Assessment of Blood Lead Levels in Mothers Addicted to Opium and Their Neonates in Kerman: A Cross-sectional Study

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Abstract

Background: High blood lead levels (BLLs) in pregnant women are associated with poor outcome in neonates. One of the newest non-occupational sources of lead contamination is opium consumption. Accordingly, this study aimed to assess BLLs in mothers addicted to opium and their neonates in Kerman.

Methods: This cross-sectional was conducted in Afzalipour hospital in Kerman, from February 2019 to February 2020. The BLLs were measured in 100 opium-addicted and non-addicted mothers and their newborns, and the lead levels higher than 5 μg/dL were considered contamination. Then, the demographic and anthropometric data were compared.

Findings: Based on the results of the present study, the BLLs of opium-addicted mothers (33.40 ± 9.22 μg/dL vs 3.2 ± 1.5 μg/dL) and their neonates (13.46 ± 4.86 vs 1.1 ± 0.9) were significantly higher (P<0.001) than those of non-addicts. Moreover, the average birth weight of the newborns in the addicted group was significantly lower than in the non-addicted group (2572.8 ± 77.49 vs 2946 ± 46.87) (P=0.001). Besides, there was a significant relationship between the average birth weight and the BLL of the mother and baby, and the average weight of the babies was significantly lower at higher levels of lead. However, no correlation was observed regarding the average height and head circumference of the neonates (P>0.05).

Conclusion: It seems that the serum level of lead in neonates of opium-addicted mothers contaminated with lead is significantly higher than that of non-addicts, but their anthropometric characteristics at birth were not different from those of the non-addicted group.

Keywords: Environmental exposure, Maternal exposure, Neonatal screening, Maternal behavior

Introduction

Lead is a heavy metal and as it is widely used in several chemical products, lead poisoning has become a common problem mainly in developing countries.1,2 Lead is simply absorbed through the skin, respiratory system, and intestinal tract. It freely crosses the blood-brain barrier and placenta after crossing the plasma and is spread in all soft and hard tissues. Abdominal pain, fatigue, anemia, memory impairment, joint pain, headache, ataxia, peripheral neuropathy, weakened immunity, reduced birth weight, abortion, and premature birth are some of the most significant signs of lead poisoning.3,4 Lead poisoning is diagnosed based on the elevation of blood lead level (BLL) higher than 10 μg/dL.5 Recently, there have been reports about lead poisoning in opium-addicted people in Iran.6 For instance, a study in Iran reported the mean concentration of lead in opium was 1.88 ± 0.35 ppm which is harmful in chronic consumption.6

Although lead poisoning frequently occurs only when the individual has a history of contact with old-style sources of lead, new kinds of non-occupational poisoning have led to certain problems. One of the newest non-occupational sources of lead poisoning is drug addiction, which has recently been reported as a major source of lead poisoning in some countries, including Iran.7-10

Lead freely crosses the placenta. An increased rate of abortion and preterm deliveries seems to be associated with high lead exposures in pregnant women. Low birth weight, cognitive and behavioral impairments, and increased blood pressure have been observed in children born to mothers with elevated lead in venous blood or cord blood.11-13

Lead contact during fetal growth may result from the mobilization of bone lead stored from the previous contact into the maternal bloodstream and/or from the direct elevation of maternal BLL caused by acute or chronic
environmental lead contact through pregnancy. In utero, lead exposure relates to postnatal neurodevelopmental delay and behavioral abnormalities.17,19

Substance abuse is a complex public health problem with social and economic health implications.20,21 Although maternal substance abuse during pregnancy occurs in all socioeconomic classes, ages, and races, there is an increased prevalence in younger women.22-25 Nearly 90% of drug-using women are of childbearing age.26 In the United States, the reported prevalence of substance abuse among non-pregnant and pregnant women aged 15 to 44 was 10% and 4% respectively, but this level increased to 15.5% among pregnant women aged 15 to 17 years.27,28 The results of a study in Iran showed out of 100,620 deliveries, substance abuse was recorded for 519 women with a prevalence of 0.5%, with opium being the most common substance abused followed by crack (a combination of heroin and amphetamine).27

Therefore, exposure to lead during pregnancy can affect the developmental process of the fetus as opium- or other drug-addicted women may have a high BLL. Accordingly, this study aimed to evaluate the BLLs in mothers addicted to opium and their neonates.

Methods

Study population and design

This cross-sectional study was conducted in gynecology, obstetrics, and neonatology tertiary referral center of Afzalipour hospital in Kerman, from February 2019 to February 2020. A total of 50 full-term pregnant women addicted to opium and its derivatives and 50 non-addicted mothers and their newborns, were randomly selected for the study through convenience sampling after giving written consent. Sampling continued until the completion of the sample size. None of the participants had a history of working in plastic, crystal, and toy factories, or living outside Kerman.

Immediately after birth, blood samples from the mother and the baby were sent simultaneously to determine the serum lead level. The blood samples were analyzed by Atomic Absorption Spectrophotometry (Dong, Anyang, 431-836, Korea). In addition, anthropometric variables, including gestational age, weight, and head circumference of neonates as well as maternal age, education level, and socioeconomic status were recorded. The BLL values higher than 5 μg/dL were considered positive and the p-value less than 0.05 was considered significant.

According to previous study29 and given a test power of 98% and a significance level of less than 0.05, the minimum sample size for each group was calculated as 45.

Statistical analysis

Frequency, relative frequency, and central average index were used for descriptive statistics, the chi-square or Fisher test was utilized for comparison of qualitative data between the two groups, and the t-test was used for comparison of quantitative data between the two groups. All analyses were conducted using SPSS (Version 20). A two-sided P value less than 0.05 was considered statistically significant.

Results

The BLLs of 100 mothers who enrolled in the study and their neonates were measured. Table 1 shows data on mean (± SD) age, weight, height, blood pressure (systolic and diastolic), hemoglobin, and lead levels of mothers at the time of delivery.

A total of 50 participants in the addicted group and 50 in the non-addicted group met the inclusion criteria and were analyzed. In terms of education level, the majority of the mothers had higher education (addicted: 66% and non-addicted: 56%). Table 1 shows the other demographic characteristics of the study groups.

Table 1. Comparison of demographic variables in the two study groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Addicted group</th>
<th>Non-addicted group</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Level of Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>3</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Under diploma</td>
<td>14</td>
<td>28</td>
<td>21</td>
</tr>
<tr>
<td>Diploma and higher</td>
<td>33</td>
<td>66</td>
<td>28</td>
</tr>
<tr>
<td>Job</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housewife</td>
<td>41</td>
<td>82</td>
<td>36</td>
</tr>
<tr>
<td>Employed</td>
<td>9</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>Type of delivery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal delivery</td>
<td>24</td>
<td>48</td>
<td>20</td>
</tr>
<tr>
<td>Cesarean section</td>
<td>26</td>
<td>52</td>
<td>30</td>
</tr>
<tr>
<td>Neonate’s gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>27</td>
<td>54</td>
<td>29</td>
</tr>
<tr>
<td>Female</td>
<td>23</td>
<td>46</td>
<td>21</td>
</tr>
<tr>
<td>Age (y)</td>
<td>29.32</td>
<td>4.96</td>
<td>29.64</td>
</tr>
<tr>
<td>Gravida</td>
<td>2.92</td>
<td>0.26</td>
<td>2.48</td>
</tr>
<tr>
<td>Parity</td>
<td>2.46</td>
<td>0.20</td>
<td>2.28</td>
</tr>
<tr>
<td>Live birth</td>
<td>2.22</td>
<td>0.16</td>
<td>2.29</td>
</tr>
<tr>
<td>Abortion</td>
<td>1</td>
<td>0.24</td>
<td>1.07</td>
</tr>
<tr>
<td>Death</td>
<td>0.29</td>
<td>0.23</td>
<td>1</td>
</tr>
<tr>
<td>Weight (g)</td>
<td>2572.8</td>
<td>77.49</td>
<td>2946</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>48.17</td>
<td>0.60</td>
<td>48.60</td>
</tr>
<tr>
<td>Head circumference (cm)</td>
<td>33.78</td>
<td>0.37</td>
<td>34.40</td>
</tr>
</tbody>
</table>
The mean age of women in the two groups was approximately equal (addicted: 29.33 years and non-addicted: 29.64 years). There was no significant difference between the two groups in terms of demographic variables (Table 1).

Although the mean gravida, parity, and live birth in the addicted group were higher than those of the non-addicted group, this difference was not statistically significant (Table 1). The mean live birth, abortion, and death were not significantly different between the two groups. Table 1 shows the results of comparing demographic variables between the two groups.

The mean BLL of infants and mothers in the addicted group were 13.46 ± 4.86 µg/dL and 33.40 ± 9.22 µg/dL, respectively. In addition, in the non-addicted group, the mean BLL in infants and mothers were 1.1 ± 0.9 and 3.2 ± 1.5 µg/dL, respectively. Besides, there was a significant relationship between the BLL of mothers and neonates in both groups (P < 0.01).

The average weight, height, and head circumference of the neonates in the two groups were compared, and only the average weight of the neonates in the addicted group was significantly lower than that of the non-addicted group (P = 0.001). Furthermore, there was no significant difference between the average height and head circumference of the infants in the two groups (P > 0.05; Table 1).

The average weight, height, and head circumference of the newborns in the two groups were determined in relation to the serum lead level of the mother and the newborn, and only the average weight of the newborns showed a significant relationship with their serum lead level. Height and head circumference of neonates in the two groups were not related to serum lead level of the mother or the infant (Table 2).

The results showed that BLLs were significantly higher in opium-addicted mothers and infants than in non-addicted ones (P = 0.001) (Table 3).

The mean neonatal and maternal BLLs were 2.36 ± 1.03 µg/dL and 2.74 ± 0.46 µg/dL in the addicted group, 2.22 ± 0.63 µg/dL in oral opium users, and 2.53 ± 0.64 µg/dL in inhalers, but there was no significant difference between the two groups (P1 = 0.942 and P2 = 0.917) (Table 4).

Univariate linear regression analysis of BLL with weight, height, and head circumference in neonates is shown in Table 5. Weight was negatively correlated with maternal BLL (β = -0.07), which was not statistically significant. Although there was a positive correlation between the BLL of mothers and neonates and height, this relationship was not statistically significant (P = 0.6 and P = 0.7). The correlation between maternal and neonatal BLL and head circumference was not statistically significant (P = 0.9).

Table 6 shows the relationship between maternal and neonatal BLL and weight, height, and head circumference after controlling the confounding factors. There was an inverse relationship between maternal and neonatal BLL, which was not statistically significant (P = 0.7 and P = 0.5). Furthermore, there was an association between maternal and neonatal BLL and height, but this relation was not statistically significant (β = 0.04 and β = 0.01) (P = 0.7 and P = 0.9). In addition, there was no statistically significant relationship between maternal and neonatal BLL and head circumference (P = 0.9 and P = 0.7)

**Discussion**
In terms of demographic variables, including age, gravidity, parity, and live birth, there was no difference between the two groups. In addition, there was no significant difference in terms of education, occupation, type of delivery, and gender (P > 0.05).

In the opium-addicted group, the total mean neonatal and maternal BLLs were 13.46 ± 4.86 and 33.40 ± 9.22, respectively and in the non-opium addicted group, the corresponding values were 1.1 ± 0.9 and 3.2 ± 1.5, respectively, which were significantly different (P < 0.05).

In line with the results of a number of previous studies, the present study showed maternal and neonatal BLLs in the opium-addicted group were significantly higher than in the non-addicted group. Salesmen may add lead to opium during the process of opium preparation to escalate the weight of opium for more income.

Saleshi et al., showed the BLL in the opium-addicted group was higher than in the non-addicted group. The mean difference was statistically significant (P < 0.0001). In the study by Li et al., maternal serum lead level was only associated with an increased risk of late preterm birth. This study provided evidence that maternal serum lead level during pregnancy was positively associated with the risk of preterm birth in a Chinese population.

In the present study, there was no relationship between maternal and neonatal lead levels and weight, height, and

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**Table 2.** The relationship of weight, height, and head circumference with maternal and neonatal lead in the study groups

<table>
<thead>
<tr>
<th></th>
<th>Weight</th>
<th></th>
<th>Height</th>
<th></th>
<th>Head circumference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spearman correlation</td>
<td>P</td>
<td>Spearman correlation</td>
<td>P</td>
<td>Spearman correlation</td>
</tr>
<tr>
<td>Case group</td>
<td>Maternal BLL</td>
<td>-0.07</td>
<td>0.58</td>
<td>0.1</td>
<td>0.48</td>
</tr>
<tr>
<td></td>
<td>Neonatal BLL</td>
<td>-0.07</td>
<td>0.6</td>
<td>0.06</td>
<td>0.6</td>
</tr>
</tbody>
</table>

BLL, blood lead level.
head circumference ($P > 0.05$). However, the neonates of addicted mothers had significantly lower weight than the non-addicted group. This finding is consistent with those of several previous studies showing that infants of mothers using opium, have a higher risk of low birth weight. Rahi et al. showed that the low birth weight of the infants of addicted mothers was 5 times more than those of non-addicted mothers. Maghsoudlou et al. in a cohort study, showed that the increased risk of small for gestational age was higher in mothers who used opium during their pregnancy. In their study, there was also an increased risk of a short birth length and a small head circumference in infants of the addicted mothers. However, the sample size of this study was larger than that of the present study. Another study by Derakhshan et al. indicated that low birth weight was more frequent in the opium-exposed neonates compared with the control group. Nevertheless, none of these studies measured BLLs. However, although maternal and neonatal BLLs do not affect infant size at birth, their adverse effects may be evident in later years of life.

In patients addicted to opium, whether asymptomatic or with clinical symptoms, we should think about lead poisoning and increased lead levels. It seems reasonable that addicted patients should be monitored for BLLs. In addition, if the patient has certain symptoms such as abdominal pain, nausea and vomiting, jaundice, weight loss, and increased liver enzymes, we should consider lead poisoning. Based on the results, it can be concluded that addicted women who are pregnant need to check their BLLs to prevent pregnancy complications and fetal problems. However, more studies should be conducted to determine the exact relationship of BLL in neonates and their opium-addicted mothers.

**Conclusion**

According to the results, it can be concluded that in pregnant women who are addicted to drugs, checking the BLLs of addicted mothers is essential to prevent pregnancy complications and fetal problems.

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**Authors’ Contribution**

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**Software:** Fatemeh Sabzevari and Abbas Jahanara.

**Supervision:** Maryam Ahmadipour.

**Visualization:** Maryam Ahmadipour and Najmeh Nezamabadipour.

**Writing–original draft:** Fatemeh Sabzevari, Abbas Jahanara and Najmeh Nezamabadipour.

**Writing–review & editing:** Maryam Ahmadipour.

**Competing Interests**

The authors declare that there is no conflict of interest.

**Ethical Approval**

This research project was approved by the Ethics Committee of the Vice-Chancellor for Research of Kerman University of Medical Sciences with the Code of Ethics IR.KMU.AH.REC.1397.098.

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**References**

