ORIGINAL ARTICLE

Elevated Blood Selenium Level has a Non-Linear Association with Risk of Anemia in U.S.A. Adults: Data from the NHANES 2011-2016

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SUMMARY

Background: Only a few epidemiological studies have reported the association between blood selenium and the prevalence of anemia. To date, the evidence is limited and inconsistent.
Methods: We enrolled 9,335 participants ($\geq$ 20 years) who participated in the National Health and Nutrition Examination Survey (NHANES) from 2011 to 2016 to assess the link between blood selenium and the risk of anemia. Multivariate logistic regression analysis and a generalized additive model (GAM) was applied to assess the relationship between blood selenium and anemia risk.
Results: We found a significant adverse association between blood selenium and the prevalence of anemia after adjusting for all potential covariates (OR = 0.98, 95% CI: 0.97, 0.98, p < 0.001). After a sequence of sensitive analyses, the conclusion remains stable (p for trend < 0.001). However, a non-linear relationship was detected based on GAM. We calculated a turning point of 205.89 µg/L using a two-piecewise linear regression model.
Conclusions: When blood selenium level is lower than 205.89 µg/L, blood selenium level is inversely associated with the risk of anemia. Our results provide a new strategy to reduce the risk of anemia.
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Supplementary Data

Table S1. Subgroups analysis of association between blood selenium and anemia.

Subgroup		No. total	No. event (%)	Crude OR 95%CI	Crude p-value	AOR 95% CI	p-value	p for interactio
Age	**20 - 39**	3,145	263 (8.4)	0.98 (0.97 - 0.98)	< 0.001	0.98 (0.97 - 0.98)	< 0.001	0.017
	40 - 59	3,038	297 (9.8)	0.97 (0.96 - 0.97)	< 0.001	0.97 (0.96 - 0.97)	< 0.001	
	≥ 60	3,152	499 (15.8)	0.98 (0.97 - 0.98)	< 0.001	0.98 (0.97 - 0.98)	< 0.001	
Gender	**female**	4,701	677 (14.4)	0.98 (0.97 - 0.98)	< 0.001	0.98 (0.97 - 0.98)	< 0.001	0.177
	male	4,634	382 (8.2)	0.97 (0.97 - 0.98)	< 0.001	0.97 (0.97 - 0.98)	< 0.001	
Race	**Mexican American**	1,185	118 (10)	0.97 (0.96 - 0.98)	< 0.001	0.97 (0.96 - 0.98)	< 0.001	< 0.001
	Non-Hispanic Black	2,121	460 (21.7)	0.98 (0.98 - 0.99)	< 0.001	0.98 (0.98 - 0.99)	< 0.001	
	Non-Hispanic White	3,657	252 (6.9)	0.96 (0.95 - 0.97)	< 0.001	0.96 (0.95 - 0.97)	< 0.001	
	Other Hispanic	998	93 (9.3)	0.97 (0.96 - 0.98)	< 0.001	0.97 (0.96 - 0.98)	< 0.001	
	Other Race	1,374	136 (9.9)	0.98 (0.97 - 0.99)	< 0.001	0.98 (0.97 - 0.99)	< 0.001	
Poverty-income ratio	**PIR < 1**	1,949	256 (13.1)	0.98 (0.97 - 0.98)	< 0.001	0.97 (0.97 - 0.98)	< 0.001	
	PIR ≥ 1	6,629	701 (10.6)	0.97 (0.97 - 0.98)	< 0.001	0.97 (0.97 - 0.98)	< 0.001	
Education level	**College education**	5,208	537 (10.3)	0.97 (0.97 - 0.98)	< 0.001	0.97 (0.97 - 0.98)	< 0.001	0.334
	Graduated from	2,050	226 (11)	0.98 (0.97 - 0.98)	< 0.001	0.98 (0.97 - 0.98)	< 0.001	
	< High school	2,073	295 (14.2)	0.97 (0.97 - 0.98)	< 0.001	0.97 (0.97 - 0.98)	< 0.001	
BMI	**< 25**	2,730	307 (11.2)	0.98 (0.97 - 0.98)	< 0.001	0.98 (0.97 - 0.98)	< 0.001	0.496
	25 - 30	3,000	305 (10.2)	0.98 (0.97 - 0.98)	< 0.001	0.98 (0.97 - 0.98)	< 0.001	
	≥ 30	3,515	420 (11.9)	0.97 (0.97 - 0.98)	< 0.001	0.97 (0.97 - 0.98)	< 0.001	
Calcium intake (mg)	**< 800**	4,374	566 (12.9)	0.97 (0.97 - 0.98)	< 0.001	0.97 (0.97 - 0.98)	< 0.001	0.38
	≥ 800	4,502	415 (9.2)	0.97 (0.97 - 0.98)	< 0.001	0.97 (0.97 - 0.98)	< 0.001	
Magnesium intake (mg)	**< 260**	4,101	543 (13.2)	0.97 (0.97 - 0.98)	< 0.001	0.97 (0.97 - 0.98)	< 0.001	0.891
	≥ 260	4,775	438 (9.2)	0.97 (0.97 - 0.98)	< 0.001	0.97 (0.97 - 0.98)	< 0.001	
Smoking status n (%)	**Never smoker**	5,300	665 (12.5)	0.98 (0.97 - 0.98)	< 0.001	0.98 (0.97 - 0.98)	< 0.001	0.012
	Former smoker	2,220	257 (11.6)	0.97 (0.96 - 0.98)	< 0.001	0.97 (0.97 - 0.98)	< 0.001	
	Current smoker	1,815	137 (7.5)	0.96 (0.95 - 0.97)	< 0.001	0.96 (0.95 - 0.97)	< 0.001	
Physical activity n (%)	**Light work activity**	5,759	741 (12.9)	0.97 (0.97 - 0.98)	< 0.001	0.97 (0.97 - 0.98)	< 0.001	0.597
	Moderate work activity	1,889	206 (10.9)	0.98 (0.97 - 0.98)	< 0.001	0.98 (0.97 - 0.98)	< 0.001	
	Vigorous work activity	1,687	112 (6.6)	0.98 (0.97 - 0.99)	< 0.001	0.98 (0.97 - 0.99)	< 0.001	

Adjusted for all covariates listed in Table 1.