Original Article

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Evaluation of Serum Lead Levels in Children with Constipation and Normal Controls in Northern Iran

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Abstract

Objective: Constipation is a major debilitating problem in children. We aimed to assess the serum lead levels of 2-13 year-old children complaining from constipation who referred to our center in Guilan province, Northern Iran.

Methods: This cross-sectional study was done on ninety 2-13 year-old children referring to 17th Shahrivar Hospital, complaining from constipation (case group) and 90 healthy children The demographic data as well as the children's serum lead levels were evaluated and recorded. Data were analyzed using SPSS software. Chi-square test was used as applicable.

Findings: Lead poisoning was significantly more frequent in the case group (37.8%) compared with the control group (8.9%). The frequency of lead poisoning in the case group compared with the control group, was significantly higher in children <7 years old (40.2% vs. 10%), boys (40.9% vs. 9.3%), girls (34.8% vs 8.3%), residents of old houses (43.1% vs. 9.7%), residents of new houses (28.1% vs. 8.5%), residents of low-traffic areas (26.8% vs. 5.3%), urban residents (40.5% vs. 9.9%), children whose fathers had low risk (33.3% vs. 10.9%) and high risk jobs (40.7% vs. 3.8%).

Conclusion: The frequency of lead poisoning was higher in children suffering from constipation .No significant difference was found between the two groups with respect to their sex, age, father's job, and living in urban or rural areas.

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Key Words: Constipation; Lead; Children; Lead Poisoning

Introduction

Constipation is a major debilitating problem in children, which can be caused by various factors. It is a common complaint comprising 3% of referrals to pediatricians and 25% of referrals to pediatric gastroenterologists. Its prevalence ranges from 10% to 30% in different parts of the world[1-3].

Constipation is commonly caused by functional disorders. In other words, it can be caused by any anatomical or organic reasons; it is caused by taking medications. Fecal incontinency is the most obvious complication of constipation, which is seen in 34% of affected patients. Chronic abdominal pain, as well as rectal and anal pain, is observed in nearly half of the children suffering

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from constipation. Other complications of constipation are urinary signs such as enuresis or urinary incontinency[4,5].

According to Issenmen's report from North America, 16% of parents of 22-month-old infants complained from their children's constipation[6]. In England, Yong and Bettie reported that 34% of 4-11 year-old healthy children had short term constipation with few complications, while chronic constipation was often the result of a poorly treated acute episode affecting 5% of such British children[7].

Lead poisoning is an environmental cause of constipation. Evaluating the blood level of lead is the gold standard for determining the effect of lead on health status. The Center for Disease Control, the American Academy of Pediatrics, and many national and international organizations consider a blood lead level ≥10 microgram/dl as lead poisoning. It has been estimated that 99% of lead poisoning cases can be identified through screening[5,8]. Atomic absorption is the most accurate method for measuring serum lead levels[9,10].

Previous studies have shown a prevalence of 7-41% for lead poisoning in different parts of the world[1,3,5,11-13]. Lead poisoning can occur through ingestion, inhalation, and dermal contact.

Lead most often enters children's bodies through swallowing surface dust or ingesting peeled pieces of paint, and less frequently by drinking water from lead taps and eating food that is in contact with lead-stained ceramic surfaces. Other sources of lead poisoning include paint, fishing rods, pots soldered with lead, vinyl miniblind, old walls, electric cables, car exhaust fumes [14-21].

Gastrointestinal signs of lead poisoning include frequent and recurrent loss of appetite, abdominal pain, vomiting, and constipation, which last for some weeks. Children with a serum lead level >20 microgram/dL complain about gastroenterological problems two times more than those with serum level <20 microgram/dL[5].

Having considered the prevalence of constipation in children and its complications, and as one of the less discussed causes of constipation is lead poisoning, we aimed to assess the serum lead levels of 2-13 year-old children complaining from constipation who referred to our center in Guilan province, Northern Iran. To the best of our knowledge no studies have been done so far on the prevalence of lead poisoning in children in our region.

Subjects and Methods

In this cross-sectional study, we evaluated 90 2-13 year-old children complaining from constipation who referred to 17thShahrivar Hospital, Rasht, Guilan province, Northern Iran, over a one–year period from March 2009 to April 2010. We took 2-13 year-old children with a history of constipation lasting for longer than one month as the case group. The control group consisted of 90 2-13 year-old Guilani children admitted to pediatric surgery ward for non-emergency surgeries without any complaint of constipation. The patients who did not agree to participate in the study or those who did not consent to blood withdrawal were excluded from the study. Written informed consent was obtained from the parents.

The demographic data of both groups including their full name, age, sex, place of residence, and parents' occupation were recorded. To determine the serum lead level, 2cc of whole blood was withdrawn from all individuals. The blood was kept in a plastic tube containing EDTA anticoagulant, and transferred to the laboratory while maintaining the cold chain. The serum lead level was measured using the atomic absorption method by graphite furnace method with standard lead (Merek device, Germany).

With respect to their age, the children were divided into two groups; preschool (below 7 years) and over 7 years. The parents' occupation was classified as high risk or low risk. Occupations such as painting and battery manufacturing, working in lead mines, and any occupation linked to lead were classified as high risk jobs. Other occupations were considered as low risk. The place of residence was assessed considering three aspects: rural or urban areas, high traffic or low traffic, and old building (more than 15 years old) or new building (less than 15 years old). The amount of traffic was measured based on the residential address stated by the parents. Crowded highways, main squares or crowded streets were considered as high traffic areas.

Table 1: Comparison of the demographic data in children with constipation and controls on the basis of low and high serum lead levels

Variable		Group	Lead serum level (%) <10 µg/dL	Lead serum level (%) ≥10 µg/dL	Total	*P* value
Age	**<7**	Case	49(59.8)	33(40.2)	82(100)	0.001
		Control	63(90)	7(10)	70(100)	
	≥7	Case	7(87.5)	1(12.5)	8(100)	0.5
		Control	19(95)	1(5)	20(100)	
Sex	**Boy**	Case	26(59.1)	18(40.9)	44(100)	0.0002
		Control	49(90.7)	5(9.3)	54(100)	
	Girl	Case	30(65.2)	16(34.8)	46(100)	0.005
		Control	33(91.7)	3(8.3)	36(100)	
Age of residential building	**New**	Case	23(71.9)	9(28.1)	32(100)	0.01
		Control	54(91.5)	5(8.5)	59(100)	
	Old	Case	33(56.9)	35(43.1)	58(100)	0.001
		Control	28(90.3)	3(9.7)	31(100)	
Traffic of residential area	**High traffic**	Case	15(44.1)	19(55.9)	34(100)	0.08
		Control	10(71.4)	4(28.6)	14(100)	
	Low traffic	Case	41(73.2)	15(26.8)	56(100)	0.001
		Control	72(94.7)	4(5.3)	76(100)	
Parents' Job	**Low risk**	Control	24(66.7)	12(33.3)	36(100)	0.006
		Case	57(89.1)	7(10.9)	64(100)	
	High risk	Control	32(59.3)	22(40.7)	54(100)	0.001
		Case	25(96.2)	1(3.8)	26(100)	
Area of residence	**Urban**	Control	47(59.5)	32(40.5)	79(100)	0.007

Data were analyzed using SPSS software, version 18. Chi-square and Mantel Haenszel tests were used as applicable.

Findings

The mean (±SD) age of the participants in the case and control group was 4.128±2.268 and 4.878±3.027 years, respectively. The mean serum lead level of the children in the case and control group was 11.643 µg/dL and 4.924 µg/dL, respectively. Demographic data of children with constipation and the controls on the basis of low and high serum lead levels is shown in Table 1.

In the case group, 34 (37.8%) patients had a serum lead level of ≥10 µg/dL compared with 8 (8.9%) patients in the control group ($P<0.05$). The odds ratio of having constipation in patients with a serum lead level of ≥10 µg/dL was 6.22 times more than those with a serum lead level of <10 µg/dL (CI: 2.682-14.441). Comparison of the confidence interval and odds ratio in children with constipation and their controls on the basis of lead level and demographic data according to Mantel Haenszel test is shown in Table 2.

We found that lead poisoning was significantly more frequent in the children who were less than 7 years old and had constipation compared with those who did not ($P=0.001$). However, this difference was not significant for the children over 7 years old ($P=0.48$). Mantel Haenszel test showed that age was not a confounding factor in our study since no significant difference was found between both groups ($P>0.05$) (Table 2).

With respect to sex, lead poisoning was significantly more frequent in the boys and girls of the case group compared with the control group ($P=0.0002$ and 0.005 respectively). Statistical analysis showed that sex was not a confounding factor in our study because no significant difference was found between both sexes ($P>0.05$) (Table 2).

In the case group, children living in both old and new houses had significantly higher serum lead levels compared with the control group. We found a significant difference between lead level of children residing in old houses and those living in

Table 2: Comparison of the confidence interval and odds ratio in children with constipation and their controls on the basis of lead level and demographic data (Mantel Haenszel test)

Variable		Confidence Interval	Odds ratio
Age	**<7**	2.472-14.863	6.061
	≥7	0.149-49.533	2.714
Sex	**Boy**	2.261-20.362	6.785
	Girl	1.554-22.150	5.867
Age of residential building	**New**	1.267-13.992	4.226
	Old	1.929-25.922	7.071
Traffic of residential area	**High traffic**	0.827-12.126	3.164
	Low traffic	2.049-21.169	6.585
Parents' Job	**Low risk**	1.429-11.601	4.071
	High risk	2.166-136.368	17.188
Area of residence	**Urban**	2.530-15.316	6.225
	Rural	0.319-50.229	4.0

new ones which shows higher levels in old houses (OR: 5.55-6.22). Therefore, living in old or new houses was a confounding factor (Table 2).

Although the participants in the case group who lived in high and low traffic areas both had higher serum lead levels than the control groups, we found no significant difference between the case and control group in those living in high traffic areas. However, this difference was significant in those residing in low traffic areas. We found a significant difference between children residing in low traffic areas and those living in high traffic areas (OR: 4.87-6.22, Mantel Haenzel test); therefore, the amount of traffic was a confounding factor which is confirmed by statistical methods (Table 2).

In the case group, more children had significantly higher serum lead levels than the control group regardless of the low-risk or high-risk occupation of their parents (P=0.006 and 0.001 respectively). We found no significant difference between the lead level of children with respect to their parents' occupation between the two groups, and therefore, the parents' occupation was not a confounding factor (P>0.05)(Table 2).

In the children living in urban areas lead poisoning was more frequent in children with constipation (P=0.0007). Although the same figure existed in comparison of cases and controls in the rural areas, and there was no significant difference between rural and urban areas residents (P=0.3). Therefore, the place of residence was not considered as a confounding factor (Table 2).

Discussion

Evidence exists on the negative effects of high concentrations of serum lead on children's health and its negative behavioral, social, and intellectual consequences. This issue has aroused serious health related concerns throughout the globe. The need for control, supervision, and management to decrease the risks of lead exposure is deeply felt[22].

In our study, more boys suffered from lead poisoning in the case group (40.9%) compared with the control group (9.3%). More girls in the case group (34.8%) suffered from lead poisoning compared with the control group (8.3%). In a study by Verbel and coworkers on 189 5-9 year-old children of 10 different schools in Columbia, 7.4% of the children had serum lead levels of ≥10μg/dL. Consistent with our study, they found no significant difference in serum lead levels with respect to sex[13]. However, a review article that assessed the serum lead levels of Chinese children from 1994-2004 showed inconsistent results. The researchers found that the serum lead level of the boys (96.4 μg/l) was significantly higher (89.4 μg/l) than that of the girls[23].

We found that in the case group, the odds ratios of those suffering from lead poisoning in the boys and girls were 6.785 and 5.867, respectively, compared with the control group. We also found that boys were at a higher risk of lead poisoning which shows that boys are possibly more exposed to lead.

Considering the significant difference between the children living in old and new houses in our study, the age of the building was a confounding factor. In a randomized controlled trial, the effects of decreasing lead pollution on children's serum lead levels were evaluated after a one-year follow-up. 152 children aged less than 4 years with a serum lead level of 7-24 µg/dL were enrolled. The researchers found that lead-contaminated soil led to lead poisoning in children living in urban areas. Decontaminating the soil surrounding the houses relatively reduced the serum lead level[22,24]. Consistent with this study, we found that living in old houses was linked to lead poisoning because of the existing dust and used paint.

We found no significant difference between the children residing in urban or rural areas with respect to their serum lead levels. Therefore, the place of residence was not a confounding factor. In a study performed by Kumar and colleagues on 150, 5-15 year-old Indian children, the serum lead levels of the children living in rural areas were evidently lower than the children residing in urban areas[3]. Consistently Wang and coworkers found that the mean serum lead level of the children living in industrial or urban areas was significantly higher than those living in suburban or rural areas[23]. We also found similar results which is quite likely considering the higher load of traffic and air pollution in urban areas.

Considering the significant difference between the children living in high and low traffic areas, the amount of traffic was considered as a confounding factor. In a study done in Belize on 164, 2-8 year-old children in four different areas, the researchers found that 7% of the studied children had serum lead levels of ≥10 µg/dL. Moreover, the study showed that children residing in more crowded areas had a higher concentration of serum lead[6]. Use of unleaded diesel was initiated in Jakarta, Indonesia in 2001. Researchers then evaluated the mean serum lead levels and the prevalence of high serum lead levels in primary school children in Jakarta and assessed the risk factors of exposure to lead before using unleaded diesel. In children who lived near highways or a large intersection, the serum lead levels were significantly higher compared with children who lived in low traffic areas[25]. As shown, consistent with our study, all studies indicate the role of traffic in lead poisoning.

In our study, in the children whose parents had low-risk jobs, the odds ratio of having lead poisoning in the case group compared with the control group was 4.071. The corresponding figure for the children whose parents had high-risk jobs was 17.188. In Khan and colleagues study in Pakistan, the frequency of lead poisoning in children whose parents had high-risk jobs (31%) was significantly higher[26]. In a descriptive study, Nuwayhid and coworkers measured the serum lead level of 281 healthy 1-3 year-old children referring to a medical center in Beirut. Logistic regression analysis showed that an increased serum lead level was related to the fathers' job [27]. Furthermore, Olewe and colleagues studied the potential factors related to increased serum lead levels on 387 under 5 year-old children in Kibera slums in Nairobi. They found that high levels of serum lead was related to having unhealthy and unsuitable housing, eating and playing in contaminated soil[28]. Queirolo and coworkers conducted a study in Montevideo, Uruguay on 222 pre-school children to identify the predicting factors for high serum lead levels. They concluded that the lead-related job of the fathers was related to higher serum lead levels in the children[29]. Considering the previously mentioned studies, the high-risk job of fathers is related to lead poisoning in the children, which is consistent with our study.

Conclusion

In this study no significant difference was found between the two groups with respect to their sex, age, father's job, and living in urban or rural areas. We suggest screening high risk children such as those living in dusty and smoggy areas. Also, serum lead levels should be measured in children presenting with similar symptoms to lead poisoning such as constipation and loss of appetite. Performing extensive studies on children's serum lead levels and recording their demographic data and other factors could be beneficial.

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Conflict of Interest: None

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