

## Knowledge, attitude, practice and self reported symptoms among gasoline station workers exposed to leaded gasoline in the Gaza Strip

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### Abstract

**Objective:** This study assessed knowledge, attitude, practice, and self reported symptoms associated with leaded gasoline exposure among 200 gasoline station workers (mean age  $30.7 \pm 9.4$  years) in the Gaza Strip. **Method:** A cross section of workers was asked to fill in a questionnaire. A low level (7.5%) of illiteracy was recorded. **Results:** One hundred and fifty workers (75%) reported a relatively high level of knowledge on the health impact of leaded gasoline (75%). A higher proportion of workers (147) were aware of inhalation of leaded gasoline as a route of exposure than skin 36 (18.0%) or mouth 6 (3.0%). Knowledge concerning accumulation of lead in the body was low 52 (26.0%). The higher the education level, the more knowledge the workers had, particularly knowledge about the health effects of leaded gasoline ( $X^2=27.01$ ,  $P=0.001$ ). Protective measures were poorly used. Workers who did not use protective gear had more knowledge about the health effects of leaded gasoline, the route of lead entry and its accumulation in the body than those who did. This means that knowledge does not influence practice. Common self reported symptoms among leaded gasoline exposed workers were headache 65 (32.5%), nausea 55 (27.5%), and pallor 46 (23.0%). There was a significant increase in the prevalence of self reported symptoms with increasing years of work in the station ( $P=0.001$ ). **Conclusion:** The prevalence of symptoms was generally higher among workers who did not use the protective gear than those who did. However, the interaction between use of protective measures and self reported symptoms was significant only for hat and overall ( $X^2=4.104$ ,  $P=0.043$  and  $X^2=6.226$ ,  $P=0.013$ , respectively).

**Key Words:** Gasoline station workers, Gaza Strip, Lead exposure, Self reported symptoms, Workers awareness.

### Introduction

The unique mechanical and electrochemical properties of lead as well as its low cost make it ubiquitous in industrial society. Lead is added to gasoline to overcome the problem of "knocking" or pre-ignition in the engine<sup>1</sup>. Leaded gasoline is still

imported from Israel to the Gaza Strip<sup>2</sup>. In gasoline stations the major sources of exposure of workers to leaded gasoline are the lead fumes generated during filling cars or through exposure to fumes coming from cars, contaminated hands, food, water and clothing<sup>3,4</sup>.

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The major routes of lead entry into the human body are the respiratory and alimentary tracts and the skin. Lead absorption through the former two routes is more important in occupational exposure<sup>5</sup>. Once in the bloodstream, lead is distributed among blood and soft and hard tissues<sup>6</sup>. With chronic exposure over a long period of time, most absorbed lead accumulates in the bone which ultimately provides a source of remobilization and continued toxicity after exposure ceases<sup>7</sup>.

Occupational lead exposure adversely affects several body systems including the nervous, hematopoietic, gastrointestinal, musculoskeletal and reproductive systems<sup>8,9,10</sup>. Symptoms may be manifested as headache, fatigue, irritability, impaired concentration, wrist/foot drop, nausea, dyspepsia, constipation, colic, lead line on gingival tissue, loss of libido or anemia<sup>11,12,13,14</sup>.

The main aim of the present study was to assess knowledge, attitude, and practice, and self reported toxicity symptoms among workers exposed to leaded gasoline in the Gaza Strip with the following specific objectives:

- (1) To assess the knowledge of gasoline station workers regarding health effects of leaded gasoline, the route of lead entry into the human body and its accumulation.
- (2) To examine workers' attitudes towards the work in the station and the effectiveness of protective gear.
- (3) To evaluate workers' practices regarding the use of protective measures and their activities with potential for exposure to lead.
- (4) To identify self reported toxicity symptoms associated with leaded gasoline exposure and their relation to work practices.

### **Study area**

The Gaza Strip is a narrow coastal zone of land bordered by Egypt to the south, the green line to the North, Negev desert to the East and the Mediterranean Sea to the West. The Gaza Strip is divided geographically into five Governorates: Northern, Gaza, Mid Zone, Khan Yunis and Rafah. The total surface area of the Gaza Strip, where about 1,443,814 Palestinian people live and work<sup>15</sup>, is 360 km<sup>2</sup>. These figures classify the Gaza Strip as one of the most densely populated area in the world. The Gaza Strip is a poor area. Its economy depends mainly on agriculture, fishing, employment in the Palestinian National Authority and small industry<sup>16</sup>. The Gaza Strip suffers from a long-term pattern of economic stagnation and plummeting development indicators. The severity of the situation has increased exponentially since Israel imposed extreme restrictions on the movement of goods and people in response to the new political situation in the Gaza Strip. Unemployment in Gaza is close to 40% and is set to rise to 50%<sup>17</sup>. The Gaza Strip suffers from many environmental problems including extensive use/misuse of pesticides, water pollution and lack of sewage and solid waste treatment<sup>18,19,20</sup>. Air pollution is another environmental burden in the Gaza Strip caused to a large extent by carbon monoxide, nitrogen oxide and lead emitted by petrol vehicles. Leaded gasoline imported from Israel<sup>21</sup> is still the predominant fuel grade in the Gaza Strip. Lead emitted from such fuel imposes serious health problems on both the general population and on gasoline station workers in the Gaza Strip.

## Subjects and methods

The investigation was a cross-sectional study. The target population was gasoline station workers in different Governorates of the Gaza Strip during the year 2007.

The number of gasoline stations registered in the Gaza Strip in the year 2007 was 82 stations (Personal communication with municipalities of Gaza Governorates, Palestinian National Authority) distributed in the five Governorates of the Gaza Strip as follows: Northern (13), Gaza (31), Mid Zone (10), Khan Yunis (18) and Rafah (10). The estimated number of workers in these stations was: Northern 21 (range 1-3 workers/station), Gaza 85 (range 2-4 workers/station), Mid Zone 20 (2 workers/station), Khan Yunis 54 (3 workers/station) and Rafah 20 (2 workers/station). Therefore, the total number of gasoline station workers in the Gaza Strip during the year 2007 (sample size) was approximately 200 workers.

A meeting interview was used for filling in the questionnaire. All interviews were conducted face to face by one investigator himself. The questionnaire was based, with some modifications, on an earlier study of adult lead poisoning<sup>22,23</sup>. Most questions were one of two types: the yes/no question, which offers a dichotomous choice; and the multiple choice question, which offers several fixed alternatives<sup>24</sup>. A pilot questionnaire was tested with 12 gasoline station workers not included in the sample from the study area, and modified as necessary.

The questionnaire included questions related to: sociodemographic characteristics, for example, age, marital

status, education, income, and insurance; knowledge of health effects of leaded gasoline, the route of lead entry into the human body and its accumulation; and attitudes regarding the work in the gasoline station and the effectiveness of protective gear.

Practice questions included: the wearing of protective clothes; eating and drinking during work; washing hands before eating; whether they drink milk or not; and whether to have a water bath or not at workplace. Questions about self-reported symptoms were also included in the questionnaire. Individuals who did not meet the criterion of being involved in gasoline station work during the year 2007 were excluded.

## Data analysis

Data were analyzed by computer using the SPSS/PC (Statistical Package for the Social Sciences Inc., Chicago, Illinois) version 11.0. Simple distribution of the study variables, the cross tabulation, and normal  $X^2$  tests were applied. Yates's continuity correction test,  $X^2_{(corrected)}$ , was used when not more than 20% of the cells had an expected frequency of less than five and when the expected numbers were small. The  $X^2$  test for trend,  $X^2_{(trend)}$  with 1 df, which is a more sensitive test that looks for an increasing (or decreasing) trend in the proportions over the columns having natural order, was used<sup>25,26</sup>. These tests were used to identify the significance of the relations, associations, and interactions among knowledge, practice towards leaded gasoline, and the prevalence of self reported symptoms. The level of significance was set at  $P < 0.05$ .

## Results

### Demographic and employment aspects of the study population

Table 1 shows that the age of the gasoline station workers (n=200) ranged between 17 and 60 years with the mean age = 30.7±9.4 years old. A total of 136 (68.0%) workers were married; only eleven (8.1%) had no children. Analysis

of the educational status of the workers showed that 45 (22.5%) had a diploma or a university degree, 102 (51.0%) had finished secondary school, 33 (16.5%) had finished preparatory school, 5 (2.5%) had passed primary school, and 15 (7.5%) were illiterate.

**Table 1. Demographic characteristics of the study population (n=200)**

Demographic characteristics	n	%
<b>Age (Year)</b>		
<25	75	37.5
25-40	90	45.0
>40	35	17.5
Mean	30.7±9.4	
(range)	17-60	
<b>Marital status</b>		
Single	64	32.0
Married	136	68.0
Have children	125	91.9
Have no children	11	8.1
<b>Education</b>		
Illiterate	15	7.5
Primary school	5	2.5
Preparatory school	33	16.5
Secondary school	102	51.0
Diploma or University	45	22.5

A description of the employment patterns of the study population (n=200) is provided in Table 2. When asked 'Why did you choose this job?' a total of 175 (87.5%) workers said that there were no alternatives. The average weekly work hours were 51.4±11.1 hr/week; 151 (75.5%) workers worked 48 hr/week or less and forty nine (24.5%) worked more than 48 hr/week (had up to 4 hr

overtime/day). The number of years as a gasoline worker ranged between 1 and 25 years; 139 (69.5%), 50 (25.0%) and 11 (5.5%) workers had been engaged in the work for <5, 5-15 and >15 years, respectively. Most workers 131(65.5%) had salaries ranging between 800 and 1000 NIS/month (~208-260\$). Eighty seven (43.5%) had no work insurance.

**Table 2. Employment aspects of the study population (n=200)**

<b>Employment aspect</b>	<b>n</b>	<b>%</b>
<b>Why did you Choose this job?</b>		
Family job	22	11.0
No alternatives	175	87.5
High salary	3	1.5
<b>Weekly work hours</b>		
≤48	151	75.5
>48*	49	24.5
Mean	51.4±11.1	
Range	18-72	
<b>Work duration (Year)</b>		
<5	139	69.5
5-15	50	25.0
>15	11	5.5
Mean	5.3±4.9	
(range)	1-25	
<b>Salary (NIS/month)</b>		
800-1000	131	65.5
1100-1500	64	32.0
>1500	5	2.5
<b>Having work insurance</b>		
Yes	113	56.5
No	87	43.5

\* Workers had up to 4 hr overtime/day, NIS: New Israeli Shekel (~0.26\$)

### **Knowledge of gasoline station workers about lead**

Table 3 shows the knowledge of the workers (n=200) regarding health effects of leaded gasoline, route of lead entry into the body, and accumulation of lead in the body. A total of 150 (75.0%) workers knew that leaded gasoline does affect human health. When questioned

about the possible routes of exposure to lead; 147 (73.5%) workers claimed that inhalation is the route of entry, followed by 36 (18.0%) who reported that skin is the route of entry, and 6 (3.0%) who claimed that the mouth is the route of entry of lead into the body. Only 52 (26.0%) knew that lead accumulates in human body.

**Table 3. Knowledge of gasoline station workers (n=200) regarding health effects of leaded gasoline, route of lead entry and its accumulation in body**

Knowledge about	n	%
<b>Health effects of leaded gasoline</b>	150	75.0
<b>Route of lead entry into body</b>		
Inhalation	147	73.5
Skin	36	18.0
Mouth	6	3.0
<b>Accumulation of lead in the body</b>	52	26.0

The education of the gasoline station workers related to their knowledge about health effects of leaded gasoline showed that the higher the

level of education, the more knowledge they had (Table 4) ( $\chi^2=27.01$ ,  $p=0.001$ ).

**Table 4. Frequency and percentage of gasoline station workers' education in relation to their knowledge**

Knowledge about	Education					p *
	Illiterate (n=15)	Primary school (n=5)	Preparatory school (n=33)	Secondary school (n=102)	Diploma or University (n=45)	
Health effects of leaded gasoline	5 (33.3)	2 (40.0)	20 (60.6)	84 (82.4)	39 (86.7)	0.001
<b>Route of lead entry into body</b>						
Inhalation	7 (46.7)	3 (60.0)	24 (72.7)	76 (74.5)	37 (82.2)	0.098
Skin	0 (0.0)	1 (20.0)	3 (9.1)	23 (22.5)	9 (20.0)	0.157
Mouth	1 (6.7)	0 (0.0)	2 (6.1)	2 (2.0)	1 (2.2)	0.666
Accumulation of lead in body	1 (6.7)	1 (20.0)	7 (21.2)	26 (25.5)	17 (37.8)	0.155

\*  $\chi^2$  (corrected) test.

Table 5 relates the use of protective gear among gasoline station workers (n=200) to their knowledge. Workers who did not use protective gear had more knowledge about health effects of leaded gasoline, route of lead entry and its accumulation in the body than those who did. This means that

knowledge does not influence practice. However, the interaction between use of protective gear and knowledge of workers towards health effects of leaded gasoline, route of lead entry and its accumulation in the body was not significant ( $p>0.05$ ).

**Table 5. Use of protective gear among gasoline station workers (n=200) in relation to their knowledge**

Knowledge about	Using Protective gear		Not using Protective gear		p value*
	(n=35) n	%	(n=165) n	%	
Health effect of leaded gasoline (n=150)	26	17.3	124	82.7	0.914
Route of lead entry into body					
Inhalation (n=147)	23	15.6	124	84.4	0.251
Skin (n=36)	5	13.9	31	86.1	0.529
Mouth (n=6)	1	16.7	5	83.3	0.957
Accumulation of lead in body (n=52)	5	9.6	47	90.4	0.082

\* p value of  $X^2$  (corrected) test.

#### **Attitudes of workers towards work in the station and the protective gear**

A total of 57 (28.5%) workers (n=200) were against work in the station. They justified that by searching for suitable alternatives, and citing health hazards, low salary, hardness of work and their lack of interest. A total of 150 (75.0%) workers (n=200) believed that use of protective gear is effective in preventing lead exposure, whereas 50 (25.0%) had the opposite opinion.

#### **Practices of gasoline station workers towards protective measures**

Table 6 lists the different protective measures regularly used by gasoline

station workers (n=200) during work at a station. The highest number (n=26, 13.0%) wore overalls and the lowest number (n=2, 1.0%) wore goggles. Workers who did not use such protective items (n=165) claimed that they are not necessary 62 (37.6%), not provided 61 (37.0%), carelessness 23 (13.9%), and discomfort 19 (11.5%). The number of workers who mentioned not eating and not drinking during work was only 6 (3.0%). A total of 185 (92.5%) washed their hands before eating and 51 (25.5%) frequently drunk milk. Moreover, 30 (15.0%) had a water bath directly after work at the work place.

**Table 6. Gasoline station workers (n=200) who reported using protective measures during work at the station**

Protective measures in use	n	%
Wear gloves	14	7.0
Wear goggles	2	1.0
Wear hat	8	4.0
Wear oral-nasal mask	6	3.0
Wear special boots	3	1.5
Wear overall	26	13.0
Not eating and not drinking during work	6	3.0
Hand wash before eating	185	92.5
Frequently drink milk	51	25.5
Have water bath at work place	30	15.0

**Seminars and training course participation, health professional visits, safety methods, and accidents in the station**

As indicated in Table 7, sixty five gasoline station workers (32.5%) participated in seminars and training courses related to the hazards of leaded gasoline and its effect on human health. A total of 99 (49.5%) workers mentioned

that health professionals visited them in the station; of these, 28 (28.3%) and 71 (71.7%) mentioned frequent and intermittent visits, respectively. Almost all workers 199 (99.5%) admitted the presence of safety means in the station and only 5 (2.5%) workers reported that they had had accidents in the station. The nature of such accidents was car accidents and fainting.

**Table 7. Distribution of gasoline station workers (n=200) in relation to seminars and training courses participation, health professional visits, safety means and accidents in the station**

<b>Variable</b>	<b>n</b>	<b>%</b>
<b>Seminars and training courses participation</b>	65	32.5
<b>Health professional visits</b>	99	49.5
Frequent	28	28.3
Intermittent	71	71.7
<b>Safety means*</b>	199	99.5
<b>Have had an accident</b>	5	2.5

\* Safety means included fire extinguisher, water pumps, first aid and sometimes fire alarm

**Prevalence of self reported symptoms**

The prevalence of self reported symptoms among the gasoline station workers (n=200) is summarized in Table 8. A total of 87 (43.5%) had self reported symptoms related to leaded gasoline exposure, with headache being the most common (n=65, 32.5%) and

infertility the least common (n=2, 1.0%). A total of 66 (33.0%) workers had 2 or more self reported symptoms. However, one worker (0.5%) recalled one death and 5 (2.5%) workers recalled poisoning cases associated with leaded gasoline exposure.

**Table 8. Prevalence of self reported symptoms among gasoline station workers (n=200) in the Gaza strip**

Self- reported symptom	n	%
Impaired concentration	14	7.0
Headache	65	32.5
Sleep disturbance	10	5.0
Anorexia	16	8.0
Nausea	55	27.5
Constipation	13	6.5
Abdominal pain	16	8.0
Lead line in gingival tissue	20	10.0
Infertility	2	1.0
Pallor	46	23.0
Have 2 or more symptoms	66	33.0

Table 9 points out the prevalence of self reported symptoms by education and yearly work duration. The variation of the prevalence of self reported toxicity symptoms in relation to

education was not significant (P=0.163). Regarding the work duration, there was a significant increase in the prevalence of self reported symptoms with increasing years of work in the station (P=0.001).

**Table 9. Distribution of the study population (n=200) according to prevalence of self reported symptoms in relation to education and yearly work duration**

Variable	Have symptoms (n=66)*		P value**
	n	%	
<b>Education</b>			
Illiterate (n=15)	5	33.3	0.163
Primary school (n=5)	2	4.0	
Preparatory school (n=33)	17	51.5	
Secondary school (n=102)	29	28.4	
Diploma or University (n=45)	13	28.9	
<b>Work duration (Year)</b>			
<5 (n=139)	34	24.5	0.001
5-15 (n=50)	25	50.0	
>15 (n=11)	7	63.6	

\* Workers reported 2 or more symptoms, \*\* p value of  $X^2_{(corrected)}$  test

As shown in Table 10, the prevalence of self reported symptoms was higher among workers who did not use the protective gear than those who did. The interaction between the use of

protective gear and self reported symptoms was statistically significant for hat and overall ( $X^2=4.104$ ,  $p=0.043$  and  $X^2=6.226$ ,  $p=0.013$ , respectively).

**Table 10. Prevalence of self reported symptoms among gasoline station workers (n=200) in relation to protective gear in use**

Protective gear in use	Have symptoms (n=66)*		
	n	%	p value**
<b>Wear gloves</b>			
Yes (n=14)	2	14.3	0.123
No (n=186)	64	34.4	
<b>Wear goggles</b>			
Yes (n=2)	0	0.0	0.319
No (n=198)	66	33.3	
<b>Wear hat</b>			
Yes (n=8)	0	0.0	0.043
No (n=192)	66	34.4	
<b>Wear oral-nasal mask</b>			
Yes (n=6)	1	16.7	0.388
No (n=194)	65	33.5	
<b>Wear special boots</b>			
Yes (n=3)	0	0.0	0.221
No (n=197)	66	33.5	
<b>Wear overall</b>			
Yes (n=26)	3	11.5	0.013
No (n=174)	63	36.2	

\* Workers reported 2 or more symptoms

\*\* p value of  $X^2$  (corrected) test.

## Discussion

Leaded gasoline is still being imported from Israel and used in the Gaza Strip. To our knowledge no previous published work has addressed occupational aspects of exposure to leaded gasoline in the Gaza Strip. This is the first study to describe the knowledge, attitude, practice, and self reported symptoms related to leaded gasoline exposure among gasoline station workers in the Gaza Strip.

A low level of illiteracy was recorded among gasoline station workers, reflecting a well educated community. This may give the impression that the high rate of educated workers is a result of them not getting another job because of the unemployment crisis in the Gaza Strip. In addition, restriction of jobs in the Gaza Strip forced the educated population to work in gasoline stations.

Although the actual weekly work hours were determined by the Palestinian labor law to be 45 hr<sup>27</sup>, almost quarter of gasoline station workers worked more than 48 hr/week. This may be attributed to increasing life expenses, particularly after the economic siege on the Gaza Strip<sup>28</sup>, in addition to their low salaries, which have been reported here. Lack of law enforcement on station owners may be the cause of many workers having no work insurance.

Knowledge of the gasoline station workers in the Gaza Strip about the effects of leaded gasoline on human health was relatively high. The result was that a high proportion of gasoline station workers were aware that inhalation of leaded gasoline was more hazardous than other routes of exposure, and this knowledge is in accord with other studies which have found that most

occupational exposures to lead occur through inhalation<sup>5,29,30</sup>. Knowledge concerning accumulation of lead in the body was low. This necessitates the launch of educational extension program among gasoline station workers in the Gaza Strip on the fate of lead in the human body.

The interaction of workers' education with their knowledge reflects a positive influence of workers' education on their knowledge particularly on their knowledge about health effects of leaded gasoline.

The majority of workers did not use protective measures during work in the station. The reasons for not using protective gear as claimed by the workers was that it not necessary, was unavailable, carelessness and discomfort. Such practice in combination with personal habits and lack of control measures at the workplace could put workers at risk of lead exposure<sup>31</sup>. In addition, workers who did not use protective gear had more knowledge about health effects of leaded gasoline, route of lead entry and its accumulation in the body than those who did. This implies that knowledge does not have much influence on practice. Also, the positive attitude of workers towards the effectiveness of protective gear in preventing lead exposure seems not to translate into practice.

When asked 'Did health professionals visit the station?' almost half of workers agreed. However, the majority of gasoline station workers did not participate in seminars and training courses related to the hazards of leaded gasoline. This is an alarming issue to different governmental and non governmental bodies that necessitates an urgent campaign represented by introducing seminars and training

courses, and frequent health professionals' visits to the gasoline stations. Such action would alleviate lead exposure and poisoning among workers. It was reported that workers should receive training courses including instruction about the use and care of appropriate protective equipment and on the manner of wearing it<sup>32,33</sup>.

Regarding symptoms associated with leaded gasoline exposure, results showed that common self reported symptoms among gasoline station workers were headache, nausea, and pallor. These findings require urgent prevention, intervention, and protection from the Ministry of Health and other non-governmental organizations. Similar data were reported in many countries, including neighbouring ones<sup>12,34,35,36</sup>.

According to the present data there was a significant increase in the prevalence of self reported symptoms with increasing years of work in the gasoline station. This positive relationship means that increasing work duration led to increase workers exposure to leaded gasoline and put their health at a higher risk. Lead toxicity was more frequently encountered with longer term occupational lead exposure<sup>37,38,39</sup>.

In relation to protective gear, self reported symptoms were more prevalent among workers who did not use the protective gear (particularly hat and overall) than those who did. This indicates that use of protective gear can help to prevent or limit exposure to lead hazards. It has been recommended that appropriate protective work clothing and equipment including overalls, gloves, hats, shoes and mask or respirators should be provided to all workers by the employer<sup>40</sup>.

## Conclusions

Gasoline station workers in the Gaza Strip are exposed to leaded gasoline from lead fumes generated during filling cars and from the fumes of cars. Despite their knowledge about the adverse health impact of the leaded gasoline, the workers made poor use of protective measures. This implies that knowledge does not have much influence on practice. Common self reported symptoms among gasoline station workers were headache, nausea, and

pallor. There was a significant increase in the prevalence of self reported symptoms with increasing years of work in the gasoline station. In relation to protective gear, self reported symptoms were more prevalent among workers who did not use the protective gear than those who did. Prevention and intervention programs regarding the use of protective measures and monitoring the health status of gasoline station workers should be implemented.

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