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Letter to the Editor

High Blood Cadmium Level in Short Sleepers: Results from the 2008–2013 Korean National Health and Nutrition Survey

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Dear Editor-in-Chief

Heavy metals are present naturally in the environment, but human activities have drastically altered their geochemical cycles, causing them to accumulate in plants and ultimately in the vital organs of humans. Once heavy metals enter into biological systems, they are not easily excreted, which poses serious threats to human health (1). There are several lines of evidence suggesting that some metals interact with the circadian rhythms, including the sleep-wake cycle (2). The data on the interactions between heavy metals and circadian rhythms come mostly from small studies of occupational exposures. We found evidence for associations between three heavy metals and sleep duration using large-scale, nationally representative data from Korea.

We identified 40,328 participants 20 yr of age or older from the 2008–2013 Korea National Health and Nutrition Examination Survey. We excluded those who were diagnosed with cancer (n = 277) or myocardial infarction or stroke (n = 1,652) and those for whom there were no available data on two main variables (heavy metals and sleep duration; n = 3,291). Our final analysis included 35,108 individuals. Information on demographics, health behaviors, history of disease as diagnosed by a physician, and sleep duration was collected via self-reported questionnaire. The responses to sleep duration were classified into three categories (<6 h, 6–8 h, and >8 h).

Table 1 shows the characteristics of the participants stratified by sleep duration. Mean blood levels of lead and cadmium were significantly higher in short sleepers than in optimal sleepers or long sleepers. The mean cadmium levels were far above the normal range in all three groups of sleepers, in contrast to those of lead and mercury (cut-off values: lead > 5 μg/dL; mercury > 20 μg/dL; cadmium > 0.315 μg/L). Table 2 presents the estimated blood levels of lead, mercury, and cadmium in short and optimal sleepers: the blood cadmium levels were significantly higher in young short sleepers than in young optimal sleepers.

There has been little clinical research on the association between sleep and heavy metals, especially cadmium. In a nationwide study, we found that exposures to cadmium have reached serious levels in Korean adults, and, furthermore, that a lack of sleep in young people was associated with higher blood concentrations of cadmium.

Table 1: Characteristics of the study participants by sleep duration

Variable	*Short sleep duration (<6 h) (n = 5,396)*		*Optimal sleep duration (6–8 h) (n = 26,994)*		*Long sleep duration (>8 h) (n = 2,718)*		*P*-value
	%	Mean (SD)	%	Mean (SD)	%	Mean (SD)	
Demographics							
Age (yr)		57.1 (16.1)		47.7 (15.4)		50.2 (19.3)	<0.001
<60	49.7		75.5		62.8		<0.001
≥60	50.4		24.5		37.2		
Female	65.1		56.2		62.1		<0.001
Married	72.1		87.7		82.8		<0.001
High economic status	40.8		59.2		47.0		<0.001
Employed	52.3		63.2		46.9		<0.001
Lifestyles							
Obese[a]	34.8		31.2		28.7		<0.001
Current smoker	18.0		20.7		20.9		<0.001
Frequent drinker	5.4		4.6		5.4		0.012
Regular physical activity	20.3		22.0		18.3		<0.001
Common comorbidities							
Hypertension	30.2		17.6		21.7		<0.001
Diabetes	11.0		6.5		9.4		<0.001
Heavy metals							
Lead (μg/dL)		2.43 (1.14)		2.36 (1.18)		2.30 (1.24)	0.026
Mercury (μg/L)		4.73 (3.72)		4.69 (3.57)		4.82 (6.91)	0.620
Cadmium (μg/L)		1.24 (0.74)		1.10 (0.66)		1.13 (0.71)	<0.001

P-values were from one-way analysis of variance or χ^2 test
[a]Body mass index≥25kg/m^2

Table 2: Blood levels of heavy metals in optimal and short sleepers

Variable	*Estimated[a] blood levels (95% confidence interval)*		
	Lead (μg/dL)	Mercury (μg/dL)	Cadmium (μg/L)
Age <60 yr			
Optimal sleepers	2.36 (2.33–2.39)	4.86 (4.77–4.95)	1.17 (1.16–1.19)
Short sleepers	2.38 (2.30–2.46)	4.99 (4.75–5.24)	1.24 (1.20–1.29)
P-value	0.777	0.323	0.004
Age ≥60 yr			
Optimal sleepers	2.64 (2.58–2.70)	4.51 (4.32–4.71)	1.39 (1.36–1.43)
Short sleepers	2.61 (2.51–2.71)	4.77 (4.45–5.10)	1.33 (1.27–1.39)
P-value	0.626	0.180	0.054

[a]Adjusted for demographics, lifestyles, and comorbidities (described in Table 1)

The cross-sectional design prevents us from attributing causality. One possibility is that cadmium toxicity interferes with sleep. Exposure to cadmium might directly affect the sleep cycle by disturbing the secretion of sleep hormones such as serotonin and cortisol. In an experimental study using Wistar laboratory rats, Vataev and colleagues reported that single injections of cadmium chloride resulted in significant alterations in the structure of the wake-sleep cycle (3). Another possible explanation for our result was that sleep deprivation can facilitate cadmium accumulation or interrupt cadmium excretion. Short sleep duration predicts a future decline in renal function (4, 5).
Longitudinal studies are needed to confirm our results and to test hypotheses about the causal relationships between cadmium levels and sleep duration. If possible, such studies should be conducted in young individuals who have relatively few factors associated with sleep problems (6). Further epidemiological investigation is also warranted to explore the sources of cadmium exposure in the Korean population (7).

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Conflict of interest

The authors declare that there is no conflict of interest.

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