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Lead Poisoning Frequency and its Associated Factors

Research Article

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Abstract

Background: Despite wide range of measures to control lead pollution in recent decades, this heavy metal poisoning remains as a health problem in all societies particularly industrialized communities. In this study, frequency of lead poisoning and its related factors in 2-12 years old children in Kashan-Iran were evaluated. Methods: This cross sectional study was conducted on 150 healthy children referred to health centers to receive routine health care. Samples were selected based on cluster. Serum lead levels determined by atomic spectroscopy. Results: The mean lead levels in children were 9.27±9.55µg/dl. The frequency of lead poisoning was 30.0% and it was related to moderate social status (OR=1.72, 95% CI=1.04-2.86, p=0.03) and weak economic status (OR= 3.12, 95% CI=1.69-5.56, p<0.001). There were no significant relation between age, gender and place of residence and lead poisoning. Conclusion: Lead poisoning was found to be prevalent and is related to the socio-economic situation.

Keywords: Lead, Serum levels, socioeconomic state.

Introduction

Lead is one of the most important environmental pollutants that can causes neurological damage and behavioral disorders (1). Although all age groups are exposed to lead contamination, fetuses and children are at the greater risk because the absorption rate in children is higher than the adults (2 & 3). The lead can absorb through the respiratory tract, digestive system and skin. After absorption, lead pollute blood cells, soft tissue and bones (4 & 5). Lead absorption affected by dietary factors, nutritional status, and metal mode (6). In adults, 5-15% foods' lead are absorbed, and in children, due to physiological and metabolic differences, this amount ranges from 30 to 40% (7-9).

Lead has many destructive effects, which affects many organs of the body. It transmitted from mother to fetus and affects infants due to secretion into the mother's milk (10 & 11). This element affects the central and peripheral nervous system. Irritability, fatigue, anxiety, insomnia, dizziness and seizure are some of the central effects of the lead (12-14). Other complications such as memory loss, visual impairment, and hearing loss have also been observed in lead poisoning (15 & 16). High levels of lead (100-200 µg/ dL in adults and 80-100 µg/dL in children) can cause encephalopathy. Excessive lead exposure in the children reduces Intelligence Quotient (IQ) and short-term memory and impair read, write and other motor skills (13-15).

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Studies in Iran show a high prevalence of lead poisoning in children. Farhat et al. indicates that 74.8% of the children aged 1 to 7 years are contaminated with lead (18). In a survey of 320 primary school students in Semnan, Franoosh et al. pollution was reported at 78.8% (19). In another study in Yazd, it was found that 93.1% of children in this city have a serum lead level higher than allowed limits (20).

Another study was conducted to determine the relationship between spiritual health and depression, anxiety, and stress among the students of Ilam University of medical sciences in 1395. This is a descriptive-cross sectional study that was performed on 300 randomly selected students of Ilam University of medical sciences in 1395. In order to measure the level of spiritual health among the participants, Paloutzian-Ellison's 20-item standard questionnaire was utilized and DASS-21 questionnaire was used to measure variables depression, anxiety, and stress. Findings: In the present study, of 300 subjects under investigation, 194 subjects (64.6 percent) were female. The highest frequencies for depression, anxiety, severe stress, and extremely severe stress were observed among single subjects (12, 20, and 10.6 respectively). Pearson's correlation coefficient indicated that there is a statistically significant linear correlation between the mean score of spiritual health and the level of depression, anxiety, and stress in students (p=0.001). Conclusion: Results of this research showed a positive correlation between spiritual health and indices depression, anxiety, and stress among students of Islam University of medical sciences. Accordingly, it can be said that acquiring skills in the domain of spiritual health for medical sciences students is as necessary as acquiring nursing and medical care skills (21).

Considering the significant effects of lead on children's health, necessity of contamination control and

lack of sufficient information about the status of children's lead contamination in Kashan- Iran, This study was conducted to evaluate the frequency of lead poisoning and its related factors.

Methods

This cross-sectional study was conducted on 150 healthy children in Kashan who were referred to health centers in order to receive routine health care. Cluster sampling was used to access the appropriate research community. For this purpose, a health care center was randomly selected from each of the five areas of Kashan. The required number of samples from each center was calculated based on the covered population and finally, by random sampling, participates were selected in each center. Children with congenital anomalies, hematological disorders such as thalassemia, chronic illness and malignancies were excluded from study.

After providing information about the goals and methods of the study, informed consent was obtained from the child's parents. The children's demographic information including age, sex, place of residence, economic and social status of the family were obtained and recorded in designed questionnaire. The socioeconomic status of the family was studied using socioeconomic status questionnaire designed by Garmaroodi et al. (22). According to the results of this questionnaire, the families were divided into four socioeconomic groups: weak, moderate, good and excellent.

Six milliliter of venous blood was taken by a qualified nurse. The blood was stored in two separate tubes. One sample for complete blood cells counting was sent to the referral laboratory of Kashan University of Medical Sciences. Another sample after centrifugation and serum separation was frozen at -20 ° C. After the completion of sampling, serum samples were defreezing and serum lead levels were measured by atomic spectrometry method (Flame Atomic Absorption Spectroscopy, Spect AA.20 instrument and SOPS:7439-92-1 CASRN). Serum lead levels higher than 10 µg/dL was considered as lead poisoning.

Data were analyzed using SPSS software version 18. Qualitative results have been reported as absolute and relative frequency and quantitative results have been reported as mean±standard deviation. Chi-square, One-way ANOVA and T-test were used for data analysis. The p value less than 0.05 was considered significant, (To test the relationship between variables, Pearson and Spearman was used).

Results

This study was conducted to determine the frequency of lead contamination and its related factors on 150 children aged 2-12 years. The mean age of the children was 6.75±3.54 years. The place of residence of 68 (45.3%) of participants was the city and 82 (54.7%) people was the village and the city border. Table 1 shown participants' basic characteristics.

The mean serum levels of lead was 9.27±9.55 µg/dL. Mean serum concentrations of lead in male and female children were 9.92±9.93 and 8.6±9.15 µg/dL, respectively. Overall, 45 children (30.0%) has lead serum level higher than 10 µg/dL. Male children aged 5-9 years living in village and suburbs that had moderate social and weak economic status had the highest levels of lead poisoning. Moderate social status (odds ratio=1.72, 95% confidence Interval=1.04-2.86, p=0.03) and weak economic status (odds ratio = 3.12, 95% confidence Interval = 1.69-5.56, p<0.001) were associated with lead poisoning. Factors associated with lead poisoning are shown in Table 2.

According to Table 3, The highest frequency of serum levels above 10 µg / dl was observed in children with poor socioeconomic status. 65.1% of people with a poor socioeconomic status had a serum level above 5 µg / dL, which is in the family. The average and good situation was 55.7% and 17.23%, respectively. There was a significant relationship between the socioeconomic status of the family and serum lead level in the children (Table 3).

Also Lead levels were found to be less than 5 and 9.9-5 µg / dL in children resident in the city, while the highest frequency of serum lead levels was higher than 10 µg / dl for children in the outskirts of the city. The difference between the two groups was not statistically significant (p = 0.05) (Table 4).

Based on the results of this study, children living in homes less than 10 years of age had the highest frequency of serum lead levels below 5 µg / dL. Also, children living in homes 10 to 10 years of age have the highest serum levels of more than 10 micrograms per deciliter. There was a statistically significant relationship between age of place of residence and serum level of lead in children (P = 0.0001) (Table 5).

Discussion

This study was conducted to evaluate the serum levels, frequency of lead poisoning and its related factors in children aged 12-29 years old in Kashan. In this study, the mean serum lead level in children was 9.27±9.55 µg/dL. Few studies have been done in Iran to study the serum levels of lead in children. In a study Daroogar et al. compare serum lead levels in children with ADHD and healthy children in Tehran, serum lead level in healthy children was 7.19±3.19 µg/dL and in children with ADHD was 7.2±2.36 µg/dL (23). Khosravi et al. investigated the serum level of lead in neonate's umbilical cord blood in a study that was performed on 60 newborn infants from 2011 to 2012 years. It was found that mean serum lead level in umbilical cord blood of these infants was 2.97±2.24 µg/dL (24). In a study in Mashhad, Farhat et al. examined 206 children aged 1 to 7 referring to the pediatric emergency department in 2001-2003. In this study, the mean serum lead level in healthy children was 11.8 ± 32.1 µg/dl and in children with seizure it was 12.65±3.6 µg/dL (25). Although serum levels of lead in this study were higher than those in Tehran, the frequency of lead poisoning was lower than what has been reported by Khosravi et al (24). The higher serum levels of lead in the Farhat's study be due to the differences in the methods and place of sampling. However, the reported amounts in the above studies indicate that there are notable sources of pollution in the community that serious actions must be taken to control them.

In this study, lead poisoning was found to be associated with the economic and social status of the

family. In a study conducted by Etchevers et al. In France in 2009-2008, 3831 patients referred to the hospital were evaluated for serum levels of lead and its related factors, and it was found that only 0.9% of children had higher levels of 10 µg/dL of lead. The associated factors with lead levels poisoning were the use of tap water, scaled wall paintings, reconstruction of old homes, and hands-mouth habit and exposure to cigarette smoke (26). In another study, Bernard et al. examined the risk factors associated with high serum levels of lead. In this study, which evaluated data from 1988 to 1988, the Non-Hispanic race, home age, country, and economic levels were associated with lead poisoning (27). Edwards et al. described drinking water as the most important factor associated with serum lead levels in young children in the United States (28). In a study by Levin et al., The risk factors of lead poisoning in United States' children were studied and it was found that age, race and ethnicity, income level, Location age, place of residence and occupation of parents were the most important factors associated with serum lead levels in children. (29).

Hore and his colleagues reviewed the lead serum levels and its related factors in a study in 2016 on 230 South Asian child and adult residents in New York. In this study, it was found that race, ethnicity and recent home renovation are the most important factors associated with high serum lead levels in these individuals (30). Pelc et al. examined the environmental and socioeconomic factors of the children of the industrial zone of Silesia in Europe. In this study, 4882 people aged 3 to 18 years were surveyed during the years of 1998-1998. Parents' low levels of education, unemployment, parental employment, low socioeconomic status, smoking at home, living in underground buildings and consuming native fruits and vegetables were identified as factors associated of higher lead levels lead in children (31). Another study in Taiwan has examined the factors associated with lead poisoning in the suburbs of Thailand. Contacting with solar energy batteries and the use of non-standard cookware were the lead poisoning related factors (32). In another similar study done in China, gender, height, weight, consuming more beans, greater use of canned foods, smoking by family members, proximity to the street, presence of electronics recycling centers and mother's education level has been mentioned as risk factors for higher serum levels of lead in Chinese children (33). Another study conducted in China indicated that the mother, age, male gender and lower education were the risk factors for more contamination with lead (34). These risk factors have been reported in similar survey conducted in Southwestern China for the sex of the boy, age, mother's age at birth and living in crowded places. (35).

Although many efforts have been made in recent years to reduce the sources of lead release in different societies, lead poisoning continues to be a major health problem with significant effects in all societies, especially industrialized countries. According to the results of this study and the mentioned studies, the correction of many risk factors for lead poisoning is difficult or impossible. Therefore, it seems that the most effective and easiest way to prevent lead poisoning in children is to eliminate sources of dissemination.

Table 1. Basic characteristics of participants

Variables	Gender groups	
	Male Number (percent)	Female Number (percent)
Age group		
2-4	25 (32.5)	26 (35.6)
5-9	28 (36.4)	32 (43.8)
10-12	24 (31.2)	15 (20.5)
Place of residence		
City	36 (46.8)	32 (43.8)
Countryside	41 (53.2)	41 (56.2)
Economic Status		
Weak	34 (44.2)	35 (47.9)
Moderate	32 (41.6)	20 (27.4)
Good	11 (14.3)	18 (24.7)
Social Status		
Weak	28 (36.4)	22 (30.2)
Moderate	42 (54.5)	25 (34.2)
Good	7 (9.1)	26 (35.6)

Table 2. Related factors of Lead poisoning

Variables	Lead poisoning		OR (95%CI)	P value
	No Number (percent)	Yes Number (percent)		
Age group				
2-4	37 (35.2)	14 (31.1)	1.09 (0.69- 1.71)	0.88
5-9	41 (39.0)	19 (42.2)		
10-12	27 (25.8)	12 (26.7)		
Place of residence				
City	53 (77.95)	15(22.05)	2.04 (0.98- 4.22)	0.05
Countryside	52(63.42)	30(36.58)		
Economic Status				
Weak	39 (37.1)	30 (66.7)	3.12 (1.69- 5.56)	<0.001
Moderate	38 (36.2)	14 (31.1)		
Good	28 (26.7)	1 (2.2)		
Social Status				
Weak	31 (29.5)	19 (42.2)	1.72 (1.04- 2.86)	0.03
Moderate	46 (43.8)	21 (46.7)		
Good	28 (26.7)	5 (11.1)		

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Table 3: Frequency of serum lead level in terms of socio-economic status in children under study

Socio-economic status	Serum lead level µg/dl			Total
	>5 Number (percent)	9/9-5 Number (percent)	<10 Number (percent)	
Weak	24(34.78)	15(21.73)	30(43.47)	69(100)
Moderate	23(44.23)	15(28.84)	14(26.92)	52(100)
Good	23(79.31)	5(17.24)	1(0.03)	29(100)
Total	70(46.67)	35(23.33)	45(30)	150(100)

Table 4: Frequency of serum lead level in terms of place of living in children under study

Location	Serum lead level µg/dl			Total
	>5 Number (percent)	9/9-5 Number (percent)	<10 Number (percent)	
City	39(57.37)	14(20.58)	15(22.05)	68(100)
Countryside	31(37.8)	21(25.6)	30(36.58)	82(100)
Total	70(46.67)	35(23.33)	45(30)	150(100)

Table 5:Frequency of serum lead levels based on the age of residence in children under study

Age of residence based on year	Serum lead level µg/dl			Total
	>5 Number (percent)	9/9-5 Number (percent)	<10 Number (percent)	
>10	35(61.4)	16(28.07)	6(10.52)	57(100)
10-20	26(39.39)	16(24.24)	24(36.36)	66(100)
<20	9(33.33)	3(11.11)	15(55.55)	27(100)
Total	70(100)	35(23.33)	45(30)	150(100)

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