DOI: *http://dx.doi.org/10.22122/ahj.v12i3.268*

Published by Vesnu Publication

Blood Lead Levels in Opium-Poisoned Children: One Cross-Sectional Study in Iran

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Original Article

Abstract

Background: Lead poisoning is now more common due to accidental or intentional exposure to opium impregnated with lead. We aimed to determine the relationship between the blood lead levels (BLLs) and basic characteristics in opium-poisoned children.

Methods: In this cross-sectional study, 32 children younger than 13 years old who had been admitted to Loghman Hakim Poison Center, Tehran, Iran, due to opium poisoning, were evaluated for BLLs. Patients' demographics, symptoms, signs, and lab tests were evaluated as well as the BLLs.

Findings: The median and range of age in children with opium poisoning were 14 and 141 months with minimum and maximum age of 3 and 144 months, respectively, and 62.5% were boys. Their mean BLL was 9.78 ± 3.44 µg/dl and in 70% of opium-poisoned children, BLL was ≥ 5 µg/dl. There was a significant difference between mean BLLs in girls and boys (17.07 ± 6.57 µg/dl in girls and 6.61 ± 3.22 µg/dl in boys, P = 0.02). We found a significant correlation between BLL and hemoglobin (Hb) level. In very low Hb level (< 8 g/dl), the BLL was higher but with increasing Hb level, BLL increased as well; in Hb levels > 14 g/dl, BLL decreased again (P = 0.01).

Conclusion: Although none of the children needed chelation therapy, strategies should be developed to prevent children from being exposed to opium and other materials impregnated with lead regarding its effects on all organs of children.

Keyword: Lead; Opium; Child

Citation: Chouhdari A, Farnaghi F, Hassanian-Moghaddam H, Zamani N, Sabeti S, Shahrabi Farahani H. **Blood Lead Levels in Opium-Poisoned Children: One Cross-Sectional Study in Iran.** Addict Health 2020; 12(3): 159-66.

Received: 28.02.2020 **Accepted:** 02.05.2020

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Introduction

Lead is a dangerous toxicant that is particularly harmful in young children. It distributes to the brain, liver, kidney, and the bones.[1-4] Since children absorb 50% of the ingested lead compared to 10% of that in adults, complications may be graver in them.[5-7] There are many sources of environmental lead poisoning in children including contaminated food and water, polluted air, parents' occupation, toys, and cosmetic material. Also, increased maternal blood lead levels (BLLs) during pregnancy and breastfeeding may be a major cause of lead poisoning in the pediatric population. There are no known safe BLLs.[8-14] Based on Centers for Disease Control and Prevention (CDC), BLLs ≥ 5 µg/dl in children indicate high exposure to lead.[13-15] Nowadays, lead poisoning is reported in opium users particularly in middle- and low-income countries including Iran.[16-20] Opium smugglers may add lead to opium to increase the weight for more profit leading to life-threatening adulteration. There is a variety of clinical signs and symptoms in lead-contaminated opium consumers. Gastrointestinal (GI) complications (abdominal pain, constipation, anorexia, nausea, and vomiting), bone and muscle weakness, decreased libido, headache, and hypertension (HTN) have been reported in these patients. Farzaneh et al. indicated other signs including sleep disorders, irritability, anemia, kidney damage, seizure, and encephalopathy.[17]

The severity of signs and symptoms depends on the amount of lead concentration and the duration of exposure. Although exposure to trivial amounts of lead does not cause significant signs/symptoms in adults, it may be harmful in children due to their vulnerability to lead toxic effects. Generally, lead exposure causes anemia, acute encephalopathy, renal failure, seizure, coma, decreased intelligence quotient **(**IQ), and behavioral changes such as lack of concentration, anti-social behavior, and academic failure in young children.[18-20] Children may be exposed to oral opium or smoke with a high absorption rate.[21] Nutritional factors such as a low-calcium diet, iron deficiency, and fasting increase lead absorption.[22-24] The aim of this study was to evaluate BLL in children exposed to opium and its relationship with basic characteristics.

Methods

This cross-sectional study was performed in pediatric poisoning ward of Loghman Hakim Hospital, Tehran, Iran (the biggest poisoning center in Iran) from March 2018 to March 2019. All children who had been referred with the signs and symptoms of opium poisoning were hospitalized and considered to be included. Information about type of narcotic substance, living area (polluted versus non-polluted), living in old buildings (older than 10 years or less) because of ingestion of small quantities of lead paint flakes, and time interval between oral intake or exposure to opium smoke and admission was collected. Complete physical examination was performed. So, growth retardation, short stature, hearing impairment, autism, abdominal pain, muscle and bone weakness, anemia, neurological disorders, lack of attention and concentration, pica (eating disorder), and constipation were recorded. BLL was measured using LeadCare II Analyzers (ESA Biosciences, Inc. 22 Alpha Road, Chelmsford, MA, USA) (Model 70-6529, Magellan Diagnostics, Inc. Massachusetts, USA) (portable electrochemical technique) on 0.5 ml heparinized venous blood samples at least 24 hours after opium exposure. This device shows the BLL within three minutes and detects a BLL range of 3.3 to 65.0 µg/dl. Higher BLLs should be confirmed by more accurate laboratory tests.[25,26] Serum calcium and blood hemoglobin (Hb) were also checked. Parents were asked if they would like to participate in the study. If parents agreed, a consent form was taken from them explaining the purpose of the survey. BLLs higher than 45 µg/dl were considered to be treated. There was no financial support. This study was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences, Tehran, Iran (Ethical Code: IR.SBMU.REC.1396.107).

To report descriptive results, mean, standard deviation (SD), median, and number (percent) were used. Independent t-test, Mann-Whitney U test, and one-way analysis of variance (ANOVA) were performed for data analysis using SPSS software (version 19, SPSS Inc., Chicago, IL, USA). A P-value less than 0.05 was considered to be statistically significant.

Results

Basic characteristics: The median and range

were 14 and 141 months, respectively. The minimum and maximum age was 3 months and 12 years, respectively, and 62.5% were boys. Exposure time was different in each patient. Mean BLL, calcium, and Hb were 9.78 ± 3.44 µg/dl, 9.88 ± 0.70 mg/dl, and 10.84 ± 1.59 g/dl, respectively. Although none of the cases were candidates of admission for chelating agents (BLL > 45 mcg/dl), all patients received conservative treatment and correction of electrolyte imbalance. Demographic characteristics are shown in table 1.

Table 1. Demographic characteristics of opium-poisoned children

Variables	n (%)
Age (year)	
≤ 3	27 (84.4)
> 3	5 (15.6)
Sex	
Boy	20 (62.5)
Girl	12 (37.5)
Ethnicity	
Fars	18 (56.3)
Other	14 (43.7)
Old house (more than 10 years)	
Yes	17 (53.1)
No	15 (46.9)
Living location	
The area with high air pollution	27 (84.4)
The area with low air pollution	5 (15.6)
Types of opium consumed by the child	
Oral	3 (9.4)
SHS (inhaler)	16 (55.1)
Both	10 (36.5)

SHS: Secondhand smoke

Clinical manifestations and lab tests in children poisoned with opium are shown in tables 2 and 3.

The mean BLL was significantly different between the two genders (17.07 ± 6.57 µg/dl in girls versus 6.60 ± 3.22 µg/dl in boys, P = 0.02). Although we did not find a significant difference between ages less or more than 3 years (P = 0.50) as well as clinical manifestation (P > 0.05), serum calcium (P = 0.20, r^2 = 0.1), and BLL, there was a significant nonlinear correlation (cubic) (P = 0.01, r^2 = 0.2) between BLL and Hb level (Figure 1). In this survey, only one 5-month-old boy who was exposed to opium during the fetal period expired with severe sepsis. Rest of patients discharged in good condition.

Table 2. Clinical manifestation and lab tests in opium-poisoned children

Variables	Value
Time passed from opium consumption (hour)	
≤ 24	26 (81.3)
> 24	6 (18.7)
BLL (µg/dl)	9.78 ± 3.44
BLL (µg/dl)	
< 5 µg/dl	10 (31.3)
≥ 5 µg/dl	22 (68.8)
Serum calcium (mg/dl)	9.88 ± 0.70
Hb (g/dl)	10.84 ± 1.59
Abdominal pain	
Yes	5 (15.6)
No	27 (84.4)
Musculoskeletal pain	
Yes	1 (3.1)
No	31 (96.9)
Anemia	
Yes	13 (40.6)
No	19 (59.4)
Constipation	
Yes	10 (31.3)
No	22 (68.7)
Growth disorder	
Yes	8 (25.0)
No	24 (75.0)
Delayed teeth	
Yes	2 (6.3)
No	30 (93.7)
Neurologic disorder	
Yes	5 (15.6)
No	27 (84.4)
Lack of concentration	
Yes	6 (18.8)
No	26 (81.2)
Hearing disorder	
Yes	4 (12.5)
No	28 (87.5)
Autism	
Yes	0 (0)
No	32 (100)
Pica	
Yes	8 (25.0)
No	24 (75.0)

Values are expressed as mean ± standard deviation (SD) or number and percentage
BLL: Blood lead level; Hb: Hemoglobin

Discussion

Lead poisoning is a serious concern in childhood which can lead to many complications.[27] Recently, it has grown in Iran due to adding lead to opium for weighting it. Children may be exposed to opium

smoke or its accidental oral consumption.[16,17]

Table 3. Blood lead level (BLL) and categorical variables in children admitted due to opium poisoning

Variables	BLL (µg/dl) (mean ± SD)	P
Age (year)		0.50
≤ 3	9.38 ± 4.48	
> 3	11.94 ± 5.50	
Sex		0.02*
Boy	6.61 ± 3.22	
Girl	17.07 ± 6.57	
Ethnicity		0.50
Fars	6.02 ± 1.42	
Other	10.96 ± 2.93	
Types of opium consumed by child		0.30
Oral	4.93 ± 2.90	
SHS (inhaler)	12.06 ± 7.12	
Both	8.73 ± 3.56	
Time passed from opium consumption (hour)		0.20
≤ 24	8.96 ± 5.24	
> 24	13.33 ± 6.11	
Abdominal pain		0.50
Yes	12.08 ± 9.22	
No	9.30 ± 5.40	
Anemia		0.10
Yes	7.39 ± 6.73	
No	11.41 ± 9.24	
Constipation		0.10
Yes	6.47 ± 3.21	
No	11.29 ± 5.60	
Growth disorder		0.30
Yes	7.23 ± 3.50	
No	10.60 ± 6.43	
Delayed teeth		0.09
Yes	15.05 ± 7.74	
No	9.40 ± 4.90	
Neurologic disorder		0.80
Yes	9.08 ± 3.75	
No	9.91 ± 6.09	
Lack of concentration		0.60
Yes	8.40 ± 4.18	
No	10.09 ± 9.18	
Hearing disorder		0.20
Yes	12.12 ± 5.35	
No	9.45 ± 4.30	
Pica		0.20
Yes	6.67 ± 3.22	
No	10.82 ± 9.39	
Musculoskeletal pain		0.80
Yes	11.90 ± 0.10	
No	9.70 ± 8.50	

*Statistically significant
SHS: Secondhand smoke; SD: Standard deviation

In our study, the mean ± SD of BLL was 9.78 ± 3.44 µg/dl. Based on CDC, BLLs ≥ 5 µg/dl in children indicate high exposure to lead. We cannot definitely prove that cause of high BLL was opium use because there are many resources of lead exposure in the community.[13-15] The median age of opium-poisoned children was 14 months and most of the victims were boys. There was no difference between the mean BLL and age less or more than 3 years (P = 0.50). Similar surveys indicated that children younger than six years of age (and particularly those younger than 36 months) were more vulnerable to the toxic effects of lead compared to the adults due to their imperfect blood-brain barrier (BBB) that permits lead entry into the developing nervous system. Iron deficiency is also more frequent in children and can increase lead absorption from the GI tract.[28-30]

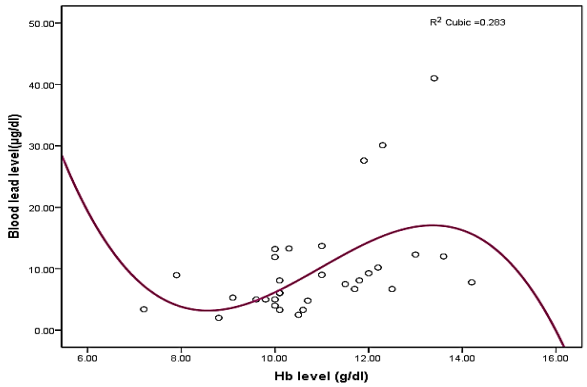

Figure 1. Cubic correlation between blood lead level (BLL) (µg/dl) and hemoglobin (Hb) level (g/dl) in children with opium poisoning. In very low Hb level (< 8 g/dl), the BLL was higher but with increasing Hb level, BLL increased. In Hb levels > 14 g/dl, BLL was decreasing again (P = 0.01).

Although most of children poisoned with opium were boys, the BLLs were statistically higher in girls (17.07 ± 6.57 in girls versus 6.61 ± 3.22 µg/dl in boys, P = 0.02). In Sampson and Winter study, there was no correlation between gender and BLL.[2] Also, Li et al. showed that gender was not a risk factor for high BLL.[31] The mean BLL was 9.78 ± 3.44 µg/dl, so that in 68.8% of patients, BLL was 5 µg/dl and more. Although none of the patients needed chelation therapy, periodic follow-up visits were encouraged due to BLL of 5 µg/dl which shows high exposure in children population.[15]

Parhoudeh et al. indicated that the BLLs ≥ 5 µg/dl were reported more in patients admitted with a neurological disorder [P = 0.024, odds ratio (OR): 2.90, 95% confidence interval (CI): 1.06-7.60].[32] Etchevers et al. showed that IQ decreased five scores for each 10 µg/dl increase in BLL.[33] Although BLL was higher in suburban residents, this mean difference was not significant statistically (P = 0.40). Many studies showed that living near main roads and highly polluted areas was associated with lead toxicity.[2,30] In this survey, there was no difference between the mean BLL and building age (P = 0.60). Previous studies emphasized that paint chips or lead dust from lead-painted surfaces of the buildings could be the cause of lead poisoning in children.[33,34] Almost 50% of opium poisonings occurred through inhalation [secondhand smoke (SHS)]. Mansori et al. showed that 88.6% of poisonings occurred orally.[35] Another survey pointed out that in Iran, the most prevalent form of opium poisoning was through SHS,[36] which could be due to higher absorption of lead through the respiratory system.[37]

Based on our results, the most common clinical symptoms of opium poisoning were anemia (40.6%) and constipation (31.3%) which are both prevalent in lead poisoning although there was no association between BLL and patients' signs/symptoms (P > 0.05). This may be due to our low statistical power (because of a small sample size). In one study in Arak, Iran, anemia was the major clinical manifestation in opium poisoning (P = 0.02, OR: 2.30, 95% CI: 1.90-2.80).[38] As previously mentioned, BLL is also associated with lower IQ scores.[39] Intellectual impairment may even occur in children with BLLs below 10 µg/dl.[40] We did not find any relation between hearing disorder and mean BLL (P = 0.50). In Ghiasvand et al. study, mean BLL was significantly associated with the high-frequency hearing loss (OR = 3.98, 95% CI: 1.63–9.71, P < 0.01).[41] The central nervous system (CNS) may also be involved manifesting with stupor and convulsion. These clinical manifestations often happen in BLLs > 60 µg/dl. Although lead poisoning can cause neuropathy, colic, and chronic renal failure, these manifestations are rare in children.[27] In this study, there was no significant relationship between anemia and BLL (P = 0.10); nevertheless, in very low Hb levels (< 8 g/dl), the BLL increased but with increasing Hb level up to 14 g/dl, BLL increased as well. In Hb levels higher than 14 g/dl, BLL and Hb levels were reversed (P = 0.01, r^2 = 0.2) (Figure 1). Bradman et al. indicated that BLL was higher in iron-deficient children.[42] In this study, no linear correlation was detected between serum calcium and BLL (P = 0.10, r = 0.1) although Alinejad et al. suggested that dietary factors such as a low-calcium diet, iron deficiency, and fasting increased lead absorption.[22] In current survey, there was not an association between BLL and time passed from opium consumption less or more than 24 hours (P = 0.20), but other study indicated opposite result.[22] The limitation of this study is the low sample size and low power of analysis which decreases generalizability.

Conclusion

Given the greater vulnerability of children, it is necessary to provide solutions to reduce the exposure to opium or any other dangerous substance.

Conflict of Interests

The authors have no conflict of interest.

Acknowledgements

The authors would like to thank the Clinical Research Development Center (CRDC) and Toxicological Research Center of Loghman Hakim Hospital, Shahid Beheshti University of Medical Sciences for their support, cooperation, and assistance throughout the period of study.

Authors' Contribution

Design of the study: AC and FF; Acquisition of data: FF, HHM, NZ and SS; Analysis and interpretation: AC; Drafting of manuscript: AC, FF and HSF; Critical revision: AC, FF, HHM and NZ.

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DOI: http://dx.doi.org/10.22122/ahj.v12i3.268 Published by Vesnu Publication

بررسی ارتباط سطح خونی سرب و مشخصات پایه‌ای در کودکان مسموم شده با تریاک: یک مطالعه توصیفی– مقطعی در ایران

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مقاله پژوهشی

چکیده

مقدمه: مسمومیت با سرب به علت مصرف از قصد یا اتفاقی اپیوم آغشته به سرب افزایش پیدا کرده است. هدف از انجام پژوهش حاضر، بررسی ارتباط بین سطح خونی سرب و مشخصات پایه‌ای در کودکان مسموم با اپیوم بود.

روش‌ها: در این مطالعه توصیفی- مقطعی، سطح خونی سرب ۳۲ کودک کمتر از ۱۳ سال که به علت مسمومیت با اپیوم در بخش مسمومیت بیمارستان لقمان حکیم بستری شده بودند، مورد ارزیابی قرار گرفت. اطلاعات دموگرافیک، علایم، نشانه‌ها و تست‌های آزمایشگاهی نیز بررسی و گزارش گردید.

یافته‌ها: میانه و دامنه سنی کودکان مسموم شده با تریاک ۱۴ و ۱۴۱ ماه با حداقل سن سه ماه و حداکثر سن ۱۲ سال (۱۴۴ ماه) گزارش شد. ۶۲/۵ درصد کودکان پسر بودند. میانگین سطح خونی سرب ۳/۴۴ ± ۹/۷۸ میکروگرم در دسی‌لیتر و در ۷۰ درصد بیماران مسموم با اپیوم، مساوی و بیشتر از ۵ میکروگرم در دسی‌لیتر گزارش گردید. اختلاف معنی‌داری بین سطح خونی سرب در دختران و پسران وجود داشت (۶/۵۷ ± ۱۷/۰۷ میکروگرم در دسی‌لیتر در دختران و ۳/۲۲ ± ۶/۶۱ میکروگرم در دسی‌لیتر در پسران) (P = ۰/۰۲). همبستگی معنی‌داری بین سطح سرب خون و هموگلوبین مشاهده شد. در سطح هموگلوبین کمتر از ۸ گرم در دسی‌لیتر، سطح خونی سرب بالاتر بود، اما با افزایش هموگلوبین، سطح خونی سرب افزایش پیدا کرد. همچنین، در هموگلوبین بالاتر از ۱۴ گرم در دسی‌لیتر، سطح خونی سرب دوباره کاهش یافت (P = ۰/۰۱).

نتیجه‌گیری: اگرچه در تحقیق حاضر هیچ کدام از موارد مسمومیت با سرب به درمان با شلاتور نیاز نداشت، استراتژی‌هایی جهت جلوگیری از تماس کودکان با اپیوم و سایر مواد مخدر آغشته به سرب به دلیل اثر بر ارگان‌های آن‌ها باید صورت گیرد.

واژگان کلیدی: سرب؛ تریاک؛ کودکان

ارجاع: چوهدری آرزو، فرنقی فریبا، حسنیان مقدم حسین، زمانی نسیم، ثابتی شهرام، شهرابی فراهانی هادی. **بررسی ارتباط سطح خونی سرب و مشخصات پایه‌ای در کودکان مسموم شده با تریاک: یک مطالعه توصیفی– مقطعی در ایران.** مجله اعتیاد و سلامت ۱۳۹۹؛ ۱۲ (۳): ۶۶–۱۵۹.

تاریخ دریافت: ۱۳۹۸/۱۲/۹ **تاریخ پذیرش:** ۱۳۹۹/۲/۱۳

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