Original Article

Lead Precipitation on the Gingival Tissue of Iraqi Workers in Some Fuel Stations in Baghdad

Dunia Wadeea Sabea

Department of Oral Pathology, College of Dentistry, Ibn Sina University of Medical and Pharmaceutical Sciences, Baghdad, Iraq

Abstract

Background: Lead usually is precipitated at the gingiva of the fuel station workers. Lead interacts with different molecules, thereby interfering with their function. An excess of lead contents could be toxic to the human body. **Objectives:** This proposed study was conducted for the evaluation of salivary lead level effect and the severity of gingival pigmentation in Iraqi fuel station workers. **Materials and Methods:** This study involves 40 individuals, who were asked to answer a questionnaire. The case sheet questions involve the personal details of participants such as gender, age, marital status, and working experience. It was filled by the participants. This is followed by an oral examination to assess the oral hygiene status and color of gingiva, then divided into three groups according to working period. To evaluate the level of lead within the saliva, it was estimated in teaching laboratories in Medical City by using atomic absorption spectrophotometer as well as clinical evaluation of the intensity of gingival discoloration according to the gingival surface and dental sites. Data were analyzed using IBM SPSS Statistics and descriptive statistics to calculate the absolute and relative frequencies. **Result:** It was shown that gingival discoloration was noticed in 40% of the total sample with light brown to mixed brown/pink (average lead level = 5.74 mg/dL). In addition, 30% of the sample had a mixed brown/pink pigmentation (average lead level = 6.75 mg/dL) and the rest (30%) presented with mixed brown/pink to dark brown (average lead level = 10 mg/dL). The working periods range from 3 months to 10 years, the lowest value and the highest of lead in saliva were 8.3 and 11.8 mg/dL, respectively. The average of these values is 10.00 mg/dL. **Conclusion:** The intensity and severity of gingival pigmentation are directly associated with the level of salivary lead. Occupational safeties are essential for workers who are at high risk of exposure to avoid adverse effects of this metal on general health.

Keywords: Fuel stations, gingiva, lead precipitation

Introduction

The color and contour of gingiva are normally influenced by several exogenous and endogenous factor/s. The endogenous factor/s is represented by the degree of pigmentation and keratinization in the gingival tissue such as melanin.[1] Some diseases and medications may affect the gingival appearance such as anticonvulsant (phenytoin) for epileptic patients and immunosuppressant drugs such as cyclosporine A. One of the exogenous factors that affect the gingival tissue color is heavy metals such as gold, arsenic, silver, mercury, bismuth, and lead.[2,3] In particular, lead is the most common metal that interferes with the integrity of oral tissue via different biological manners (molecular and cellular pathways).[4]

Workers of fuel stations are considered high-risk individuals to lead exposure. Fuel is considered the main source of lead contamination due to the utilization of lead as a booster of octane, which often releases it within the surrounding environment, and it will eventually be absorbed by the body.

Lead can be sourced from nature as well as the result of human activities. The presence of leads in the atmosphere increases with human action. The sources of lead toxic waste can come from manufacturing sectors such as battery, the cable industry and fuel. Fuel is the source of lead pollutants in the environment. The addressed examples have a great contribution to the release of high concentrations of this

Access this article online

Quick Response Code:

Website: https://journals.lww.com/mjby

DOI: 10.4103/MJBL.MJBL_614_23

Address for correspondence: Prof. Dunia Wadeea Sabea, College of Dentistry, Ibn Sina University of Medical and Pharmaceutical Sciences, Alqadissia Highway, Baghdad, Iraq.
E-mail: dunia.sabea@gmail.com

Submission: 24-May-2023 **Accepted:** 06-Jul-2023 **Published:** 27-Sep-2023

How to cite this article: Sabea DW. Lead precipitation on the gingival tissue of Iraqi workers in some fuel stations in Baghdad. Med J Babylon 2023;20:614-8.

metal.[5,6] Exposure to this element can occur mainly by inhalation of lead-contaminated air, and ingestion of lead-contaminated meals, water, and beverages.[7,8]

It is documented that lead has adverse effects on human beings. In children, several studies demonstrated a relationship between blood level poisoning and decreased intelligence, reduced hearing acuity, and antisocial attitudes.[9-12] In adult individuals, reproductive issues have been reported, such as reduction of the sperm count in the male gender. Moreover, frequent abortions in females have been directly related to high exposure to this metal.[13-15] The toxic effect of lead is exerted by processes that include the ability of lead to mimic or inhibit calcium action and to interact with proteins.[8]

Lead interacts with different molecules, thereby interfering with their function. The excess of lead content could be of toxicity to the human body. Moreover, lead may induce oxidative stress in a number of organs and tissues of the human body, counting salivary gland.[16] In addition, exposure of lead could also provide several harmful factors on oral health. As such, lead exposure may also affect the formation of enamel, which, in turn, results in the production of caries, periodontal bone loss, worsened dental fluorosis, delayed dental enamel formation, and augmented tooth loss in men.[17-23] The aforementioned effects are directly related to dental periodontitis and caries that are attributed to tooth loss. Henceforth, the proposed study aimed to categorize lead exposure via saliva as well as gingival pigmentation presence in these chancy individuals.

Materials and Methods

Inclusion criteria were the criteria that met the requirements: they were (a) at least 3 months at work, (b) physically and mentally healthy, (c) willing to undergo saliva sampling to find out their salivary lead level, and (d) willingness to undergo oral examination and be interviewed about their age, duration of work, smoking habit, as well as personal protective equipment (PPE). Exclusion criteria were the criteria that did not meet the requirements. This study is a cross-sectional one. It has been conducted at the fuel stations in Baghdad, Iraq, from March to April 2021 and consisted of 40 workers who were subdivided into three groups according to duration of working experience and the number of workers. The number of workers was 16, 12, and 12 in groups 1, 2, and 3, respectively, according to the criteria mentioned before.

Samples who worked in gas station were asked to answer a questionnaire. The case sheet questions involve the personal details of participants such as gender, age, marital status, and working experience. It was filled by the participants. This is followed by an oral examination to assess the oral hygiene status and color of gingiva.

Assessment is done by the atomic absorption spectrophotometry (4100 MP-AES, Agilent Technologies Inc., Santa Clara, CA, USA) in the Medical-Teaching Labs in Baghdad Medical City by a specialist. Assessing gingival discoloration is according to the gingival surface and dental sites as follows: score (0) = the absence of gingival lead line, score (1) = the presence gingival lead lines on one or two teeth; score (2) = the existence of gingival lead lines on three or four teeth; and score (3) = the existence of gingival lead lines on more than four teeth (Dummett's Oral Pigmentation Index [DOPI]). The involved persons in this study were requested to fast in the morning to give blood and saliva samples. The affected individuals were asked to wash their oral cavities with distilled water. Then, the patients were asked to spit inside a clean tube for five records, to have a saliva sample of 5 mL, then, immediately placed on ice following assortment and will be separated at 3000 rpm for 10 records. Furthermore, the previously mentioned separations were kept and stored at −80°C till the biological investigation.

The involved individuals were educated not to devour meals for the previous hours. Subsequently, these individuals were also instructed to rinse with deionized water for 30 s. Sampling of saliva procedure without stimulation involved was performed throughout the morning with passive drooling method. Evaluation of lead level within saliva is performed by atomic absorption spectrophotometer. Each anterior gingiva is cleaned first with a cotton swab to remove attached saliva. The maxillary and mandibular labial mucosa are retracted with a mirror, then visually observed when there is a white/blue line on the gingival and tooth mucosal boundaries in accordance with the assessment criteria. Data were analyzed using IBM SPSS Statistics for Windows Software, version 22 (IBM Corp., Armonk, New York).

This study is a cross-sectional one; it has been conducted at the fuel stations in Baghdad, Iraq, from March to April 2021 and consisted of 40 workers who were subdivided into three groups according to duration of working experience and the number of workers. The number of workers was 16, 12, and 12 in groups 1, 2, and 3, respectively.

Ethical approval

All examination protocols were approved by the College of Dentistry, Iraqia University under the reference No. 343 on 29 Feb 2022. All experiment was carried out following the approved guidelines.

Results

The evaluation of physiologic gingival discoloration was achieved according to DOPI and as follows:

0 = no discoloration

1 = mild discoloration and mild light brown

2 = moderate discoloration, and medium brown or mixed pink or brown

3 = severe discoloration, severe brown, or black/blue tissue

The 40 patients to three groups according to working experience, the results of the first group (only 16 patients)

Table 1: Group (1) work experience from 3 months to 2 years

Case no.	Age	Work experience	Oral hygiene	Smoker	Color of gingiva	Level of lead (mg/dL)
1	32	3 months	Good	No	Pink	1.7
2	40	7 months	Good	No	Pink	3.2
3	17	8 months	Good	Yes	Brown	5.1
4	25	11 months	Fair	Yes	Brown	5.4
5	23	12 months	Fair	No	Pink	5.9
6	40	12 months	Fair	No	Pink	5.7
7	28	14 months	Fair	Yes	Brown	6.2
8	30	14 months	Fair	No	Brown and pink	6.1
9	35	15 months	Bad	Yes	Dark brown	6.4
10	36	16 months	Bad	Yes	Dark brown	6.3
11	23	16 months	Fair	No	Pink	6.6
12	19	18 months	Bad	Yes	Dark brown	6.6
13	40	18 months	Bad	Yes	Brown and pink	6.8
14	40	19 months	Bad	Yes	Brown	6.6
15	35	20 months	Fair	No	Brown and pink	6.4
16	16	2 years	Bad	Yes	Dark brown	6.9

are illustrated in Tables 1 and 2. While second group (only 12 patients) listed in Tables 3 and 4. The third group (only 12 patients) listed in Tables 5 and 6 while Table 7 listed comparison between three groups.

The Dummett's oral pigmentation index for the 16 patients is 1.37

As illustrated previously, according to working experience, the lowest value of lead in saliva for 3 months of work in fuel station is 1.7 mg/dL, whereas the highest value of lead in saliva for 2 years of work in fuel station is 6.9 mg/dL. The average of these values is 5.74 mg/dL. According to Table 1, as the working period increased, the gingival discoloration become more noticeable (dark brown). Furthermore, the scoring pattern was presented in Table 2 as five patients with normal color (score 0), three patients with mixed pink and brown (score 3), and four patients for each mild and dark brown (scores 1 and 3, respectively).

The Dummett's oral pigmentation index for the 12 patients is 2.08

As revealed in Table 3, the lowest value of lead in saliva was 6.9 mg/dL (for 2 years of work experience), whereas the highest value of lead in saliva was 8.1 mg/dL (for 4 years of work period). The average of these values is 6.75 mg/dL. The more the working period, the greater discoloration of gingiva. The scoring pattern [Table 4] was recorded as five patients with dark discoloration (score 5), four patients with moderate brown discoloration (score 2), two patients with light brown discoloration (score 1), and one patient with normal gingival color (score 1).

The Dummett's oral pigmentation index for the 12 patient is 2.58

Table 5 illustrates that the working periods range from 5 to 10 years, the lowest and the highest values of lead in saliva were 8.3 and 11.8 mg/dL, respectively. The average of these values is 10.00 mg/dL. As demonstrated in Table 5, the more the working periods, the more the abnormal discoloration (dark brown) with respect to the level of the oral hygiene. Furthermore, the Scoring pattern illustrates that eight patients presented with severe dark discoloration (score 3), three patients with moderate discoloration (score 2), and one individual with mild brown discoloration (score 1).

Table 2: The scoring pattern of group 1 by using Dummett's oral pigmentation index

Scoring	Number of patients
0 = Pink	5
1 = mild brown	4
2 = Brown or mixed pink/brown tissue	3
3 = Dark brown	4

Discussion

The lead substantial confined in fuel may be inhaled directly through the air or from the addition of motor vehicle burning results in the arrangement of dust/particulates in the air. The enlarging number of vehicles and traffic will eventually promote the release of extensive amount of emissions from these automobiles. One of the most hazardous occupations with continuing exposure to lead from fuel vapors and grainy dust in the atmosphere is gas station workers.[6] It is worth mentioning that the working period of 8 h each bright, the exposure time for lead tends to be higher compared with others especially when the workers do not follow occupational safety guidelines.

Saliva is biological liquid composed of mainly water, and small amounts of protein and inorganic materials. In addition, biomarkers in the saliva serve as an assisting indicator of the detection, assessment, diagnosis, and

Table 3: Group (2): Work experience from 2 to 5 years

Case no.	Age	Work experience (year)	Oral hygiene	Smoker	Color of gingiva	Level of lead (mg/dL)
1	28	2	Fair	No	Brown and pink	6.9
2	35	2.1	Bad	Yes	Brown and pink	6.9
3	28	2.4	Bad	Yes	Brown and pink	7.1
4	30	2.4	Bad	No	Brown and pink	7.3
5	20	2.8	Fair	No	Pink	7.1
6	31	2.8	Bad	Yes	Dark brown	7.8
7	31	2.9	Bad	Yes	Dark brown	7.8
8	29	3	Bad	No	Brown	7.1
9	21	3.1	Fair	No	Brown	7.3
10	65	3.4	Bad	No	Dark brown	7.3 1
11	27	4	Bad	Yes	Dark brown	8.1
12	31	5	Bad	Yes	Dark brown	7.6

Table 4: The scoring pattern of group 2 by using Dummett's oral pigmentation index

Scoring	Number of patients
0 = Pink	1
1 = Brown	2
2 = Brown or mixed pink/brown tissue.	4
3 = Dark brown	5

monitoring of diseases. These indicators may be hormones, enzymes, immunoglobulins (IgA), and heavy metals.[24] The effect of lead on the gingival tissues and the amount of lead in the saliva vary from one worker to another depending mainly on their working period experience, age, oral hygiene status, and smoking habits. It is essential to evaluate the amount of lead in saliva before starting to suggest any solutions, to determine the most risk factor.

Table 5: Group (3): Work experience from 5 to 10 years

Case	Age	Work experience (year)	Oral hygiene	Smoker	Color of gingiva	Level of lead (mg/dL)
1	27	5	Fair	No	Brown pink	8.5
2	26	5	Fair	No	Brown	8.3
3	25	5.5	Bad	Yes	Brown pink	8.4
4	30	7	Bad	No	Brown pink	8.8
5	28	7.2	Bad	No	Dark brown	11
6	52	8	Bad	No	Dark brown	10.5
7	54	8	Bad	No	Dark brown	10
8	30	8	Bad	Yes	Dark brown	9
9	35	8.5	Bad	Yes	Dark brown	10.6
10	45	8.5	Bad	Yes	Dark brown	11.5
11	46	9.5	Bad	Yes	Dark brown	11.8
12	48	10	Bad	Yes	Dark brown	11.7

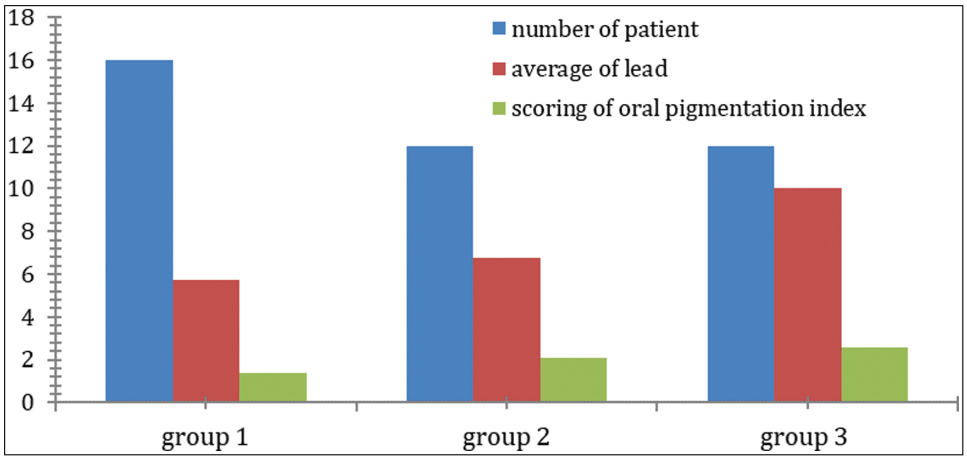

Figure 1: The result of the study

Table 6: The scoring pattern of group 3 by using Dummett's oral pigmentation index

Scoring	Number of patients
0 = Pink	0
1 = Brown	1
2 = Brown or mixed pink/brown tissue.	3
3 = Dark brown	8

Table 7: The result of the above-mentioned three subgroups

Group	No. of patients	Average of lead (mg/dL)	Scoring of oral pigmentation index	Percentage of patients
1	16	5.74	1.37 (light brown to mixed brown/pink)	40
2	12	6.75	2.08 (Mixed brown/ pink)	30
3	12	10.00	2.58 (Mixed brown/ pink to deep brown)	30

The main purpose of the presented study was to determine the level of lead in saliva and its relation to the gingival tissue color and appearance as shown in the Figure 1 above. Each anterior gingiva is cleaned first with a cotton swab to remove attached saliva. The maxillary and mandibular labial mucosa are retracted with a mirror, then visually observed whether there is any presence of white/blue line on the gingival and tooth mucosal boundaries. Clinically, chronic exposure can be identified through the presence of a lead or Burtonian line gingival line. The level of lead in saliva of population was studied, and the results were tabulated and compared to conclude that the more the level of lead increases, the more the color of gingiva will be abnormal and brown.

Oral health can be considered an essential indicator of general health that is why it is very important to obligate each worker in such environment to wear PPE. In addition, good oral health is the major resource for social, economic, and personal development of individuals, as we know the toxic effect of lead not only in the oral cavity but also in the whole body. It is demonstrated that the lead level of 40% of participants was 5.74 mg/dL with light brown to mixed brown/pink gingival discoloration. Furthermore, the lead level of 30% of the sample was 6.75 mg/dL with mixed brown/pink discoloration. Moreover, 30% of the sample recorded a lead level in their saliva of 10 mg/dL with mixed brown/pink to severe brown discoloration.

Conclusion

The possibility of lead exposure in the gingival tissue of the workers in the fuel stations increased within time of working in the stations and the severity and intensity of gingival pigmentation are directly related to the level of salivary lead precipitation.

Financial support and sponsorship

There was no financial disclosure.

Conflicts of interest

The authors declare that there are no conflicts of interest.

References

1. Tarakji B, Umair A, Prasad D, Altamimi MA. Diagnosis of oral pigmentations and malignant transformations. Singapore Dent J 2014;35:39-46.
2. Moneim RAA, El Deeb M, Rabea AA. Gingival pigmentation (cause, treatment and histological preview). Futur Dent J 2017;3:1-7.
3. Kaur H, Jain S, Mahajan G, Saxena D. Oral pigmentation . Int Dent Med J Adv Res 2015;1:1-7.
4. Arora M, Weuve J, Weisskopf MG, Sparrow D, Nie H, Garcia RI, *et al*. Cumulative lead exposure and tooth loss in men: The normative aging study. Environ Health Perspect 2009;117:1531-4.
5. Summaries MC. Mineral Commodity Summaries. Reston, VA: US Geological Survey 2021, p. 200.
6. Tchounwou PB, Yedjou CG, Patlolla AK, Sutton DJ. Heavy metal toxicity and the environment. Mol Clin Environ Toxicol 2012;3:133-64.
7. Fay M, De Rosa C. ATSDR evaluation of health effects of chemicals. VI. Di(2-ethylhexyl) phthalate. Agency for toxic substances and disease registry. Toxicol Ind Health 1999;15:651-746.
8. Gehle K. Agency for Toxic Substances and Disease Registry (ATSDR) case studies in environmental medicine toxicity of polycyclic aromatic hydrocarbons (PAHs). Atlanta: USA Department of Health and Human Services Agency for Toxic Substances and Disease Registry Division of Toxicology and Environmental Medicine. 2009.
9. Strum M, Scheffe R. National review of ambient air toxics observations. J Air Waste Manag Assoc 2016;66:120-33.
10. Kaul B, Sandhu RS, Depratt C, Reyes F. Follow-up screening of lead-poisoned children near an auto battery recycling plant, Haina, Dominican Republic. Environ Health Perspect 1999;107:917-20.
11. Factor-Litvak P, Slavkovich V, Liu X, Popovac D, Preteni E, Capuni-Paracka S, *et al*. Hyperproduction of erythropoietin in nonanemic lead-exposed children. Environ Health Perspect 1998;106:361-4.
12. Amodio-Cocchieri R, Arnese A, Prospero E, Roncioni A, Baruffo L, Ullucci R, *et al*. Lead in human blood from children living in Campania, Italy. J Toxicol Environ Health A 1996;47:311-20.
13. Hertz-Picciotto I. The evidence that lead increases the risk for spontaneous abortion. Am J Ind Med 2000;38:300-9.
14. Apostoll P. Male reproductive toxicity of lead in animals and humans. Occup Environ Med 1998;55:364-74.
15. Atsdr U. Agency for Toxic Substances and Disease Registry. Case Studies in Environmental Medicine. Available from: http://www.atsdr.cdc.gov/HEC/CSEM/csem.html. 1997.
16. Koh DS-Q, Koh GC-H. The use of salivary biomarkers in occupational and environmental medicine. Occup Environ Med 2007;64:202-10.
17. Bowen WH. Exposure to metal ions and susceptibility to dental caries. J Dent Educ 2001;65:1046-53.
18. Moss ME, Lanphear BP, Auinger P. Association of dental caries and blood lead levels. JAMA 1999;281:2294-8.
19. Weiss B. Aging and vulnerability to environmental chemicals: Age-related disorders and their origins in environmental exposures. R Soc Chem 2012;16:202-7.
20. Whitney EN, Rolfes SR. Understanding Nutrition: Cengage Learning; 2015. 4th ed. p. 392-4.
21. Gerlach RF, Cury JA, Krug FJ, Line SR. Effect of lead on dental enamel formation. Toxicology 2002;175:27-34.
22. Leite G, Sawan R, Teófilo J, Porto I, Sousa F, Gerlach RF. Exposure to lead exacerbates dental fluorosis. Arch Oral Biol 2011;56:695-702.
23. Dye BA, Hirsch R, Brody DJ. The relationship between blood lead levels and periodontal bone loss in the United States, 1988-1994. Environ Health Perspect 2002;110:997-1002.
24. Yoshizawa JM, Schafer CA, Schafer JJ, Farrell JJ, Paster BJ, Wong DT. Salivary biomarkers: Toward future clinical and diagnostic utilities. Clin Microbiol Rev 2013;26:781-91.