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The Prevalence of Lead Contamination in Children with Chronic Abdominal Pain in South East of Iran

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Abstract

Introduction:

Chronic abdominal pain (CAP) in children generally affected the child's normal function. Lead poisoning has many symptoms, which is one of the most prominent symptoms of abdominal pain, besides, in our country, various factors may lead children to exposure to lead. The purpose of this study was to evaluate the prevalence of lead poisoning in children with CAP by measuring the level of blood to give a guide to a pediatrician to propose this diagnosis in the early stages of their evaluations.

Methods:

This cross-sectional study was all children referred to the clinic with chronic abdominal pain. Informed consent was obtained from their parents, and then a self-designed checklist containing demographic information and variables was given to the parents by the project. Blood samples were also taken from the patients to determine the level of lead in the blood of the patients.

Results:

93 children aged 1-15 years with chronic abdominal pain were referred to the pediatric GI referral clinic the results showed that 18(19.4%) had lead contamination, 2(2.2%) had lead poisoning and the only clinical symptoms such as bone pain (p-value = 0.013), aggression (p-value = 0.036), and anemia (p-value = 0.004) were significantly related to lead contamination. Fifteen (83%) of children with chronic abdominal pain had opium addicted (p-value = 0.02).

Conclusion:

Due to the high level of lead contamination in Kerman city, the risk of lead poisoning increases the future generation .Therefore, extensive investigations should be performed to find possible sources of lead contamination. An attempt to resolve these problems is indispensable.

Keywords: lead poisoning, abdominal pain, children.

Introduction

Chronic Abdominal Pain (CAP) is a common complaint in childhood and adolescence. It is observed in 10 to 15% of children aged 4 to 16 years (1). ROM III criteria are used for its diagnosis and a large percentage of them are abdominal pain-related functional gastrointestinal disorder (AP-FGID). The important point in the diagnose of these disorders is that it lasts at least 2 months and there is no evidence of anatomical, metabolic, infectious, and inflammatory disorders (2). Chronic abdominal pain is divided into two types, including organic and non-organic. The causes of gastrointestinal disorders

include gastroesophageal reflux disease, esophagitis, peptic ulcer, and causes of non-gastrointestinal disorders include UTI, leukemia, HSP, and lead poisoning. Children who suffer chronic abdominal pain are at risk for problems such as anxiety, depression, and loss of self-confidence. One of the causes of chronic abdominal pain is lead poisoning, which occurs mostly in urban areas of developed countries, although high concentrations of lead have also been observed in rural areas (7,6). Researchers have attributed the main cause of lead accumulation in the body to be the consumption of leaded gasoline in countries and one of the most important public health interventions in developed countries is to reduce and control chronic exposure to lead (8). Due to reduced exposure to lead, blood lead level (BLL) has reduced from 13.1 mcg/dl between the years1980 and 1979 to 1.64 mcg/dl in 2000 (9). Environmental factors such as air, dust, foods, inks, smoking, cereals, and fruits produced with contaminated water or land, and pottery and crystal containers can be the main source of lead exposure. In an article, Yaman modeled long-term concentrations of lead from major sources of air, waste, soil, food, and water (10).

Lead enters the body through the gastrointestinal tract, inhalation, and skin [11]. Lead is more received through swallowing than inhaling. In terms of air pollution, the direct share of modern sources of emissions, such as urban waste disposal, is small compared to other sources (12). In Iran, drug use is one of the most important causes of lead poisoning (13). Children are often exposed to opium smoke as a passive smoker at home and are prone to lead poisoning. The half-life of lead is 25 days in blood, 40 days in soft tissues, 7 years in kidneys, and 25-23 years in bones (14). Lead poisoning can manifest itself with nonspecific symptoms and symptoms such as abdominal pain, constipation, irritability, impaired concentration, and anemia. The clinical symptoms of acute lead poisoning vary from one person to another. In cases where the blood lead level is more than 80 mcg/dl, the symptoms, including abdominal pain (lead colic), constipation, joint pain, muscle pains, headache, decreased libido, and impaired concentration, short-term memory impairment, hypochromic or microcytic anemia, and nephropathy occur, and when its level is between 30-73 mcg/dl, the symptoms are nonspecific (15, 16).

It should be noted that there is not always a direct association between serum lead levels and clinical symptoms. For example, a child with a lead level of 100 mcg/dl may be clinically healthy, but another child with a lead level of 35 mcg/dl might be symptomatic (17). Although this level is not representative of stored lead in the whole body, blood lead levels above 10 mcg/dl should be considered at the level of concern and require serious measures to find and eliminate the source of poisoning, prescribe supplements, and re-control of the lead level. Although levels below 10 may also cause a slight decrease in IQ and impaired learning and attention, levels above 45 require chelation therapy (18,19). Since lead poisoning has several symptoms and abdominal pain is one of its most obvious manifestations and various factors in Iran expose children to lead and lead-containing substances, the present study aimed at measuring the level of lead in children with chronic abdominal pain and investigating the prevalence of poisoning with this toxic substance, so that by transferring the obtained information to physicians, they can measure lead and poisoning with it in their early diagnostic stages.

Materials and Methods

This was a descriptive-analytical, cross-sectional study and the population included all children aged 1-15 years referred to the gastrointestinal tertiary clinic of Kerman University of Medical Sciences with chronic abdominal pain complaints. After approving the project in the research department of Kerman University of Medical Sciences and providing complete and comprehensible explanations, informed consent was obtained from the parents and in the case of children over 4 years old, the consent was obtained from the children themselves and then a checklist containing demographic information and study variables were completed by the project coworker. Obtained blood samples stored at -20 °C and blood lead level was assessed by atomic absorption spectrometry.

Statistical analysis

In the regression model, by entering the serum level of lead as a dependent variable and comparing it with age, sex, educational status, socio-economic status opium Addiction history in parents Oral Supplement history using the Backward method, the following results were obtained.

Statistical analysis was performed using SPSS software version 21 and *P*-values <0.05 were considered as statistically significant.

Results

In the present study, 93 children aged 1-15 years referred to the clinic with a complaint of abdominal pain had a mean age of 8.53±2.80 years and 44 (47.3%) were female and 49 (52.7%) were male. Other patient demographics are presented in the table below (Table1). As shown, 18 (20%) of the 93 children with abdominal pain were also contaminated with lead, of which 8 (44%) were female and 10 (66%) were male, but no significant relationship was observed between the gender of patients with lead poisoning (0.72pv =). In total, 2 children had higher blood levels than lead poisoning (2.2%). It was observed that 7 (38.8%) out of 18 children with abdominal pain who also had lead contamination had socioeconomic status below the average level, while 46 (61.3%) of the 75 children with abdominal pain with similar socioeconomic status did not have symptoms of lead poisoning. These results suggest that lead contamination in children with chronic abdominal pain is not associated with the socioeconomic status of the family (p-value = 0.45). In 15(83%) children with abdominal pain who had lead contamination, there was a positive history of opium addiction in parents, while in the group without contamination, 35 (46.6%) reported drug addiction in the family. According to these results, abdominal pain in children contaminated with lead has significant relationship with parents opium addiction (p-value = 0.02).

Table 1- Comparison of the frequency distributions of lead contamination based on demographic information, socioeconomic status, and addiction in the family

variable		Lead contamination		p-value
		pos	neg	
sex	male	10(55%)	39(41.9%)	0.72
	female	8(45%)	36(38.7%)	
Addiction in parents	pos	15(83%)	35(46.6%)	0.02
	neg	3(17%)	40(53.3%)	
Socio-economic	low	7(38.8%)	46(61.3%)	0.45
	high	11(61.1%)	29(38.6%)	

Since supplements containing iron, zinc and some vitamins reduce the absorption of lead from the gastrointestinal tract and thus reduce the risk of lead poisoning, this study was conducted to investigate the relationship between the use of such supplements and lead contamination. It was found that 2 people (11.1%) with lead contamination had a history of using supplements, while 16 patients (88.9%) had no history of using supplements, indicating a significant effect of lead absorbent supplements in reducing lead contamination (P-value = 0.042). Out of 18 patients with lead contamination, 4 (22.2%) had an educational failure, while 10 (55.6%) had desirable educational conditions and 4 (22.2%) cases were not examinable, indicating a lack of clear effect of poisoning with lead on children's learning status (P-value =0.067)

Table 2- Comparison of the frequency distributions of lead contamination based on supplements and education failure in children

variable	NO/percent		p-value
Oral Supplement history	pos	2(11.1%)	0.042
	neg	16(88.9%)	
Academic failure	pos	4(22.2%)	0.067
	neg	10(55.5%)	
	Unverifiable	4(22.2%)	

The most common symptoms in children with lead poisoning were anemia (16 cases or 88.8%) and limb pain (16 cases or 88.8%), aggression (12 cases or 66.6%), nausea (9 cases or 50%), anorexia (3 cases or 16.6%), weakness and lethargy (2 cases or 11.1%) and finally diarrhea (1case or 5.5%) and

vomiting (1 case or 5.5%). As shown in Table 3, among the above symptoms, only anemia (p-value = 0.004), limb pain (p-value = 0.013) and aggression (p-value = 0.036) had a significant relationship with lead contamination.

Table 3- Comparison of the frequency distributions of lead contamination based on clinical symptoms and anemia

Demonstration	No/percent	p-value
Nausea	9(50%)	0.067
Vomiting	1(5.5%)	0.394
Weakness	2(11.1%)	0.167
Diarrhea	1(5.5%)	0.397
Anorexia	3(16.6%)	0.240
aggression	12(66.6%)	0.036
Bone pain	16(88.8%)	0.013
Anemia	16(88.8%)	0.004

Discussion

One of the consequences of the increasing development of industries and technology is harmful to human beings and the environment. In this regard, heavy metal poisoning, especially lead poisoning, is considered a special public health problem in children. Given the growth and development of industries in urban communities and an increase in urban transportation and pollution caused by it, lead poisoning has attracted much attention (20). Considering the effects of lead poisoning on children and its effects on inhibiting adequate growth and reducing IQ and other side effects, even small amounts (10-15 µg / dl) of lead should not be ignored (21). In the present study, the frequency of lead contamination in patients with chronic pain referred to the Pediatric Gastroenterology Clinic of Kerman University of Medical Sciences during 2017-2018 was examined. The results showed that out of 93 children with chronic abdominal pain, 18 children (19.4%) had lead contamination, of which 8 (44%) were female and 10 (66%) were male. There was no significant relationship between the gender of patients and lead poisoning (p-v = 0.72) and only two cases of these children had lead poisoning (2.2%). Seven (38.8%) of children with lead contamination belonged to low socioeconomic levels, while 46 (61.3%) of children with similar socio-economic status had no lead contamination, indicating a lack of a relationship between lead contamination and socio-economic status of the family (p-value =0.45). In 15 cases of children with abdominal pain and lead contamination, there was a positive history of opium addiction in the parents, while in the non-contaminated group, 35 cases (46.6%) reported drug addiction in the family. Based on these results, lead contamination had significant relationship with addiction in the parents (p-value=0.02). In 2 (22.2%) cases of lead contamination, there was a history of using lead absorbing supplements, while 16 (77.8%) had no history of using supplements, indicating a significant role of supplements in preventing lead contamination (P-value = 0.042). Out of 18 patients with lead contamination, 4 cases (22.2%) had educational failure, while 10 (55.6%) had good educational status and 4 (22.2%) cases were not examinable, indicating lack of significant effect of contamination on children's educational status (P-value =0.067) The most common gastrointestinal symptoms in children contaminated with lead were nausea (50%), anorexia (16.6%), diarrhea (5.5%) and vomiting (5.5%), respectively, none of which had a significant relationship with lead contamination (p-v> 0.05), but anemia (p-value = 0.004), limb pain (p-value = 0.013) and aggression (p-value = 0.036) were significantly associated with lead contamination.

Lead can cause abdominal pain and gastrointestinal motility disorders through various mechanisms (22). One of the most important mechanisms of ileus and abdominal pain caused by lead poisoning is the dysfunction of the small intestine sodium channels. Abdominal pain can also be due to pancreatitis caused by lead poisoning (23). Eighteen (19.3%) of all children with abdominal pain referred to the hospital had lead contamination, two of whom were at the level of poisoning (2.2%), which is a significant level, and in children with chronic abdominal pain, the serum lead level must be examined. A meta-analysis conducted by Kosnett MJ et al found that serum lead levels above 40- µg / ml can

cause anemia and gastrointestinal disorders in adults (24). A study conducted by Meybodi et al in 2012 revealed that the most common gastrointestinal manifestations in patients with lead poisoning were anorexia (96%), abdominal pain (92%), weight loss >10% within a 2-month period (84%), constipation (88%), and nausea (56%), respectively. In 12% of patients, the first manifestation was acute abdominal pain symptoms due to obstruction and peritonitis (25).

In our study, the most common gastrointestinal symptoms in children with lead contamination were nausea (50%), anorexia (16.6%), diarrhea (5.5%), and vomiting (5.5%), none of which had a significant relationship with lead contamination (p- value> 0.05). The results of a study conducted by Gholamreza Panahandeh in southwestern Iran showed that among 262 children aged 2-6 years, 12.9% had lead contamination, which the lead level in 3.4% of children was at the toxic level (26). In another multicenter study in the United States, 18% of children aged 1–5 years had lead contamination and 6.6% had toxic lead levels. In the present study, the rate of contamination with lead in children was 19.4% and the rate of lead poisoning was 2.2%, which was not significantly different from similar studies.

In a study conducted by Ghasem et al to compare the rates of lead poisoning in the two groups addicted to traditional opium and methadone/tramadol, it was found that 86.2% in the first group and 78.6% in the second group had lead poisoning. Also, 33. 9% in the first group and 43.6% in the second group had anemia, which statistically no relationship was observed between anemia and lead poisoning (p-value = 0.241) (28). In our patients, anemia was the most common symptom in children with abdominal pain and lead contamination (88.8%) and this relationship was statistically significant (0.004). The difference between the results of our study and the above study might be attributed to differences in the study population. In a study conducted by Hsieh et al on 751 people who had occupational exposure to lead, it was found that people with serum lead levels above 15 µg / dL were more likely to have anemia, which is consistent with our results (29).

In a study conducted by Balali-Mood et al on 108 men with lead poisoning, the most common symptoms were the presence of lead line (64.8%), peripheral neuropathy of the upper extremities (37%), depressed deep tendon reflexes in the upper extremities (25.7%), tremor (23.3%), peripheral neuropathy of the lower extremities (17%) and abdominal tenderness (15.1%), respectively, and the most common subjective findings were loss of memory (57%)moodiness (56.1%), agitation (47.7%), drowsiness (36.4%) and headache (29.9%) respectively (30). In our study, aggression (66.6%) and limb pain (88.8%) were among the most common symptoms that were significantly associated with lead contamination in children (PV <0.05), but no clear learning impairment was observed in children based on their educational status.

In a study conducted by Sina Kianoush et al (2013) on car battery industry workers, results showed that the mean serum lead level in these workers was 398.95 ± 177.40 µg / L, and the most common symptoms included irritability and arthralgia, which is consistent with results of our study (31). In a study conducted by Julia Keosaian to investigate lead contamination in Indian children treated with traditional medicines in 2019, no significant relationship was found between lead contamination and family economic status. In our study, no significant relationship was observed between lead contamination and patients' economic status, so that 7 cases (38.8%) of children with lead contamination were in low socio-economic level, while 46 (61.3%) of children with similar socio-economic status had no lead contamination, indicating lack of relationship between lead contamination and socio-economic status of the family (p-v =0.45) (32).

In a study conducted by Winneke G study, it was found that per 10 -100 µg / ml increase in serum lead levels in children, IQ decreased by 4-7 grades (33), while some other experts believe that no direct relationship can be found between a specific serum lead level and a decrease in IQ (34). Some studies have reported that children contamination with lead can cause peripheral nerve damage, hearing impairment, and hyperactivity syndrome in children with decreased attention and learning disabilities (35). Based on the results of a study conducted by Gidlow DA in 2015, children contaminated with lead

experienced physical growth retardation, learning disabilities at school, and more behavioral problems than normal individuals (36).

In a study conducted by Bellinger D et al, a significant relationship was observed between lead poisoning and memory impairment, speech delay, and skill acquisition disorder. In our study, out of 18 patients with lead contamination, 4 (22.2%) had an educational failure, 10 (55.6%) had normal educational conditions and 4 cases (22.2%) were not examinable. There was no significant relationship between lead contamination and children's educational status (PV = 0.067).

Conclusion:

The results of the present study showed that one of the causes of chronic abdominal pain in children can be lead contamination, especially in opium addicted families.

Ethical statement:

This project was approved in ethical committee of Kerman University of medical sciences and assigning the code of (IR.KMU.AH.REC.1396.2162) to this study.

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