the reports of eczema, which appears to have a dose-response relationship. Our finding provides additional evidence that some vitamin deficiencies are possible risk factors in the development of eczema. Our study has several limitations. First, NHANES is a cross-sectional survey, which cannot infer a causal relationship. Second, self-reporting eczema is subjected to a potential of recall bias. Disease severity and healthcare utilization may also underrepresent the true prevalence of eczema. Third, because the survey question was about ever-report of eczema, we do not know the vitamin levels when the patients had active disease, which may weaken the association. Considering that there is no consensus on using vitamins for eczema prevention and treatment in the current clinical guidelines, vitamin supplementation, in relationship with serum vitamin levels, especially vitamin D, needs to be elucidated in future studies.

Key Message

Vitamin D, but not other vitamins, might have an association with eczema in US adults.

Disclosure Statement

The authors have no conflicts of interest to declare.

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Author Contributions

J.W. and J.S.J. designed the study. J.W. had access to raw data and conducted statistical analysis. J.W. and J.S.J. interpreted the results. Both authors contributed to the paper and approved of the final version.

Table 1. Eczema prevalence and serum vitamin levels according to demographic, lifestyle, stress, and medical co-morbidity

Total	Eczema, <i>n</i> (%)	No eczema, <i>n</i> (%)	OR (95% CI)	<i>p</i> value	Vitamin D, nmol/L	Vitamin A, μmol/L	Vitamin E, μmol/L	Vitamin B ₆ , nmol/L	Vitamin B ₁₂ , pmol/L
<i>Overall, n (%)</i>	265 (7.9)	3,660 (92.1)			61.3 (1.1)	2.12 (0.02)	29.3 (0.4)	76.9 (2.8)	401.5 (8.3)
<i>Age, years</i>					[0.046]	[<0.001]	[0.07]	[0.0003]	[<0.001]
Mean	45.4 (1.2)	46.6 (0.8)		0.36					
<i>Sex</i>					[0.54]	[<0.001]	[0.07]	[0.03]	[0.001]
Female	154 (9.3)	1,877 (90.7)	1 (ref.)		61.5 (1.3)	2.01 (0.02)	30.0 (0.5)	73.1 (2.2)	417.8 (13.5)
Male	111 (6.5)	1,783 (93.5)	0.67 (0.53–0.84)	0.002	61.1 (1.0)	2.23 (0.02)	28.6 (0.3)	81.0 (4.5)	384.2 (6.9)
<i>Season at sampling</i>					[<0.001]	[0.90]	[0.24]	[0.18]	[0.48]
Winter	82 (5.4)	1,682 (94.6)	1 (ref.)		55.6 (1.4)	2.12 (0.03)	29.6 (0.4)	73.9 (3.1)	421.5 (19.7)
Summer	183 (9.7)	1,972 (90.3)	1.90 (1.19–3.04)	0.01	65.2 (1.0)	2.12 (0.02)	29.2 (0.4)	78.9 (1.5)	387.6 (7.5)
<i>Race/ethnicity</i>					[<0.001]	[0.89]	[0.14]	[0.04]	[0.03]
Mexican American	13 (1.9)	757 (98.1)	0.20 (0.13–0.30)	<0.001	51.9 (2.0)	1.88 (0.02)	27.7 (0.5)	67.2 (3.0)	570.8 (70.7)
Other Hispanic	6 (4.7)	115 (95.3)	0.51 (0.23–1.14)	0.01	53.6 (1.4)	1.94 (0.03)	27.7 (0.5)	74.1 (4.7)	408.9 (11.9)
Non-Hispanic white	176 (8.9)	1,862 (91.1)	1 (ref.)		65.8 (1.1)	2.20 (0.02)	30.4 (0.4)	81.3 (3.8)	382.5 (7.5)
Non-Hispanic black	60 (6.9)	793 (93.1)	0.77 (0.54–1.08)	0.12	41.9 (1.3)	1.90 (0.02)	24.7 (0.3)	58.6 (4.3)	425.8 (10.2)
Other	10 (7.0)	133 (93.0)	0.77 (0.45–1.32)	0.31	54.9 (1.9)	1.91 (0.06)	26.9 (0.7)	65.5 (5.8)	369.1 (18.9)
<i>Education</i>					[<0.001]	[<0.001]	[<0.001]	[0.16]	[<0.001]
Less than 9th grade	12 (3.2)	429 (96.8)	1 (ref.)		55.7 (1.3)	2.06 (0.03)	29.8 (0.7)	61.1 (4.0)	592.8 (115.3)
9th–11th grade	31 (6.8)	558 (93.2)	2.20 (0.80–6.04)	0.12	56.2 (2.0)	2.01 (0.04)	26.5 (0.5)	56.0 (3.6)	387.7 (11.6)
High school graduate	59 (7.8)	877 (92.2)	2.55 (1.27–5.12)	0.01	60.3 (1.2)	2.13 (0.03)	28.9 (0.7)	70.8 (3.6)	387.9 (13.1)
Some college or associate degree	90 (8.3)	1,043 (91.7)	2.76 (1.19–6.40)	0.02	62.0 (1.3)	2.11 (0.03)	29.0 (0.5)	75.6 (3.2)	383.9 (9.8)
College graduate and above	73 (9.1)	753 (90.9)	3.05 (1.17–7.94)	0.03	64.7 (1.1)	2.18 (0.03)	31.1 (0.6)	95.7 (7.0)	400.0 (10.0)
<i>Income (PIR)</i>					[<0.001]	[<0.001]	[<0.001]	[0.007]	[<0.001]
0–1.85	84 (6.3)	1,411 (93.7)	1 (ref.)		56.7 (1.5)	2.03 (0.02)	27.3 (0.4)	60.2 (1.9)	406.0 (10.7)
1.86–3.50	68 (7.8)	993 (92.2)	1.24 (0.76–2.04)	0.36	60.8 (1.3)	2.12 (0.02)	29.2 (0.5)	75.0 (5.0)	419.8 (28.5)
>3.50	113 (9.0)	1,256 (91.0)	1.45 (1.00–2.11)	0.05	64.3 (1.3)	2.17 (0.02)	30.6 (0.4)	87.6 (3.8)	387.8 (5.9)
<i>Smoking</i>					[0.36]	[0.28]	[<0.001]	[0.004]	[<0.001]
Never smoker	126 (7.4)	1,912 (92.6)	1 (ref.)		60.5 (1.3)	2.08 (0.02)	29.7 (0.5)	83.6 (3.3)	422.8 (14.5)
Past smoker	73 (9.0)	951 (91.0)	1.23 (0.85–1.80)	0.26	62.7 (1.3)	2.24 (0.03)	31.3 (0.3)	83.1 (4.6)	405.9 (10.0)
Current smoker	66 (7.9)	797 (92.1)	1.06 (0.78–1.45)	0.67	61.5 (1.2)	2.08 (0.03)	26.3 (0.4)	56.2 (3.1)	352.0 (9.0)
<i>Drinking</i>					[<0.001]	[<0.001]	[0.84]	[0.14]	[0.01]
Never drinker	25 (5.5)	506 (94.5)	1 (ref.)		57.0 (2.0)	1.97 (0.04)	29.1 (0.8)	67.6 (3.5)	419.7 (14.5)
Past drinker	43 (5.9)	778 (94.1)	1.07 (0.53–2.15)	0.84	57.5 (1.1)	2.07 (0.03)	30.4 (0.8)	83.5 (6.7)	415.4 (14.2)
Current drinker light	76 (10.1)	793 (89.9)	1.94 (0.97–3.90)	0.06	61.3 (1.2)	2.12 (0.03)	31.1 (0.5)	78.8 (3.4)	410.8 (11.7)
Current drinker heavy	121 (8.1)	1,583 (91.9)	1.52 (0.81–2.83)	0.18	63.6 (1.2)	2.17 (0.02)	28.1 (0.3)	75.7 (3.1)	387.9 (15.3)
<i>BMI, kg/m²</i>					[<0.001]	[0.71]	[<0.001]	[0.09]	[<0.001]
Underweight	3 (3.9)	63 (96.1)	0.37 (0.09–1.58)	0.17	61.9 (3.6)	1.80 (0.04)	24.3 (1.4)	65.4 (7.7)	482.6 (52.0)
Normal	87 (9.9)	1,016 (90.1)	1 (ref.)		66.5 (1.2)	2.09 (0.03)	27.8 (0.5)	84.1 (4.1)	400.2 (5.4)
Overweight	73 (6.2)	1,287 (93.8)	0.60 (0.39–0.94)	0.03	62.7 (1.3)	2.21 (0.02)	30.9 (0.5)	89.0 (5.6)	420.9 (21.3)
Obesity	102 (8.1)	1,294 (91.9)	0.81 (0.62–1.05)	0.10	55.4 (1.1)	2.08 (0.02)	29.4 (0.4)	59.8 (3.0)	380.2 (13.9)
<i>Sleep</i>					[0.001]	[0.05]	[0.08]	[0.38]	[0.02]
<6 hours	41 (7.4)	545 (92.6)	0.93 (0.63–1.37)	0.68	54.7 (1.5)	2.07 (0.03)	27.7 (0.6)	64.2 (3.4)	428.4 (46.9)
6–7 h	130 (7.9)	1,823 (92.1)	1 (ref.)		61.9 (1.1)	2.12 (0.02)	29.4 (0.5)	76.9 (2.1)	398.9 (7.9)
7+ h	94 (8.2)	1,292 (91.8)	1.04 (0.63–1.72)	0.88	63.0 (1.3)	2.14 (0.02)	29.9 (0.4)	81.9 (6.1)	395.2 (7.6)
<i>Depression</i>					[0.03]	[0.94]	[0.003]	[0.43]	[0.04]
Never	190 (7.1)	2,939 (92.9)	1 (ref.)		61.8 (1.1)	2.12 (0.02)	29.5 (0.4)	79.5 (2.7)	396.1 (6.6)
Mild	38 (9.0)	512 (91.0)	1.29 (0.69–2.40)	0.39	60.3 (2.0)	2.08 (0.03)	29.6 (0.6)	72.0 (7.3)	400.1 (17.3)
Moderate-severe	37 (17.6)	209 (82.4)	2.80 (1.96–4.00)	<0.001	55.8 (2.0)	2.17 (0.06)	26.6 (0.9)	51.7 (5.6)	485.7 (112.6)

Table 1. (continued)

Total	Eczema, <i>n</i> (%)	No eczema, <i>n</i> (%)	OR (95% CI)	<i>p</i> value	Vitamin D, nmol/L	Vitamin A, μmol/L	Vitamin E, μmol/L	Vitamin B ₆ , nmol/L	Vitamin B ₁₂ , pmol/L
<i>IgE, kU/L</i>					[<0.001]	[0.002]	[0.02]	[0.96]	[<0.001]
Tertile 1 (1.41–24.00)	79 (7.3)	1,230 (92.7)	1 (ref.)		63.6 (1.2)	2.15 (0.02)	30.5 (0.4)	80.4 (5.1)	398.8 (8.2)
Tertile 2 (24.10–90.30)	99 (8.9)	1,210 (91.1)	1.25 (0.85–1.83)	0.23	61.7 (1.0)	2.12 (0.03)	29.0 (0.5)	80.3 (2.3)	407.2 (22.8)
Tertile 3 (90.5–16,148)	87 (7.6)	1,220 (92.4)	1.05 (0.77–1.44)	0.73	57.7 (1.4)	2.08 (0.02)	28.1 (0.4)	68.1 (3.1)	398.5 (11.1)
<i>Asthma</i>					[0.59]	[0.03]	[<0.001]	[0.16]	[0.002]
Never	208 (7.1)	3,206 (92.9)	1 (ref.)		60.8 (1.84)	2.13 (0.02)	29.6 (0.4)	79.0 (2.9)	405.2 (9.4)
Ever	57 (12.9)	454 (87.1)	1.93 (1.31–2.84)	0.003	61.4 (1.01)	2.06 (0.03)	27.7 (0.5)	64.0 (4.1)	379.0 (14.6)
<i>Hay fever</i>					[0.01]	[0.003]	[0.44]	[0.56]	[0.01]
Never	206 (6.9)	3,300 (93.1)	1 (ref.)		64.4 (1.60)	2.11 (0.02)	29.1 (0.3)	76.3 (3.1)	403.1 (8.7)
Ever	59 (14.9)	360 (85.1)	2.39 (1.54–3.69)	0.001	60.8 (1.08)	2.19 (0.03)	30.9 (0.8)	80.6 (4.8)	391.4 (18.6)

Eczema prevalence values are weighted. Serum vitamin levels are presented as mean (SEM). Values in square brackets represent *p* values. PIR, poverty-to-income ratio.

Table 2. Predicted ORs and 95% CIs of eczema according to serum vitamin D, A, E, B₆, and B₁₂ levels (tertiles)

	<i>n</i>	Crude	<i>p</i> value	Model 1	<i>p</i> value	Model 2	<i>p</i> value	Model 3	<i>p</i> value	Model 4	<i>p</i> value
<i>Vitamin D, nmol/L</i>											
13.2–47.1	1,352	1.08 (0.72–1.62)	0.70	1.60 (1.00–2.56)	0.05	1.67 (1.05–2.67)	0.03	1.64 (1.04–2.58)	0.03	1.70 (1.05–2.74)	0.03
49.5–66.5	1,408	1.21 (0.84–1.75)	0.27	1.46 (0.99–2.13)	0.05	1.49 (1.01–2.13)	0.04	1.43 (0.98–2.11)	0.07	1.45 (0.99–2.11)	0.05
68.9–195	1,161	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)	
<i>Vitamin A, μmol/L</i>											
0.024–1.746	1,304	1.19 (0.75–1.90)	0.43	1.17 (0.79–1.72)	0.44	1.19 (0.81–1.74)	0.37	1.22 (0.84–1.77)	0.29	1.26 (0.86–1.83)	0.23
1.749–2.238	1,282	1.17 (0.79–1.73)	0.40	1.14 (0.79–1.63)	0.49	1.14 (0.79–1.66)	0.49	1.18 (0.82–1.70)	0.37	1.19 (0.82–1.72)	0.36
2.241–6.458	1,289	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)	
<i>Vitamin E, μmol/L</i>											
7.245–23.011	1,292	1.32 (0.82–2.12)	0.24	1.40 (0.84–2.32)	0.20	1.37 (0.83–2.28)	0.22	1.32 (0.80–2.18)	0.28	1.34 (0.81–2.20)	0.25
23.034–30.883	1,313	0.77 (0.59–1.02)	0.07	0.76 (0.55–1.06)	0.10	0.74 (0.54–1.03)	0.07	0.73 (0.52–1.01)	0.05	0.73 (0.52–1.04)	0.08
31.115–137.23	1,270	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)	
<i>Vitamin B₆, nmol/L</i>											
2.0–31.0	1,306	1.11 (0.73–1.67)	0.60	1.16 (0.76–1.77)	0.50	1.16 (0.77–1.75)	0.49	1.08 (0.70–1.67)	0.73	1.07 (0.72–1.60)	0.73
31.1–64.0	1,306	1.11 (0.80–1.54)	0.49	1.20 (0.92–1.57)	0.19	1.20 (0.91–1.57)	0.19	1.18 (0.88–1.57)	0.27	1.17 (0.87–1.56)	0.29
64.1–1,740	1,304	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)	
<i>Vitamin B₁₂, pmol/L</i>											
36.9–281.92	1,283	1.32 (0.76–2.27)	0.30	1.28 (0.76–2.17)	0.34	1.28 (0.75–2.18)	0.36	1.27 (0.76–2.12)	0.36	1.25 (0.74–2.10)	0.41
282.65–419.92	1,274	0.96 (0.55–1.67)	0.86	0.94 (0.55–1.58)	0.81	0.93 (0.55–1.58)	0.79	0.93 (0.56–1.56)	0.79	0.89 (0.53–1.49)	0.65
420.66–51,807.6	1,275	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)	

Model 1: adjusted for demographic variables (age, sex, season, race, education, income). Model 2: adjusted for demographic and lifestyle variables (BMI, smoking, drinking). Model 3: adjusted for demographic, lifestyle, and stress variables (depression, sleep). Model 4: adjusted for demographic, lifestyle, stress, and medical co-morbidity variables (asthma, hay fever, IgE).

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