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The Journal of Allergy and Clinical Immunology: In Practice

Volume 7, Issue 8, November–December 2019, Pages 2653-2660.e3

Original Article

Serum Cadmium and Lead, Current Wheeze, and Lung Function in a Nationwide Study of Adults in the United States

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https://doi.org/10.1016/j.jaip.2019.05.029

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Background

Cadmium and lead are hazardous pollutants.

Objective

We examined the relation between serum levels of cadmium and lead and current wheeze, current asthma, and lung function in US adults.

Methods

A cross-sectional study of 13,888 adults aged 20 to 79 years in 2007-2012 National Health and Nutrition Examination Survey (NHANES) was considered. Multivariable logistic or linear regression was used for the analyses of current wheeze, current asthma, and lung function measures (forced expiratory volume in 1 second [FEV_1]% predicted, forced vital capacity [FVC]% predicted, FEV_1/FVC% predicted, and fractional exhaled nitric oxide [FeNO]), which were conducted first in all participants, and then separately in never/former smokers and current smokers.

Results

High levels of serum cadmium were significantly associated with current wheeze in all participants and in current smokers (odds ratio for fourth vs first quartile= 2.84, 95% confidence interval= 2.07-3.90, $P_{\text{for linear trend}} < .01$), as well as with current asthma in current smokers. Serum lead was not significantly associated with current wheeze or current asthma, regardless of smoking status. Serum cadmium was significantly associated with lower FEV_1% predicted, FEV_1/FVC% predicted, and FeNO in all participants and in never/former smokers, and serum lead was significantly associated with lower FEV_1/FVC% predicted in all participants, with similar findings in never/former smokers and in current smokers.

Conclusions

Our findings suggest that exposure to cadmium is associated with an increased risk of wheeze and asthma in US adults who currently smoke. Moreover, our results suggest that exposure to cadmium or lead has negative effects on lung function in nonsmoking US adults.

Section snippets

Study population

The National Health and Nutrition Examination Survey (NHANES) is a cross-sectional nationwide survey of the noninstitutionalized US civilian population. Study participants are selected using a stratified multistage probability design and are thus representative of the US population. Because of study design, NHANES oversamples persons 60 years and older and ethnic minorities (African Americans and Hispanics), to increase statistical power for data analysis in those subgroups. Figure1 shows the…

Results

The main characteristics of the 13,888 study participants are shown in TableI. Compared with the 11,767 control subjects, the 2,121 subjects with current wheeze were more likely to be older, female, non-Hispanic white, current smokers, and users of oral or inhaled steroids in the previous 2 days; and to have a household income less than $20,000, a family history of asthma, vitamin D insufficiency, occupational exposure to mineral dusts or exhaust fumes, a higher BMI, a higher serum cotinine…

Discussion

In a representative sample of 13,888 adults in the United States, a high level of serum cadmium was significantly associated with current wheeze and current asthma in current smokers. Serum cadmium was also significantly associated with decreased FEV_1% predicted, FEV_1/FVC% predicted, and FeNO in all participants, and this inverse association was more pronounced in never or former smokers than in current smokers. Moreover, serum lead was significantly associated with decreased FEV_1/FVC%…

Acknowledgments

G. Yang, T. Sun, W. Chen, and J. C. Celedón participated in study design, data analysis, manuscript writing, and interpretation of the study results. Y.-Y. Han, F. Rosser, and E. Forno participated in data analysis. All authors reviewed and approved the final version of the submitted manuscript. J. C. Celedón is the guarantor of this work and takes responsibility for the integrity of the manuscript.…

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> …Urinary Cd (U–Cd) reflects the body burden of long-term environmental exposure to Cd (Lamkarkach et al., 2021). Cd exposure is associated with multiple diseases, including kidney diseases, osteoporosis and bone fractures, respiratory diseases, and cardiovascular diseases (Lv et al., 2017; Chowdhury et al., 2018; Yang et al., 2019; Zang et al., 2019). Although the mechanisms underlying Cd toxicity have not yet been fully elucidated, there is increasing evidence that Cd induces oxidative stress, activates apoptosis, inhibits cellular respiration, alters cellular physiological signaling cascades, affects homeostasis of essential metals, and modulates cell proliferation and differentiation (Genchi et al., 2020).…

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J. C. Celedón's contribution was supported by grants HL117191, HL119952, and MD011764 from the United States National Institutes of Health (NIH). E. Forno's contribution was supported by grant HD052892 from the United States NIH. G. Yang's contribution was supported by the China Scholarship Council and the Third Xiangya Hospital, Central South University.

Conflicts of interest: J. C. Celedón has received research materials from Merck and GSK (inhaled steroids), and Pharmavite (vitamin D and placebo capsules), to provide medications free of cost to participants in National Institutes of Health funded studies, unrelated to the current work. The rest of the authors declare that they have no relevant conflicts of interest.

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