Short Communication

Lead Contamination and Its Human Health Effects in India, Vietnam and Cambodia

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Abstract

In the present study, lead concentrations were determined in human blood collected from cities, dumping sites and reference sites in South India, North Vietnam and Cambodia. To evaluate human health effect of lead exposure, the δ-aminolevulinic acid dehydratase (ALAD) activities were also measured. Concentrations of lead in human blood ranged from 2.33 μg/dl to 27.4 μg/dl. Especially, concentrations in blood of residents from Perungudi (waste dumping site) and Palaverkadu (farming village) in South India were higher than those from other regions or those reported previously. Concentrations of lead in blood of some residents exceeded the threshold levels which can induce hypertension in adult and inhibit development of intelligence in fetus. Furthermore, significant negative correlations between blood lead levels and ALAD activities were observed in the residents from all the three countries, indicating possible suppression of that heme biosynthesis by lead in these residents.

Keywords : Lead, Human blood, India, Vietnam, Cambodia

Introduction

Recently, pollution by environmental contaminants has become alarming in many Asian developing countries in which economic growth and population increase are marked. Lead is widely distributed in the environment and is toxic even at low exposure levels, especially to fetuses and children [1]. Leaded gasoline, which is a significant air pollution source has been banned in developed countries but are still in use in some developing countries [2]. However, information on contamination status by lead in Asian developing countries is still limited. Furthermore, despite the significant public health effects of lead exposure, few investigations have been conducted on risk assessment to residents in Asian developing countries.

In the present study, lead concentrations were deter-

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mined in human blood collected from Chennai in South India, Hanoi in North Vietnam and Phnom Penh in Cambodia. To evaluate human health effect of lead exposure, the δ-aminolevulinic acid dehydratase (ALAD) activities were also measured.

Materials and Methods

Human blood samples were collected from three large cities, Chennai (I-C) in South India, Hanoi (V-C1 and V-C2) in North Vietnam, and Phnom Penh (C-C) in Cambodia during 2000 to 2005. Blood samples were also collected from residents at two dumping sites, where various types of wastes had been dumped directly without treatment, in Perungudi (I-DS), South India and in Steang Meanchey (C-DS), Cambodia. As reference sites, farming or fishing villages in suburban cities were selected : Chidambaram (I-R1), Palaverkadu (I-R2) and Parangipettai (I-R3) in South India, Dong My (V-R) in North Vietnam and Kampong Khleang (C-R) in Cambodia. Informed consents were obtained from all the donors. Collected samples were kept at −20 ℃ and 4 ℃ for chemical and ALAD analyses, respectively. For lead determination, blood samples were digested with nitric acid using a microwave. Lead concentrations were measured with an inductively coupled plasma-mass spectrometer (ICP-MS) [3]. Activities of ALAD in blood were determined at the Occupational Poisoning Center, Tokyo Rosai Hospital [4].

Results and Discussion

Concentrations of lead were found in all human blood samples and its range was from 2.33 μg/dl to 27.4 μg/dl. Lead concentrations in males were higher than those in females at all sites, suggesting possible occupational exposure or higher hematocrit contents in males because blood lead was significantly associated with hematocrit values [5]. To understand the regional difference in blood lead levels, we used only data of females which were collected in most locations (except I-R3). Higher lead concentrations were observed in dumping sites (geometric mean (GM) in I-DS, 10.5 μg/dl ; GM in C-DS, 6.00 μg/dl) within the same countries (Fig. 1). On the contrary, the levels in females from cities were not so high compared with those from reference sites in all the countries (Fig. 1). This might indicate little lead emission from the urban activities. Interestingly, females from I-R 2 had high lead concentrations (GM, 8.65 μg/dl) despite of its location (the reference site), suggesting that there are some potential sources of lead in this site. Levels in residents of I-DS and I-R2 were higher than those reported previously for residents in other countries [5-13]. Concentrations in blood of some residents, especially in India, exceeded the levels associated with toxic effects of lead such as hypertension in adult (10 μg/dl) [14] and development of inhibition for intelligence in fetus (20-30 μg/dl) [15]. To assess the human health effect of lead exposure, we used ALAD activities as a biomarker of heme biosynthesis. Significant negative correlations between blood lead levels and ALAD activities were found in the residents from India (R^2 = 0.57, p<0.001), Vietnam (R^2 = 0.73, p<0.001) and Cambodia (R^2 = 0.37, p<0.001) (Fig. 2). This result indicates that heme biosynthesis had

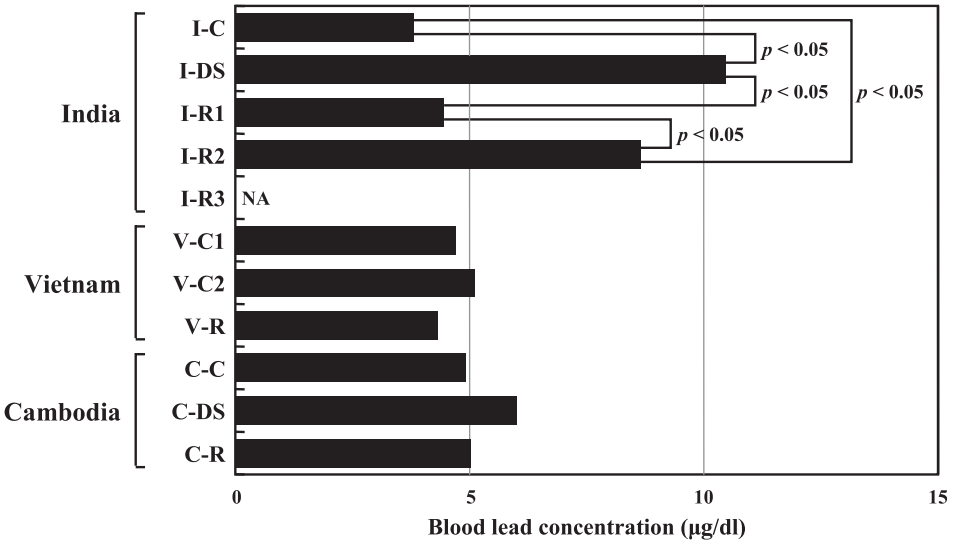

Fig. 1 Blood lead concentrations in females from India, Vietnam and Cambodia. The location codes were referred in materials and methods. NA means no available samples.

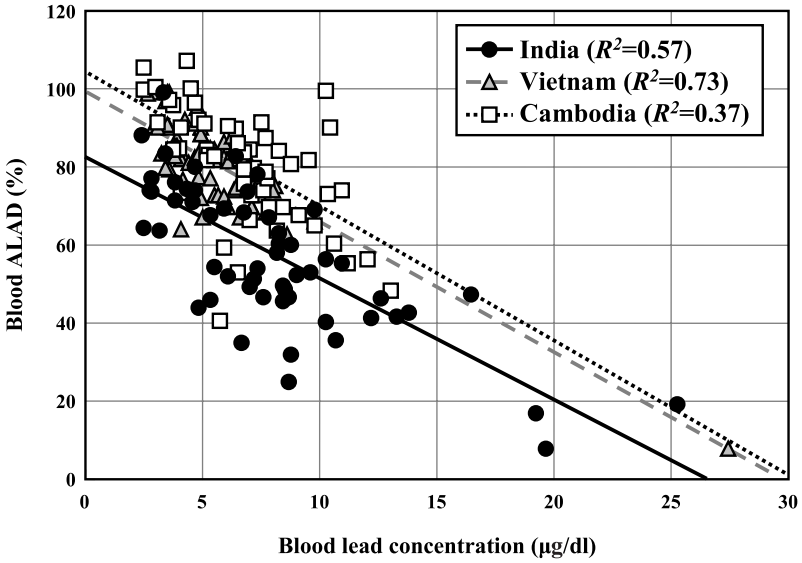

Fig. 2 Relationships between blood lead concentrations and δ-aminolevulinic acid dehydratase (ALAD) activities in residents from India, Vietnam and Cambodia.

been suppressed by lead in these residents.

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