Adverse Health Impacts of Living Near an Oil Refinery in Jordan

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Moawiah Khatatbeh[1], Karem Alzoubi[2], Omar Khabour[3] and Wael Al-Delaimy[4]

[1]Department of Basic Medical Sciences, Faculty of Medicine, Yarmouk University, Irbid, Jordan. [2]Department of Clinical Pharmacy, Jordan University of Science and Technology, Irbid, Jordan. [3]Department of Medical Laboratory Sciences, Faculty of Applied Medical Sciences, Jordan University of Science and Technology, Irbid, Jordan. [4]Department of Family Medicine and Public Health, School of Medicine, University of California at San Diego, La Jolla, CA, USA.

ABSTRACT

INTRODUCTION: Air pollution can adversely affect the health of communities and manifest as a variety of symptoms.

OBJECTIVE: This study aimed at assessing health symptoms among populations living near an oil refinery in Jordan.

METHODS: A cross-sectional survey study was conducted utilizing convenient random sampling at Al-Hashimeya town (where the refinery is located) and Bal'ma town (about 12 km further away from refinery). A total of 486 participants were recruited for the study. The data were checked, coded, and entered to excel sheet and exported to the Statistical Package for Social Science (SPSS) Version 20 for further analysis. Both bivariate and multivariate logistic regressions were used to identify associated factors. Variables having a $P \leqslant 0.25$ were fitted to multivariate logistic regression so as to assess the presence and strength of associations between socio-demographic characteristics and health symptoms and outcomes. A P value < 0.05 was considered for statistical significance.

RESULTS: In the cross tabulation analysis, there were significant differences in the reported respiratory health problems and history of abortions in the family between residents in the 2 towns ($P < 0.05$). Only 4.7% of Al-Hashimeya residents were extremely enjoying their town compared to 32.9% among Bal'ma residents ($P < 0.001$). In addition, residents of Al-Hashimeya were at several folds higher risk to have phlegm and about 3 times more likely to have skin problems compared to participants from Bal'ma ($P < 0.001$). Furthermore, reporting asthma was substantially higher among Al-Hashimeya residents (odds ratio [OR] = 5.20; 95% confidence interval [CI]: 2.11-12.84), and they were more likely to perceive the neighboring oil refinery industry as the leading cause of their health problems than Bal'ma residents (OR = 86.40; 95%CI: 45.95-162.44).

CONCLUSION: Residents living close to the oil refinery industry in Jordan report adverse impacts on their health, including respiratory problems, skin diseases, and perception of poor health.

KEYWORDS: Cross-sectional, Jordan, health, oil refinery

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CORRESPONDING AUTHOR: Moawiah Khatatbeh, Department of Basic Medical Sciences, Faculty of Medicine, Yarmouk University, Irbid 21163, Jordan. Email: moawia.m@yu.edu.jo

Introduction

Oil refinery activities have adverse health impacts by continuously emiting pollutants to the air we breath.[1] Sulphur dioxide (SO_2) emitted by oil refineries, from a study in Italy, was strongly associated with reduction of lung function and an increase in airway inflammation.[2] Sulfur dioxide was also associated with higher prevalence of active asthma and poor asthma control among children and other respiratory illnesses as a results of living near a refinery based on studies from several countries.[3] Other outcomes include the negative impact on pregnancy outcomes.[4] In Eastern Mediterranean countries, several adverse health outcomes were positively associated with various indoor/outdoor air pollutants throughout the region.[5] In Jordan, exposure to air pollution was found to lead to adverse pregnancy outcomes.[6]

Based on the above, the evidence is clear that there are consistent adverse health impacts from living near petrochemical refineries. Air pollution is not the only source of negative health impacts. Stress and quality of life associated with being near a refinery has also been assessed by several studies.[7,8] It was shown that this infirmity is both direct and mediated by individuals' perceptions of neighborhood disorder and personal powerlessness, and the impact is greater for minorities and the poor than it is for whites and wealthier individuals.[7,9,10] There are indirect impacts such as the environmental stressors from air pollution, waste, and odors leading to psychosocial stress of those living near an oil refinery.[8] Further to that, cancer has been associated with living near oil refinery but the results are not consistent.[11–13]

There is limited data from the Middle East on health impact of living near an oil refinery.

Al-Hashimeya town is located north of Zarqa city, 35 km northeast of Amman, and it has been described as the most polluted city in Jordan as it hosts the only oil refinery in the

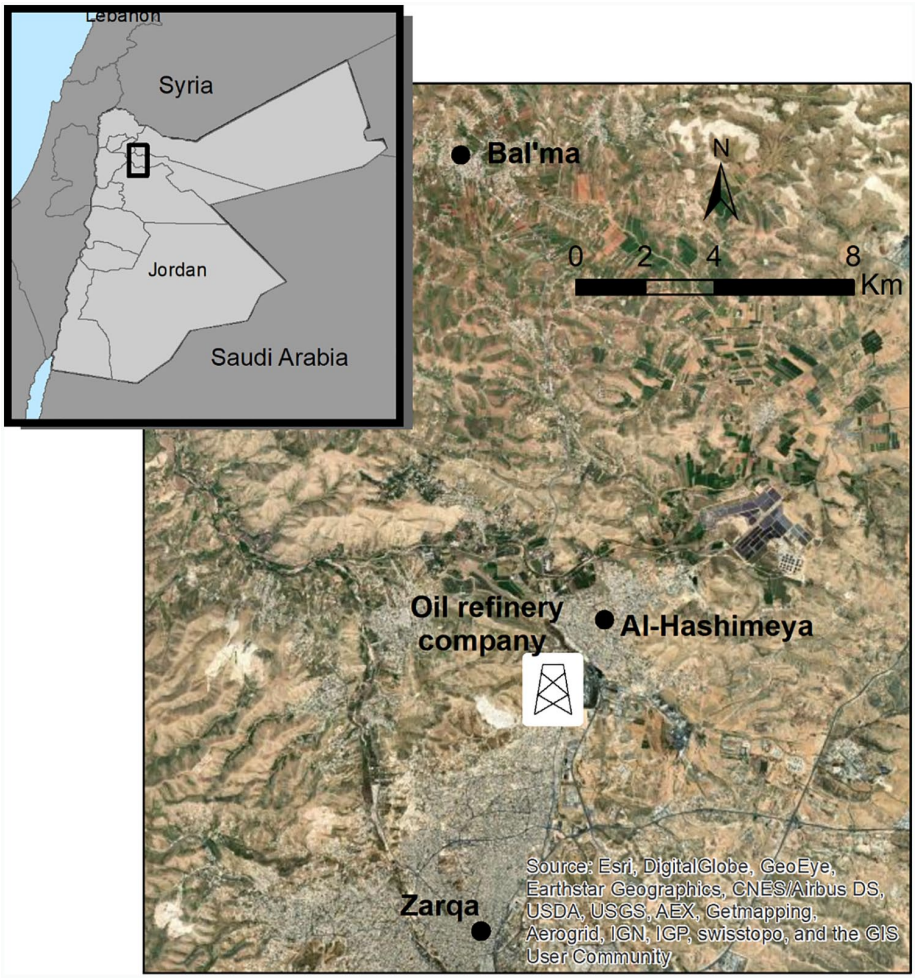

Figure 1. Study sites laid over a satellite imagery provided by ESRI (courtesy of Dr. Rana Jawarneh).

country.[14] The oil refinery produces air pollutants through its processes of fuel combustion, especially the emitted sulfur dioxide, nitrogen oxides, carbon monoxide, sulfide hydrogen besides black carbon.[15] The current study aimed at assessing the reported health status and perceptions of health status among populations living near the oil refinery (Al-Hashimeya) in comparison with another town which is further away from that area (Bal'ma).

Materials and Methods

Setting

The study was conducted among residents of Al-Hashimeya town (located about 1 km from the oil refinery), and Bal'ma town, which is located about 12 km from the same oil refinery. Figure 1 shows Jordan's map and the study sites. According to the latest statistics from 2018, Al-Hashimeya population was close to 50 000 inhabitants and Bal'ma population was 20 000.[16]

Design and participants

A cross-sectional design was implemented. Participants were conveniently sampled from different locations in the 2 study sites, including shops, government facilities, youth centers, worship places, and other public areas. Convenient random sampling recruitment continued until the target sample (>384 participants) was achieved. About 350 questionnaires were distributed in each town and response rates of 73.7% and 65.1% in Al-Hashimeya and Bal'ma towns were achieved, respectively. The overall response rate for the whole study was 69.4% (486 out of 700). Participants had to meet the following inclusion criteria: aged 18 years or older, have been a resident in the specific town for 6 months or more, and be a Jordanian citizen.

Data collection instrument

A pilot tested structured questionnaire was prepared for data collection to suit the Jordanian context. Twenty participants completed the questionnaire and their responses were tested for internal consistency using SPSS (SPSS Inc., Chicago, IL, USA) version 20. Cronbach's alpha score of 0.88 was revealed from the pilot testing, and responses from the pilot testing were not included in the final analysis. The final questionnaire consisted of 42 items divided into 3 attributes: demographics

items, clinical information, and perception of general health. The same questionnaire was provided to participants from the 2 towns by 4 interviewers. The interviewers were a postgraduate student and 3 fifth year medical students who were trained for 2 days on the purpose of the study, field protocol, questionnaire administration, and ethical issues. The instrument was pre-tested for language clarity during the training and modified based on the feedback.

Operational definitions

Cough: Cough was defined as a cough as much as 4 to 6 times per day.[17]

Phlegm: Chronic phlegm was classified as sputum expectoration as much as twice a day.[17]

Asthma, skin diseases, abortions, chronic diseases: Confirmed diagnosis and/or received treatment.

Sample size

The sample size for this study was computed using SurveyMonkey.[18] The assumptions were that the total population in the 2 towns was >75 000, the confidence level was 95%, and margin of error was 5%. This sample size calculator which uses a normal distribution (50%) method yielded an optimum sample size of 384. The following equation was used where N = population size; e = margin of error; z = z-score.

$$\text{Sample size} = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1 + \left(\frac{z^2 \times p(1-p)}{e^2 z} \right)}$$

Statistical analysis

Data were analyzed using the Statistical Package for Social Sciences software, SPSS (SPSS Inc., Chicago, IL, USA) version 20. Preliminary descriptive analysis was done to identify outliers, determine the normality in distribution of continuous variables, and identify any patterns in the data. Bivariate analysis was performed using Pearson's or Fisher's Chi square tests to examine the correlations between demographic variables and health outcomes. To identify health problems associated with living near the oil refinery, a stepwise binary logistic regression analysis was performed involving all variables with a P value ⩽ 0.25 in the cross tabulation analysis. The regression analysis was used to explore the relationships between socio-demographic factors as independent variables and the outcome measures as dependent variables such as enjoyment at the place of living, having asthma, and having cough or phlegm among participants or their family members while controlling for potential confounding variables. A $P < 0.05$ was considered for statistical significance in all cases.

Results

A total of 486 participants with valid responses were involved in the study. About 40% ($n = 195$) of participants were males and 60% ($n = 291$) were females. The socio-demographic characteristics of the study population according to their residence are shown in Table 1. As shown, this was a relatively young population with low income and education.

A cross tabulation analysis was performed to assess differences in clinical characteristics between the 2 population groups. As illustrated in Table 2, differences between the 2 towns in the presence of respiratory health problems among participants and their families, history of abortions in the family, having chronic diseases, having skin diseases, and family history of cancer had statistical significance ($P < 0.05$).

As noted in Table 2, only 15% of Al-Hashimeya residents reported that the surrounding air is clean compared to 50% from Bal'ma residents. Another cross tabulation analysis was performed to assess the presence of certain clinical characteristics and enjoyment at the residence in the last 14 days among study participants. Consistently, Al-Hashimeya residents had more health problems than Bal'ma residents, and they perceived poor health status. These associations are shown in Table 3.

As shown in Table 3, about 78% % of Al-Hashimeya residents thought that their health problems are related to the oil refinery compared to only 1.3% among Bal'ma residents ($P < 0.001$). About 8% of Al-Hashimeya residents rated their health as very poor, however, only 1.3% of Bal'ma residents had the same belief. Furthermore, about 20% of Al-Hashimeya sample were not extremely enjoying the place where they live compared to 2.6% of Bal'ma sample with the same feeling ($P < 0.001$).

Table 4 illustrates the statistical significant results from the last regression model.

As seen in Table 4, after adjusting for possible confounders including sex, age, income, and education level, participants and their family members from Al-Hashimeya were at higher risk to have phlegm by 2 folds for participants and 4 folds for family members. Furthermore, residents of Al-Hashimeya were about three times more likely to have skin problems in the last 14 days compared to Bal'ma residents ($P = 0.004$). Remarkably, having asthma was higher among Al-Hashimeya residents (OR = 5.20; 95%CI: 2.11-12.84). While participants from Bal'ma enjoyed the place where they live 14 folds more than those from Al-Hashimeya. Undoubtedly, Al-Hashimeya participants were more likely to perceive that the oil refinery around them is the leading cause of their health problems (OR = 86.40; 95%CI: 45.95-162.44).

Discussion

This study aimed at investigating the association between the presence of health problems and the residency near an oil refinery in Jordan. Several adverse health impacts were reported by

Table 1. Demographic characteristics of study population by town of residence ($n = 486$).

CHARACTERISTIC	TOWN OF RESIDENCE		TOTAL *N* (%)	*P* VALUE
	AL-HASHIMEYA *N* (%)	BAL'MA *N* (%)		
Sex				.163
Male	96 (37.2)	99 (43.4)	195 (40.1)	
Female	162 (62.8)	129 (56.6)	291 (59.9)	
Age/year				.002
18-19	15 (5.8)	36 (15.8)	51 (10.5)	
20-39	141 (54.7)	126 (55.3)	267 (54.9)	
40-59	96 (37.2)	54 (23.7)	150 (30.9)	
⩾60	6 (2.3)	12 (5.3)	18 (3.7)	
Job				.082
Employed	114 (44.2)	108 (47.4)	222 (45.7)	
Retired	18 (7.0)	30 (13.2)	48 (9.9)	
Housewife	114 (44.2)	60 (26.3)	174 (35.8)	
Student	12 (4.7)	30 (13.2)	42 (8.6)	
Income/JOD				.112
<250	78 (30.2)	39 (17.1)	117 (24.1)	
250-499	138 (53.5)	156 (68.4)	294 (60.5)	
⩾500	42 (15.4)	33 (14.5)	75 (15.4)	
Education				.491
⩽Secondary	174 (67.4)	147(64.5)	321 (66.0)	
Diploma or bachelors	78 (30.2)	78 (34.2)	156 (32.1)	
Postgraduate	6 2.3)	3 (1.3)	9 (1.9)	

Table 2. Cross tabulation of clinical characteristics among participants by town of residence ($n = 486$).

VARIABLE	TOWN OF RESIDENCE		*P* VALUE*
	AL-HASHIMEYA *N* (%)	BAL'MA *N* (%)	
Having skin diseases	57 (22.1)	27 (11.8)	.003
Family members with skin disease	54 (20.9)	24 (10.5)	.002
Sit on balcony			.005
Daily	147 (57.0)	159 (69.7)	
<3 times/week	81 (31.4)	57 (25.0)	
None	30 (11.6)	12 (5.3)	
Having abortions in family	117 (45.3)	48 (21.3)	<.001
Have chronic diseases	87 (33.7)	51 (22.4)	.006
Chronic diseases among family members	183 (70.9)	156 (68.4)	.548
Having family history of cancer	51 (19.8)	21 (9.2)	.001
Participant has cough			<.001
Most days/week	63 (24.4)	33 (14.5)	
Few days/week	51 (19.8)	18 (7.9)	
Only with chest infection	66 (25.6)	126 (55.3)	
None	78 (30.2)	51 (22.4)	

(Continued)

Table 2. (Continued)

VARIABLE	TOWN OF RESIDENCE		*P* VALUE*
	AL-HASHIMEYA *N* (%)	BAL'MA *N* (%)	
Cough in family members			<.001
Most days/week	90 (34.9)	42 (18.4)	
Few days/week	51 (19.8)	21 (9.2)	
Only with chest infection	21 (8.1)	81 (35.5)	
None	96 (37.2)	84 (36.8)	
Participant has phlegm			<.001
Most days/week	48 (18.6)	33 (14.5)	
Few days/week	39 (15.1)	18 (7.9)	
Only with chest infection	57 (22.1)	105 (46.1)	
None	114 (44.2)	72 (31.6)	
Phlegm in family members			<.001
Most days/week	75 (29.1)	24 (10.5)	
Few days/week	42 (16.3)	18 (7.9)	
Only with chest infection	27 (10.5)	96 (42.1)	
None	114 (44.2)	90 (39.5)	
Participant has asthma			<.001
Yes	33 (12.8)	6 (2.6)	
Number of chest infection attacks in the last 12 mo			<.001**
⩾3	57 (52.8)	51 (47.2)	
1-2	201 (71.3)	81 (28.7)	
None	0 (0.0)	96 (100.0)	
Air around is clean			<.001
Agree	39 (15.1)	114 (50.0)	
Neutral	3 (1.2)	30 (13.2)	
Disagree	216 (83.7)	84 (36.8)	
How often do you open windows to air the house?			.010
Most days/week	216 (84.7)	210 (93.3)	
Few days/week	27 (10.6)	9 (4.0)	
Very rare	12 (4.7)	6 (2.7)	

*Pearson's Chi-squared test.
**Fisher's Chi-squared test.

Table 3. Cross tabulation of clinical characteristics and enjoyment at the residence in the last 14 days among participants ($n = 486$).

VARIABLE	TOWN OF RESIDENCE		*P* VALUE*
	AL-HASHIMEYA *N* (%)	BAL'MA *N* (%)	
Have headache	198 (76.7)	174 (76.3)	.911
Lack of concentration	195 (75.6)	153 (67.1)	.039
Ear, nose, and throat irritation	153 (59.3)	84 (36.8)	<.001
Memory problems	177 (68.6)	132 (57.9)	.014
Have skin diseases	93 (36.0)	36 (15.8)	<.001

(Continued)

Table 3. (Continued)

VARIABLE	TOWN OF RESIDENCE		*P* VALUE*
	AL-HASHIMEYA *N* (%)	BAL'MA *N* (%)	
Have extreme fatigue	216 (83.7)	153 (67.1)	<.001
Have stomach discomfort	126 (48.8)	117 (51.3)	.585
Have eye irritation	141 (54.7)	78 (34.7)	<.001
Have a sick child in the last 14 d	159 (61.6)	129 (56.6)	.114
The previous symptoms are related to air/environment around you?			<.001**
Strongly agree	186 (72.1)	39 (17.1)	
Agree	48 (18.6)	75 (32.9)	
Neutral	9 (3.5)	21 (9.2)	
Disagree	12 (4.7)	78 (34.2)	
Strongly disagree	3 (1.2)	15 (6.6)	
The previous symptoms are related to the oil refinery?			<.001**
Strongly agree	201 (77.9)	3 (1.3)	
Agree	36 (14.0)	21 (9.2)	
Neutral	6 (2.3)	12 (5.3)	
Disagree	12 (4.7)	138 (60.5)	
Strongly disagree	3 (1.2)	54 (23.7)	
You enjoy the place where you live?			<.001
Extremely enjoying	12 (4.7)	75 (32.9)	
Enjoying	45 (17.4)	81 (35.5)	
So-so	72 (27.9)	57 (25.0)	
Not enjoying	78 (30.2)	9 (3.9)	
Extremely not enjoying	51 (19.8)	6 (2.6)	
How do you rate your health?			<.001**
Excellent	27 (10.5)	48 (21.1)	
Good	99 (38.4)	111 (48.7)	
So-so	90(34.9)	51 (22.4)	
Poor	21(8.1)	15 (6.6)	
Very poor	21 (8.1)	3 (1.3)	

*Pearson's Chi-squared test.
**Fisher's Chi-squared test.

Table 4. The multivariate logistic regression analysis of health problems associated with living near oil refinery. The results are controlled for sex, age, education, and income.

HEALTH PROBLEM	OR; 95% CI*	*P* VALUE
Having phlegm	2.03; 1.32-3.12	.001
Having other family members with phlegm	4.28; 2.76-6.64	.001
Family history of abortions	3.07; 2.05-4.60	.001
Having ear, nose, throat irritation in the last 14 d	2.43; 1.68-3.51	.001
Having skin diseases	2.84; 1.82-4.43	.004
Having other family members with skin diseases	2.31; 1.35-3.95	.002

(Continued)

Table 4. (Continued)

HEALTH PROBLEM	OR; 95% CI*	*P* VALUE
Enjoyment at the place where you live**	14.47; 8.07-25.93	<.001
You have cough	2.96; 1.96-4.46	.001
Having other family members with cough	3.58; 2.40-5.34	.001
Family history of cancer	2.42; 1.41-4.18	.001
Having eye irritations	2.27; 1.57-3.28	.001
Having chronic diseases	1.76; 1.16-2.66	.007
You walk slower than others at your age/get tired	1.73; 1.20-2.49	.003
Having asthma	5.20; 2.11-12.84	.001
Concentration difficulties	1.50; 1.00-2.25	.048
Having memory problems	1.55; 1.06-2.25	.022
Having extreme fatigue	2.69; 1.73-4.17	.001
You think that the above health problems are R/to oil refinery	86.40; 45.95-162.44	.001

*All OR results are for Al-Hashimeya residents compared to Bal'ma residents as a reference category.
**Result for Bal'ma residents compared to Al-Hashimeya residents as a reference category.

participants. With respect to the presence of family history of cancer, difference in the prevalence between the 2 study groups was significant ($P = 0.001$) and revealed an OR of 2.4 (95%CI: 1.41-4.18). Two studies from Italy demonstrated a link between cancers and living near an oil refinery or near an industrial area reporting that the relative risk (RR) for all cancers as 3.6 (except myelodysplasia syndromes and myeloproliferative syndromes).[19,20] Two other studies from the US assessed the relationship between environmental toxins and cancer rates and revealed that environmental health hazards are reasons for increased cancer rates.[21,22] The results of the current study are consistent with results from China reporting that the risk of having breast cancer was OR = 1.87 among women living near an oil refinery.[23]

In the current study, Al-Hashimeya residents reported significantly higher frequency of having skin diseases compared to Bal'ma residents (OR = 2.84; CI: 1.82-4.43). This result is consistent with results from China which reported that the OR for having dermatitis in an industrial area involving oil refinery as 1.72.[23] The higher odds in the current study may refer to the fact that Al-Hashimeya town is very close to the oil refinery (about 1 km).

It has been reported in the literature that the health risk of petrochemical air pollutants may be more serious to individuals in the close proximity especially among the vulnerable groups such as children, elderly, pregnant women, and their unborn children.[24] The results of the current study reported an elevated family history of abortion among Al-Hashimeya population compared to Bal'ma population (OR = 3.07; 95% CI: 2.05-4.60). This result is consistent with results from a previous study in Jordan which reported that exposure to air pollution was associated with adverse pregnancy outcomes including spontaneous abortion (OR = 1.95).[6] Similarly, in Brazil, the risk of early abortion was 2.6 folds significantly higher in mothers who had exposure to particulate air pollution than in control mothers.[25] Another study from Mongolia identified strong statistical associations between air pollutants and abortions.[26]

The results from this study are similar to findings from other studies that revealed an association between living near the petrochemical plant and having more respiratory symptoms, including cough and lower lung function.[24,27–30] Additionally, an increase in wheezing symptoms was associated with children living in areas close to an oil refinery versus children living in the reference area in Italy.[31]

Results of the current study show that participants from Al-Hashimeya have a higher asthma prevalence than participants from Bal'ma (OR = 5.20; 95%CI: 2.11-12.84). This finding is congruent with results from a cross sectional study conducted in Canada and revealed that petroleum refineries increased the prevalence of active asthma and poor asthma control among children living nearby.[3] A similar trend was observed in Argentina and Taiwan.[27,29]

The previous literature reported that populations living near an oil refinery had eyes, ears, nose, and throat irritations.[24,28] Participants in the current study reported significant statistical difference between residents from the 2 towns for having eye irritation (OR = 2.27; 95%CI: 1.57-3.28) and phlegm (OR = 2.03; 95%CI: 1.32-3.12). Similar to the results of the current study, the study from Thailand found that cases have higher odds of having eye irritation (OR = 4.55) and phlegm (OR = 1.05) compared to controls.[24] However, the other study from Thailand reported an OR = 1.59 for having eye irriations

among cases participants.[28] The current study collected data from participants living at 1 km from the oil refinery plant, however, both studies from Thailand collected data from cases at about 5 km and within 2 km from the industry site, respectively.[24,28] Furthermore, inhalation of cement dust was associated with irritation to the respiratory tract among Jordanians living near a major cement factory.[32]

Al-Hashimeya residents reported the number of chest infection attacks in the last 12 months at a higher rate than that for the Bal'ma residents. In Spain, children and adolescents living near a petrochemical site had a statistically significant higher prevalence of respiratory hospitalizations.[30]

In the current study, Al-Hashimeya residents reported a perception of poor health status compared to Bal'ma residents. Moreover, they reported that their health complaints and the associated symptoms are related to the nearby oil refinery (OR = 86.40; 95%CI: 45.95-162.44). These results are consistant with previous literature stating that those living close to the oil refinery continue to report negative health impacts and viewed odor perception and annoyance as vital elements in ill health reporting.[10] Furthermore, the perceived risk associated with chemicals and their industrial emissions usually turns into a generalized stress[33] or into emotional responses such as fear of cancer.[34]

We asked a question regarding enjoying the place where they live and found that Bal'ma residents reported a substantially higher rate of enjoyment feeling compared to Al-Hashimeya residents (OR = 14.47; 95%CI: 8.07-25.93). These results are similar to a study aimed at investigating levels of disease symptoms and environmental distress (worry, annoyance, and intolerance) associated with oil pollution in Nigeria.[35] Relationships between sources of air pollution and emotional reactions revealed that exposed individuals perceived their general health, mental health, and vitality worse than non exposed subjects, and felt themself more limited in their roles due to emotional problems.[35] Although these feelings might be related to perception, it is indicative of perceived quality of life and its subjective nature is valid and reliable similar to well-established quality of life measures.[36]

Overall, Al-Hashimeya residents suffered significantly from poorer health status than Bal'ma residents. Locating to the north of the oil refinery company, Al-Hashimeya town is mainly affected by emissions from the refinery, because the prevailing winds in the region are west headed.[14] Oil refineries are large industrial installations that are responsible for the emission of several pollutants into the atmosphere that affect population health in one or another such as inhalation and polluting air, water, and soil at levels that are harmful to life.

Limitations of the current study is its lack of documented clinical outcomes and reliance on underestimated or overestimated self-reported history of health issues. However, there was a consistent trend of negative health outcomes reported by Al-Hashimeya residents compared to Bal'ma residents and the findings are supported by published literature. We were not able to identify the specific contaminants and pollutants from the oil refinery that might be related to the negative health outcomes. This would be the next step in a study monitoring pollutants. It would also be important to differentiate indoor from outdoor pollution, although they are related since ambient outdoor pollution will increase indoor pollution. We were not able to differentiate actual from perceived negative health impacts, which is the nature of all observational studies unless it involves clinical outcome measures or hospital records. Moreover, personal behaviors such as drinking alcohol and smoking were not assessed in this study due to the conservative nature of the community under study, given that about 60% of the sample were females. Asking such questions is problematic and might decrease response rates. In addition, a strength of our study is the clearly identified town that is at higher risk compared to another town with similar socio-demographic and economic characteristics based on proximity to the oil refinery, which is the target source of exposure in this study.

Conclusion

The results of the current study reveal significant disparities in health outcomes between the studied local communities. Living close to an oil refinery industry can cause adverse impacts on population health including respiratory problems, abortions, skin diseases, cancers, and perception of poor health. Residents' sensitivity to the negative effects of the refinery on their health and the health of their children is likely associated with perceived and actual refinery emissions. Therefore, governments have to adopt strict policies on constructing oil refinery industries near residing communities and vice versa, however, the best approach and policy is to construct oil industry in remote and uninhabited areas. Meanwhile, standardized reliable assessments for various air pollutants in such regions should be implemented and made publicly available. Strategies should focus on controlling emissions from oil facilities by fixing filters at both industry sites and neighboring residential homes. Further studies are recommended including longitudinal studies measuring emissions levels and documenting clinical outcomes can better highlight the issue and assess the impact of oil refinery industry on population health.

Author Contributions

MK KA, OK, and WD contributed to project idea, conception, and design. MK and WD developed the data collection instrument. MK was responsible for acquisition of data and data analysis. MK, KA, OK, and WD interpreted results. All authors contributed to drafting the manuscript, made critical review for important intellectual content, and approved the final manuscript.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Ethical Approval and Consent to Participate

The study was approved by the Institutional Review Board (IRB) at King Abdulla University Hospital in Northern Jordan (No. 15//122/2019). All study procedures were implemented according to the 1964 Helsinki declaration guidelines and its later amendments or comparable ethical standards. All participants gave their consent to participate.

Consent to Publish

Not applicable, no individual detail is presented.

ORCID iD

Moawiah Khatatbeh https://orcid.org/0000-0002-6299-6486

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