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A Cross-Sectional Study of Indoor and Outdoor Air Pollution Exposure in Al-Diwaniyah Governorate, Iraq

Ali Saheb Saleh*, **Alaa Kadhim Jasim, Alaa Shakir Hantoosh**

College of Health and Medical Techniques, Southern Technical University, Iraq.

Correspondence E-mail: ali.saleh.c@fgs.stu.edu.iq

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Abstract

Air pollution constitutes a prominent cause of global health complications. As outdoor pollutants continually infiltrate indoor environments, it is imperative to investigate this relationship to identify and mitigate risks associated with human exposure. Find the relationship between exposure to indoor and outdoor air pollution in the governorate of Al-Diwaniyah, Iraq. A descriptive cross-sectional study with 400 participants (aged 18-65 years) was carried out in six healthcare facilities in the Al-Diwaniyah Governorate. It performed from 15 September 2025 until the end of January 2026. It employs non-random convenient sampling by using a structured questionnaire. Most participants were female (50.7%), widowed (26.5%), lived in urban areas (66.8%), and had a primary school certificate (21.5%). The indoor pollution score was 56.0% as smoking inside, using gas/kerosene stoves, and electric generators, while the outdoor pollution score was 51.5%, such as busy main roads, open burning, and agricultural land. This score was associated with some socio-demographic characteristics, including marital status, education level, income level, and socioeconomic status (SES) (P-value <0.05). The study found a mutual influence between indoor and outdoor pollution exposure, with continuous infiltration of outdoor pollutants into indoor environments.

Keywords: Air Quality, Exposure Levels, Indoor Air Pollution, Outdoor Air Pollution, Socioeconomic Status.

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Introduction

Air pollution and its consequences for public health have emerged as one of the most pressing issues confronting researchers and the general public in recent years [1; 2]. It is defined as the presence and concentration of harmful chemical, physical, or biological substances in the atmosphere above natural or regulatory levels, thereby causing undesirable effects on human health, ecological stability, and environmental quality [3]. Globally, air pollution is a significant contributor to lung cancer, allergic rhinitis, asthma, infectious respiratory diseases, and chronic obstructive pulmonary disease (COPD) [4; 5]. Individuals with pre-existing respiratory diseases are particularly vulnerable; for instance, people with COPD may experience acute exacerbations requiring hospitalization, while asthmatic individuals often face worsened symptoms due to poor air quality [6].

This environmental threat is categorized into two main types: indoor and outdoor pollution, both of which present significant health risks. Indoor (household) air pollution is considered one of the world's most significant environmental problems, especially for those without access to clean cooking fuels [7]. It often arises from cooking with solid fuels (wood, coal, kerosene), heating, tobacco smoke, and emissions from building materials, ranking tenth among global risk factors for disease burden [8; 9]. The World Health Organization (WHO) emphasizes this danger by calling indoor air pollution "the world's largest single environmental health risk," contributing to approximately 1.6 million premature deaths annually [10; 11]. Simultaneously, outdoor (ambient) air pollution is defined as the presence of one or more substances in the atmospheric air at concentrations and duration above the natural limits [12], [13]. It also arises from industrial activities, energy production, transportation, and household fuel use, and constitutes a major public health concern because of its established links to cancer and other serious health outcomes [14]. Main pollutants such as fine particulate matter ($PM_{2.5}$ and PM_{10}), ozone (O_3), and nitrogen dioxide (NO_2) have been linked to cardiovascular diseases, stroke, and lung cancer, being responsible for more than 4.2 million deaths worldwide [13; 15].

In the context of Iraq, Al-Diwaniyah Governorate, located in southern Iraq, spans about 8,153 km² and has a population of approximately 1.32 million. It features a hot, dry climate, with summer temperatures reaching up to 50°C and frequent dust storms [16]. Rapid urbanization, traffic emissions, open burning, and weak environmental infrastructure significantly contribute to air pollution, impacting public health, especially in urban areas and healthcare settings. Recent findings indicate that air quality within sensitive environments, such as hospitals, can be even worse than the air quality outside, posing a continuous risk to staff and patients [17]. Therefore, there is an urgent need for more localized studies to understand these dynamics. This study aims to demonstrate the correlation between indoor and outdoor air pollution exposure, specifically in Al-Diwaniyah City, Iraq.

Materials and Methods

Study Period:

The period started from 15 September 2025 until the end of January 2026.

Study Design:

A cross-sectional descriptive comparative study was done in Al-Diwaniyah Governorate.

Population source:

Attendants of Al-Diwaniyah Primary Health Care Centers (PHCCs) aged 18-65 years.

Inclusion Criteria:

- Aged 18 years and above, patients and visitors of the identified primary healthcare facilities in Al-Diwaniyah.
- Participants who agreed to take part in the study and provided informed consent.
- Participants who were able to understand and respond appropriately to the study questions.

Exclusion Criteria:

- People whose chronic respiratory non-environmental diseases are diagnosed.
- Patients who had not finished the interview process.

Sample size

The appropriate sample size for the population being studied was calculated using the following statistical formula. Daniel's equation [18]:

$$n = \frac{Z^2\, p\,(1-p)}{d^2}$$

- **n=** is the required sample size
- **Z** = is the standard normal deviate corresponding to a 95% confidence level (Z = 1.96)
- **p** = is the estimated prevalence of the studied outcome; in the absence of previous local data, a conservative value of 0.5 was assumed
- **d** = is the margin of error, set at 0.05

To enhance the statistical power and precision of the study, and to compensate for potential non-response or incomplete questionnaires, the sample size was intentionally increased beyond the minimum required. Therefore, the final sample size was set at 400 participants.

Sampling techniques

A multistage sampling design was employed. It started with the stratification of Al-Diwaniyah Governorate into three main sectors (North, Central, and South). The total of primary healthcare in Al-Diwaniyah Governorate was selected (Al-Diwaniyah First Sector, Hamza Sector, and Afak Sector). Then, two PHCCs were selected in each sector. Overall, six PHCCs were used in reference to the study. The study participants were recruited to include the patients and the visitors within these centers using convenience sampling, and the number of study participants per center was proportionally distributed based on the number of patients served by the respective primary PHCCs.

Variables of the study

Dependent variables:

The dependent variables were indoor and outdoor pollution levels, categorized into low, moderate, and high based on percentage scores.

Independent variables:

The independent variables included age groups, sex, marital status, residence, education level, occupation status, income level, and SES.

Data Collection Method:

The data was collected from interviews (as face-to-face interviews) with the study participants individually by using a structured questionnaire. The study participants were interviewed at their exit point after they had received the service and just before leaving the PHCCs.

Questionnaire

A thorough analysis of pertinent literature served as the foundation for the questionnaire's construction. It includes two sections; the first section includes socio-demographic data comprising 8 items. Occupational status was categorized based on internationally recognized classifications such as the International Standard Classification of Occupations (ISCO-08), which groups occupations into high professional & managerial jobs (“doctors, engineers, professors, large employers and directors of business”), lower professionals, skilled and semiskilled workers (“school teachers, clerical workers, military men, and policemen”) and unskilled workers (“laborers, farmers casual workers, unemployed, and retired”) [19]. The second section assesses pollution levels of patients, comprising 6 items for each type of pollution (indoor and outdoor).

The questionnaire validity and reliability

The questionnaire showed a high degree of reliability, according to the results, with an overall Cronbach's alpha of 0.812. The content validity of the questionnaire is assessed by a group of specialists. All expert feedback was considered for minor adjustments.

Data scoring

In this study, SES was assessed using a structured scoring system based on the WHO guidelines. The SES score was calculated from three domains: educational level (0–5), occupation (0–2), and income level (0–2), with a total possible score of 9. Participants were classified into three categories according to their total score: "low" (1–3), "medium" (4–7), and "high" (7–9) [20].

The Likert respondent scale was used to rate the two levels. A score of 1 was given for "yes," and zero for " No,". The overall assessment was calculated according to formula (observed score / the highest score *100). Six questions were asked in the outdoor pollution, a highest score of 6. A low outdoor pollution was defined as a score of ≤1 (≤20%). A moderate outdoor pollution was defined as a score of >1 to 3 (≤50%). while a high outdoor pollution was defined as a score of >3 (>50%) [21].

Statistical Analyses:

Data coding, arrangement, and organization were done with utmost attention in this study with Microsoft Excel, both to maintain accuracy and consistency of the data. The statistical analyses were performed with the help of the Statistical Package for the Social Sciences (SPSS version 26) software. The frequencies, percentages, means, and standard deviations were used to summarize the properties of the study population and questionnaire responses using descriptive statistical methods. Associations between the categorical variables, especially demographic factors and health-related responses, were evaluated using the Chi-square test. Besides this, the Pearson correlation coefficient was also used to analyze the relationship between indoor and outdoor pollution scores. All analyses were regarded as statistically significant with a p-value of ≤ 0.05 [22].

Ethical Considerations:

Official approval to done the study was obtained from the College of Health and Medical Techniques in Basra, as well as from Al-Diwaniyah Directorate (Human Development and Training Center) to visit the health care sectors in Al-Diwaniyah City. The study was carried out in health care centers after securing the required administrative permissions. Participants were interviewed after obtaining their informed consent, both verbally and through confirmation of their willingness to participate.

Study limitations

The study was limited by its cross-sectional design, which does not allow for establishing causation. The results can be used to generalize the places and not the whole governorate. Furthermore, the data relied on self-reporting (convenience sampling), which may have introduced recall or response bias.

Results

Socio-demographic variables for participants

Table 1 shows the socio-demographic characteristics of the population used in the study. The results found that the largest proportion of the participants belonged to ages 58-65 years (19.3%), followed by those aged 18-25 years (18.5%), 42-49 years (17.8%), 50-57 years (15.3%), 26-33 years (15.0%), and 34-41 years (14.2%). The mean age was 41.8±14.3 (with a range of 18-65) years. The sex ratio is 50.7% female to 49.3% male. Regarding marital status, 32.5% of the study population were single, followed by widowed (26.5%), married (21.8%), and divorced (19.3%). Most participants live in urban areas (66.8%) compared to rural areas (33.2%). The highest proportion has a primary school certificate (21.5%), postgraduate studies (18.3%), Illiterate or read & write (16.8%), university graduate (16.5%), Intermediate school (16.3%), and high school (10.8%). Regarding occupation status, 35.0% of the participants were unskilled workers, 32.0% of the participants were lower professionals. While 33.0% of the participants have high professional and managerial jobs. Concerning income level, the results found that 38.0% of the participants have a high-income class, followed by the low-income class (31.8%), and the medium-income class (30.2%). Finally, more than half of patients have a medium SES (53.2%), followed by low SES (38.0%), and high SES (8.8%).

Table (1): Distribution based on socio-demographic variables of participants.

Socio-demographic characteristics		No.	%
Age groups	18-25 years	74	18.5
	26-33 years	60	15.0
	34-41 years	57	14.2
	42-49 years	71	17.8
	50-57 years	61	15.3
	58-65 years	77	19.3
	Mean ± Sd (Range)	**41.8±14.3 (18-65)**	
Sex	Male	197	49.3
	Female	203	50.7
Marital status	Single	130	32.5
	Married	87	21.8
	Divorced	77	19.3
	Widowed	106	26.5
Residence	Urban	267	66.8
	Rural	133	33.3
Education level	Illiterate or read & write	67	16.8
	Primary school	86	21.5
	Intermediate school	65	16.3
	High school	43	10.8
	University graduate	66	16.5
	Post Graduate Studies	73	18.3
Occupation status	Unskilled workers	140	35.0
	Lower professionals, skilled, and semiskilled workers	128	32.0
	High professional and managerial jobs	132	33.0
Income level	Low	127	31.8
	Medium	121	30.3
	High	152	38.0
SES	Low (1-3 score)	152	38.0
	Medium (4-6 score)	213	53.3
	High (7-9 score)	35	8.8

Table 2 indicates the prevalence of reported indoor and outdoor air pollution exposure among study participants. The results found that the highest percentages (69.8%, 66.8%, 65.5%) of the participants reported that there were outdoor pollutants such as busy main roads, open burning, and agricultural land, respectively. At the same time, more than half of the study population reported that there were outdoor pollutants, such as factory plants, power stations, and dust storms. While the highest percentages (ranging from 50.0% to 69.0%) of the people suffering from the indoor pollutants as smoking inside, use gas/kerosene stoves, electric generators, have poor ventilation, use coal/wood, and frequently use insecticides.

Table (2): Prevalence of reported indoor and outdoor air pollution exposure among study participants.

Pollution Questions		Yes		No	
		No.	%	No.	%
Outdoor pollution	Busy main road	279	69.8	121	30.3
	Factory plant	216	54.0	184	46.0
	Power station	216	54.0	184	46.0
	Open burning	267	66.8	133	33.3
	Agricultural land	262	65.5	138	34.5
	Dust storms	201	50.2	199	49.8
Indoor pollution	Smoking inside	249	62.3	151	37.8
	Gas/Kerosene stove	241	60.3	159	39.8
	Electric generator	276	69.0	124	31.0
	Poor ventilation	260	65.0	140	35.0
	Using coal/wood	249	62.3	151	37.8
	Frequent insecticides	200	50.0	200	50.0

Figure 1; 2 presents that a considerable proportion of participants were classified as having high exposure to both indoor and outdoor air pollution. The findings found that the proportion of indoor pollution score was 56.0%, while the outdoor pollution score was 51.5%.

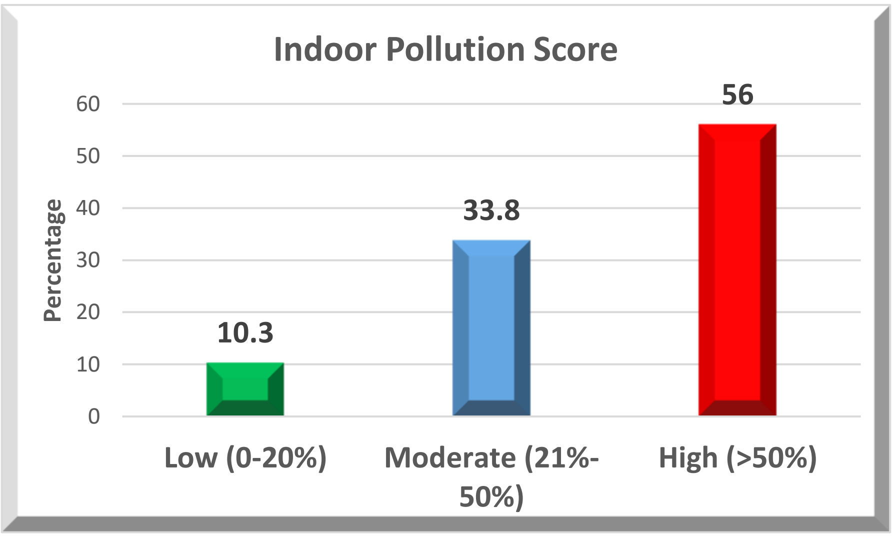

Figure (1): Distribution of Indoor Pollution Exposure Scores Among Participants.

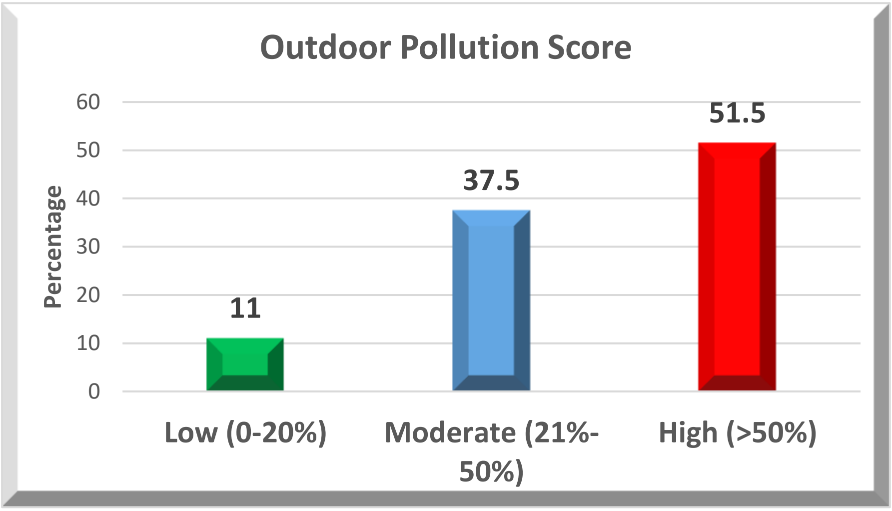

Figure (2): Distribution of Outdoor Pollution Exposure Scores Among Participants.

Table 4 shows an association between the indoor pollution score and socio-demographic characteristics. There was a statistically significant association between the indoor pollution score and socio-demographic characteristics such as marital status, education level, income level, and SES (P- value<0.05). There was no statistically significant association between the indoor pollution score and other socio-demographic characteristics such as age groups, sex, residence, and occupation status.

Table (4): The association between indoor pollution score and socio-demographic characteristics.

Socio-demographic characteristics		**Indoor pollution score**						**P-value**
		Low (0-20%)		**Moderate (21%-50%)**		**High (>50%)**		
		No.	**%**	**No.**	**%**	**No.**	**%**	
Age groups	18-25 years	6	8.1	26	35.1	42	56.8	0.208
	26-33 years	7	11.7	20	33.3	33	55.0	
	34-41 years	11	19.3	14	24.6	32	56.1	
	42-49 years	6	8.5	26	36.6	39	54.9	
	50-57 years	3	4.9	28	45.9	30	49.2	
	58-65 years	8	10.4	21	27.3	48	62.3	
Sex	Male	26	13.2	60	30.5	111	56.3	0.103
	Female	15	7.4	75	36.9	113	55.7	
Marital status	Single	8	6.2	45	34.6	77	59.2	**0.013**
	Married	6	6.9	31	35.6	50	57.5	
	Divorced	9	11.7	34	44.2	34	44.2	
	Widowed	18	17.0	25	23.6	63	59.4	
Residence	Urban	29	10.9	86	32.2	152	56.9	0.612
	Rural	12	9.0	49	36.8	72	54.1	

Socio-demographic characteristics		Indoor pollution score						P-value
		Low (0-20%)		Moderate (21%-50%)		High (>50%)		
		No.	%	No.	%	No.	%	
Education level	Illiterate or read & write	15	22.4	30	44.8	22	32.8	**<0.001**
	Primary school	7	8.1	29	33.7	50	58.1	
	Intermediate school	8	12.3	26	40.0	31	47.7	
	High school	0	.0	16	37.2	27	62.8	
	University graduate	36	54.5	24	36.4	6	9.1	
	Post Graduate Studies	58	79.5	10	13.7	5	6.8	
Occupation status	Unskilled workers	19	13.6	40	28.6	81	57.9	0.383
	Lower professionals, skilled, and semiskilled workers	11	8.6	47	36.7	70	54.7	
	High professional and managerial jobs	11	8.3	48	36.4	73	55.3	
Income level	Low	22	17.3	48	37.8	57	44.9	**<0.001**
	Medium	79	65.3	38	31.4	4	3.3	
	High	88	57.9	49	32.2	15	9.9	
SES	Low (1-3 score)	26	17.1	58	38.2	68	44.7	**0.001**
	Medium (4-6 score)	132	62.0	66	31.0	15	7.0	
	High (7-9 score)	24	68.6	11	31.4	0	0.0	

***Chi-square test (χ^2-test) at p-value ≤ 0.05**

Table 5 shows the correlation between indoor and outdoor pollution exposure scores. The results revealed that there was a significant positive correlation between outdoor pollution score and indoor pollution score (r=0.410; P- value <0.001).

Table (5): Correlation Between Indoor and Outdoor Pollution Exposure Scores

Correlations		
		Indoor pollution score
Outdoor pollution score	r	**0.410****
	P. value	**<0.001**
	N	400

***Pearson correlation coefficient test**
****Correlation is significant at the 0.01 level (2-tailed)**

Discussion

The present study assessment correlation between indoor and outdoor air pollution exposure. The results show that a significant number of participants are older adults (58-65 years), which due to their frequent occurrence of chronic diseases and a need for regular follow-up in PHCCs. These results are consistent with a recent study conducted with a large sample in the Middle East, which discovered that the highest participation rates were with older age groups because of their frequent need to attend to chronic diseases [23]. Moreover, the average age of our study, 41.8±14.3 years, is consistent with the results of another study, which indicated a similar mean age of 42.1 in one of the studies on healthcare utilization patterns, which also supports the validity of our demographic sample [24]. In addition, our outcomes reveal that the number of females was quite equal to that of males (50.7%) and the compared to males (49.3%). This indicates that those who use primary health care services are approximately equal between males and females. This convergence of categories was also found in the study, which recorded an equal percentage of female participation in the primary care setting [25]. Regarding the marital status of participants, the findings represent the unmarried population (single, divorced, and widowed) (78.2%) as a high percentage. This may influence patterns of indoor and outdoor pollution exposure, as living arrangements, housing conditions, and reduced family support may affect ventilation practices, household fuel use, and the ability to maintain healthier indoor environments. As found in the Asia study, being unmarried was a weaker social support, poorer health status, and a higher risk of chronic diseases compared to married individuals [26]. While our result demonstrated that urban housing is the predominant type of dwelling in this study. This may be attributed to easier access, better health awareness, better transportation, and greater trust in medical institutions among urban residents. This finding is supported by recent evidence from Iraq and the Kurdistan region, which indicates that healthcare services are predominantly concentrated in urban areas [27]. Moreover, all educational level categories were represented in similar proportions among the participants, and their visits were to obtain health services, as the level of education affects the extent to which these services are obtained. This is consistent with previous studies, which confirm that education influences how individuals access health services [28], [29]. In our study, the participants' categories are distributed relatively similarly in terms of professional status. A 35.0% of participants were unskilled workers who were more dependent on the services as they are not financially stable. Whereas the inclusion of skilled and professional people is a good indicator that they use available and preventive healthcare, as found in the study, has noted that low- and semi-skilled workers were predominant in healthcare users [30]. Moreover, concerning income level, the results found that 38.0% of the participants were classified as high-income. This distribution indicates the diversity of the SES of the study population. Notably, these findings are comparable to those of a similar study conducted in the United States, which reported that approximately 32% of participants were classified as high-income individuals [31]. Finally, more than half of patients have medium SES (53.2%).

The large percentage of the middle SES group could be representative of the overall population distribution in Iraq and other developing economies, with the majority of people between low- and middle-income groups. It has been shown in Iraq that SES distributions are normally skewed towards the lower and middle levels, with the largest percentage of population falling in the middle SES category when the population is classified into three levels [32].
Our results indicate that the prevalence of exposure to both outdoor and indoor air pollution among participants is high. Outdoor sources like busy roads (69.8%), open burning (66.8%), and agricultural activities (65.5%) were widely reported. This is attributed to the proximity of their places of residence to sources of pollution, which increases their direct exposure to external pollution. These findings are consistent with the study, which identified traffic emissions, biomass burning, and agricultural activities as major contributors to ambient air pollution in developing countries [33]. Whereas, there was also a significant exposure to indoor pollution, especially due to electric generators (69.0%), inadequate ventilation (65.0%), and indoor smoking (62.3%). This may be due to dependence on other sources of energy and poor housing conditions. These results are in agreement with the study, which emphasized that indoor sources such as fuel combustion, poor ventilation, and smoking significantly contribute to deteriorating indoor air quality and increased respiratory health risks [34].

The distribution of indoor and outdoor pollution in the current study shows high exposure to both air pollution. Specifically, more than half of the participants fell within the high exposure category for indoor pollution (56.0%) and outdoor pollution (51.5%), while smaller proportions were categorized as having moderate or low exposure levels. Satellite-based studies have reported persistently high PM2.5 concentrations in major cities such as Baghdad, while dust storms and regional pollutant transport extend exposure [35]. In addition, local studies have shown that indoor air quality is significantly affected by household factors such as fuel use, cooking practices, and poor housing conditions, contributing to substantial indoor exposure [36].

Our outcomes indicate that exposure to indoor air pollution was not significantly related to age, sex, residence, or occupation ($P>0.05$), suggesting that exposure is prevalent and mostly influenced by the household conditions as opposed to demographics. A study carried out in Kufa, Iraq, has confirmed this finding by showing that the concentration of indoor pollutants was highly dependent on the nature of the housing, ventilation, and domestic activities such as cooking and cleaning, rather than on an individual basis [36]. At the same time, the present study demonstrated a statistically significant association between marital status and indoor air pollution exposure ($P = 0.013$). When high indoor pollution levels get close to 50% of all marital statuses, common, improper polluting practices like smoking and using fuel indoors are to blame. These results are supported by evidence, which confirms that marital status plays a significant role in exposure to indoor air pollution due to its impact on the housing conditions, living arrangements, and daily activities [37]. Our study also found a highly significant association between education level and indoor air pollution exposure (P < 0.001). Those with university degrees and postgraduate qualifications have lower levels of exposure compared to other groups, highlighting the importance of educational level in reducing exposure levels. A study conducted in Alexandria, Egypt, indicated that education level is significantly associated with indoor air quality, though not always linear, since it is adjusted by the housing conditions, income, and the behavioral factors, including ventilation practices and household activities [38]. In addition, the results provided a strong relationship with income level (P < 0.001), as well as SES (P = 0.001). Such a relationship can be attributed to the fact that income directly affects the quality of housing, access to clean sources of energy, and the capability to implement precautions such as better ventilation systems or air purification systems. A multi-country study conducted recently showed there is a strong inverse relationship between income and the effects of indoor air pollution, and the lower the income, the greater the exposure is because the household has to use low-cost polluting fuels and because their housing conditions are poor [39]. Similarly, a recent study reported that socioeconomic disparities significantly influence indoor air quality, with lower SES consistently associated with higher exposure levels due to structural inequalities in housing, energy use, and environmental resources [40].

The study appears to show a correlation between indoor and outdoor pollution exposure scores. It demonstrated that there is a modest, statistically significant correlation between indoor and outdoor air pollution ($r = 0.410$, $p < 0.001$), indicating that increasing the exposure to indoor air is positively associated with outdoor air exposure. This is attributable to outdoor contaminants getting into the indoor environment through natural ventilation and air exchange. This finding is strongly supported by a recent modeling and sensor-based study in Australia, which demonstrated that indoor air pollution levels are significantly and directly influenced by outdoor air quality [41].

Conclusion

We found that the prevalence of both outdoor and indoor air pollution is high among study participants. The study also confirmed that outdoor pollution serves, which is statistically significant. As a key determinant of indoor air conditions, particularly in settings with natural or poorly controlled ventilation.

Recommendation

It is recommended that the Ministry of Health raise public awareness about the dangers of indoor and outdoor air pollution, improve ventilation systems in primary healthcare centers and residential settings, and reduce household sources of pollution such as smoking and generators. It is also advisable that the Environmental Directorate implement environmental policies to reduce outdoor emissions, encourage the use of clean energy, and improve housing conditions, especially for low-income families. Furthermore, universities and research institutions are encouraged to conduct broader future studies related to air pollution exposure and its health effects.

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دراسة مقطعية للتعرض لتلوث الهواء الداخلي والخارجي في محافظة الديوانية، العراق

علي صاحب صالح*، علاء كاظم جاسم ، الاء شاكر حنتوش

قسم تقنيات صحة المجتمع، الكلية التقنية الصحية والطبية، الجامعة التقنية الجنوبية، البصرة، العراق
البريد الالكتروني: ali.saleh.c@fgs.stu.edu.iq *

الخلاصة

يُعد تلوث الهواء سببًا بارزًا للمضاعفات الصحية العالمية. ونظرًا للتسرب المستمر للملوثات الخارجية إلى البيئات الداخلية، أصبح من الضروري دراسة هذه العلاقة لتحديد وتقليل المخاطر المرتبطة بتعرض الإنسان لها. **أهداف الدراسة**: إيجاد العلاقة بين التعرض لتلوث الهواء الداخلي والخارجي في محافظة الديوانية، العراق. أُجريت دراسة وصفية مقطعية شملت 400 مشارك تتراوح أعمارهم بين (18–65) سنة في ستة مرافق للرعاية الصحية في محافظة الديوانية. نُفذت الدراسة خلال الفترة من 15 أيلول 2025 ولغاية نهاية كانون الثاني 2026. واعتمدت الدراسة أسلوب أخذ العينات الملائمة غير العشوائية باستخدام استبانة مُنظمة. **النتائج**: أظهرت النتائج أن معظم المشاركين كانوا من الإناث (50.7%)، والأرامل (26.5%)، ويعيشون في المناطق الحضرية (66.8%)، ويحملون شهادة الدراسة الابتدائية (21.5%). بلغت درجة التلوث الداخلي 56.0%، وتمثلت بالتدخين داخل المنزل، واستخدام مواقد الغاز/الكيروسين، والمولدات الكهربائية، في حين بلغت درجة التلوث الخارجي 51.5%، وتمثلت بالطرق الرئيسية المزدحمة، والحرق المكشوف، والأراضي الزراعية. وقد ارتبطت هذه الدرجات ببعض الخصائص الاجتماعية والديموغرافية، بما في ذلك الحالة الاجتماعية، والمستوى التعليمي، ومستوى الدخل، والحالة الاجتماعية والاقتصادية(SES) ، بدلالة إحصائية ($P\text{-value} < 0.05$). توصلت الدراسة إلى وجود تأثير متبادل بين التعرض للتلوث الداخلي والخارجي، مع حدوث تسرب مستمر للملوثات الخارجية إلى البيئات الداخلية.

الكلمات المفتاحية: جودة الهواء، مستويات التعرض، تلوث الهواء الداخلي، تلوث الهواء الخارجي، الحالة الاجتماعية والاقتصادية.