

# Assessment of Lung Function in Scavenger Workers at Some Waste Dumpsites in Baghdad City

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**Abstract:** Waste scavengers face occupational hazards from exposure to toxic landfill emissions, putting them at risk for respiratory illnesses. This study aimed to assess the impacts of landfill gases on lung function in scavengers. Spirometry was used to evaluate lung function in scavengers at 5 dumpsites in Baghdad compared to non-exposed controls. The results showed that winter measurements in the internal measuring point for carbon dioxide indicated that the highest concentration was 454.89 ppm in the Adhamiya landfill and the lowest concentration was 397.65 ppm in the Baghdad Aljadeeda landfill. Lung disease cases were recorded and correlated to landfill sites, work duration, and seasons. The results of the lung efficiency examination showed a clear decrease in spirometry parameters at high-pollution landfill sites with varying concentrations of particulates and gases compared to the control group—more airway restriction cases correlated with increased years of scavenger exposure and higher pollutant levels. As noted, severe respiratory symptoms increased in the summer season likely due to the influence of climatic factors.

**Key words:** Landfill emissions, lung function, spirometry, scavengers, respiratory disease.

## Introduction

Urban waste and its management are a pressing environmental issue, especially in large and developed cities, because of its negative effects on public health and air quality, and the lungs are among the organs most affected by air pollution (Chlebnikovas and Jasevičius, 2022; Manisalidis et al., 2020). The accumulation and irregular burning of waste in landfill sites lead to the emission of toxic gases such as (CO) and (CO<sub>2</sub>) (Munsifet al., 2021; Rajesh et al., 2020), in addition to (NO) and (H<sub>2</sub>H) (Li et al., 2023). Scavengers play an important role in landfill sites by collecting, transporting, and sorting waste. There is a relationship between the severity of respiratory diseases, the

duration of chronic exposure to pollutants, and the degree of air pollution in the work environment (Anad et al., 2022; Ajeel et al., 2021). Therefore, gases pose a direct threat to occupational health, especially to waste workers (Mohan and Joseph, 2020; Siddiqua et al., 2022). Statistics indicate that the city of Baghdad generates about 1.4 million tons annually of municipal and mixed waste (Al-Mohammed et al., 2021). Many studies have been conducted on the impact of air pollution (Abdel-Razzaq et al., 2022). For the results of recent research on pulmonary function, the declines in spirometric parameters like FVC, FEV<sub>1</sub>, PEF, and FEF<sub>25-75%</sub> among waste scavengers in this study are supported by existing evidence. Rajesh et al. (2020) reported reductions in FEV<sub>1</sub>, FEV<sub>1</sub>/FVC ratio, and PEF

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in landfill workers exposed to high methane levels. This study aimed to assess the impacts of landfill gases on lung function in scavengers.

## Materials and Methods

In this research, field work was carried out to randomly evaluate the pulmonary efficiency of (122) samples of waste collection workers who work in five landfills (the subject of the study), namely (Al-Kadhimiya Landfill, Al-Adhamiya Landfill, Al-Shuala Landfill, Abu Dashir Landfill, and Baghdad Aljadeeda Landfill) spread across in the Karkh and Rusafa districts of the city of Baghdad and compared with the control group (people who were not exposed), whose number was (50) samples. A pulmonary efficiency test was conducted for the period (January, February for the winter season/June, July for the summer season 2021), where efficiency was measured. Breathing based on the FEV1/FVE ratio to diagnose the level of respiratory obstruction in the studied samples using the Italian MIR spirometry. The field work also included measuring the level of carbon dioxide concentration using a Gas Mat measuring device, which consists of taking a point inside the landfill and another outside the landfill, about 200 meters away from the landfill.

## Statistical Analysis

Statistical data analysis was performed using SAS software version 9.4. Means and standard deviations

were used to describe quantitative variables along with LSD post hoc tests for pairwise comparisons. The chi-square test was used to examine relationships between categorical variables. A significance level of 0.05 was adopted in the study, where a P value of less than 0.05 indicates statistically significant differences between groups. The assumptions of the ANOVA analysis regarding normality of data distribution and homogeneity of variances were examined. The statistical model used in the study was also validated.

## Results and Discussion

### Concentrations of CO<sub>2</sub> in Landfills

The results of winter measurements of the internal measuring point for carbon dioxide indicated that the highest concentration was 454.89 ppm in the Adhamiya landfill and the lowest concentration was 397.65 ppm in the Baghdad Aljadeeda landfill. Summer measurements of internal point recorded the highest concentration of 474.14 ppm for the Baghdad Aljadeeda landfill, while the lowest concentration was 444.995 ppm in the Kadhimiya landfills when comparing the concentrations of carbon dioxide (CO<sub>2</sub>) during the measurement period. Its emissions in all the landfills for both seasons were higher than the global limit limits of (250) ppm of gas (CO<sub>2</sub>), shown in Table 1.

### Landfill locations Effect

The relationship between occupational exposure of

**Table 1: The concentration of air pollutant gases (CO<sub>2</sub> mean/ppm) in landfills of the study area**

No.	Landfills name	Sampling sites	CO <sub>2</sub> mean in the winter season	CO <sub>2</sub> mean in the summer season	P-value
1	Kadhimia	External point	436.675	443.355	0.786 NS
		Internal point	425.84	444.995	0.785 NS
2	Alshuela	External point	442.09	433.525	0.897 NS
		Internal point	447.255	446.26	0.998 NS
3	Adhamiya	External point	446.325	453.67	0.897 NS
		Internal point	454.89	446.1	0.965 NS
4	Abu Dashir	External point	427.435	457.475	0.953 NS
		Internal point	418.505	469.8	0.865 NS
5	Baghdad Aljadeeda	External point	400.54	468.435	0.823 NS
		Internal point	397.65	474.14	0.0 832 NS
6	Control	External point	330.705	426.8	0.0412 *
		Internal point	271.78	421.065	0.0231 *
	P-value	---	0.02*	0.04*	

\*( $P \leq 0.05$ ). NS: Non-Significant

landfill workers and the prevalence of lung diseases such as obstructive and respiratory restriction with landfill in study area location was studied, in Tables 2-4. Table 2 shows that there is a statistically significant relationship between working in the Shualaa (P 0.001<0.01) and Baghdad Aljadeeda landfills (P 0.001<0.01) and having higher rates of respiratory restriction compared to other landfills. Table 3 does not show significant differences in the severity levels of respiratory obstruction among the different landfills. Notice, according to the results of Table 4, that there is a statistically significant relationship between work in the Shualaa landfill (P 0.0446<0.05) and moderate respiratory restrictions, while work in the Baghdad Aljadeeda landfill was associated with severe restrictions (P 0.0092<0.01).

**Table 2: The total no. of lung diseases in the studied groups according to the locations of the landfill**

<i>Landfill sites</i>	<i>Obstruction</i>	<i>Restriction</i>	<i>P-value</i>
Kadhimia landfill	1	1	1.00 NS
Shualaa landfill	0	9	0.0001 **
Adhamiya landfill	0	5	0.0392 *
Abu Dashir landfill	2	6	0.0488 *
Baghdad Aljadeeda landfill	0	9	0.0001 **
Total	3	30	0.0001 **
P-value	0.772 NS	0.0001 **	---

\* ( $P \leq 0.05$ ), \*\* ( $P \leq 0.01$ ), NA non-significant

**Table 3: The total no. of lung diseases (obstruction/symptom level) in the studied groups according to the Landfill sites**

<i>Landfill sites</i>	<i>Obstruction</i>			<i>P-value</i>
	<i>Mild</i>	<i>Moderate</i>	<i>Severe</i>	
Kadhimia landfill	1	0	0	0.903 NS
Shualaa landfill	1	0	0	0.903 NS
Adhamiya landfill	0	0	0	1.00 NS
Abu Dashir landfill	1	0	1	0.851 NS
Baghdad Aljadeeda landfill	0	0	0	1.00 NS
P-value	0.702 NS	1.00 NS	0.894 NS	---

NS: Non-significant.

**Table 4: The total no. of lung diseases (restriction/symptom level) in the studied groups according to the landfill sites**

<i>Landfill sites</i>	<i>Restriction</i>			<i>P-value</i>
	<i>Mild</i>	<i>Moderate</i>	<i>Severe</i>	
Kadhimia landfill	1	0	0	0.903 NS
Shualaa landfill	5	0	2	0.0466 *
Adhamiya landfill	1	1	3	0.473 NS
Abu Dashir landfill	2	1	3	0.571 NS
Baghdad Aljadeeda landfill	0	2	7	0.0092 **
P-value	0.0478*	0.445 NS	0.0251*	---

\*( $P \leq 0.05$ ), \*\* ( $P \leq 0.01$ ), NS: Non-Significant

### Effect of Landfill Sites and Season on Lung Function in Scavenger Workers

The effects of different landfill sites and seasons (summer/winter) have been studied on lung function in scavenger workers. Pulmonary function tests were conducted using a spirometry instrument and results were compared between 6 landfill sites and a control group during summer and winter seasons. In Table 5, the FEV1/FVC ratio was measured across sites and seasons. No significant seasonal differences emerged in any landfill location or the control for this parameter of airway obstruction.

Table 6 shows the years worked. The Baghdad Aljadeeda site had workers with significantly fewer years of experience in winter compared to summer ( $P \leq 0.05$ ). No other seasonal differences occurred across the sites. The control group demonstrated reduced pulmonary function in winter, but landfill workers maintained stable lung function between seasons,

**Table 5: Effect of landfill sites and season in FEV1/FVC pulmonary efficiency/spirometry test (PT) of scavenger (pick up)**

<i>Landfill sites</i>	<i>Mean <math>\pm</math> SE of FEV1/FVC</i>		<i>P-Value</i>
	<i>Summer</i>	<i>Winter</i>	
Kadhimia landfill	80.83 $\pm$ 0.14	80.60 $\pm$ 0.46	0.93 NS
Shualaa landfill	83.32 $\pm$ 1.06	83.37 $\pm$ 1.54	0.97 NS
Adhamiya landfill	84.38 $\pm$ 1.82	83.60 $\pm$ 3.40	0.063 NS
Abu Dashir landfill	83.84 $\pm$ 1.42	84.95 $\pm$ 2.76	0.08NS
Baghdad Aljadeeda Landfill	89.34 $\pm$ 0.67	87.65 $\pm$ 0.52	0.98 NS
Control	81.90 $\pm$ 0.40	82.10 $\pm$ 0.60	0.085 NS
LSD value	4.694 *	6.603 *	---

\*( $P \leq 0.05$ ).

despite some differences in age and experience. Further study on factors providing protection is warranted.

**Table 6: Effect of Landfill sites and season in the year of work/pulmonary efficiency/spirometry test (PT) of scavenger (pick up)**

<i>Landfill sites</i>	<i>Mean±SE of work year</i>		<i>P-Value</i>
	<i>Summer</i>	<i>Winter</i>	
Kadhimia landfill	14.00 ±4.72	10.00 ±3.39	0.315NS
Shualaa landfill	9.40 ±2.34	5.50 ±1.84	0.441 NS
Adhamiya landfill	6.40 ±2.63	12.25 ±3.04	0.675 NS
Abu Dashir landfill	7.25 ±2.60	10.25 ±3.96	0.375 NS
Baghdad Aljadeeda landfill	15.60 ±3.67	6.75 ±1.37	0.0327 *
LSD value	9.39 NS	8.712 NS	---

\* ( $P \leq 0.05$ ).

#### **Effect of Landfill sites on Disease Type for Studying Group Landfill**

Table 7 shows the results of a study examining the effect of various allergens on waste scavengers in the study area. The identified irritants included: dust, plants, molds, odours, burning smoke, cool moist air, and hot humid air.

Note that there was a statistically significant difference in the total number of irritants across the different landfill sites. Kadhimiya and Adhamiya landfills had the lowest number of irritants, while the Baghdad Aljadeeda landfill had the highest. Dust and burning smoke were the most prevalent irritant types across all sites. There were no significant differences in some types of plants, mold, and cool moist air irritants between landfill locations.

The results indicate an association between landfill sites and the type/quantity of irritants present. This is likely due to differences in waste management

practices, burning activities, and dust spread at each location. It is advisable to implement measures to reduce dust and burning smoke emissions from waste dumps to mitigate health risks for nearby populations. The prevalence of respiratory allergies near landfills can serve as an indicator of insufficient waste handling and air pollution. Targeted efforts to improve waste segregation, processing, and containment could lessen contaminant exposures.

Statistics were also conducted for the effects associated with these irritating substances, shown in Table 8. These effects were varied, such as coughing, sneezing, sputum, difficulty breathing, sensitive nose, irritation of the nose, and suffocation.

The results of this study showed a strong relationship between chronic exposure to landfill gases and reduced lung function among waste pickers. This study appeared to the increase in CO<sub>2</sub> concentration in landfills therefore, it found the problems in the lung function of scavenger workers in Baghdad Aljadeeda. Where the occurrence of COPD-associated hospitalizations and death increase continuously from FEV1/FVC=0.80 (Torén et al., 2021). Landfill and Adhamiya landfill and this is consistent with the study (Manisalidis et al., 2020) that showed that lung function is affected by occupational hazards associated with harmful waste. Gases or molecules. This relationship was evident across different variables including age groups, work duration, seasons, and landfill locations. The results of previous studies also indicate that there is a strong relationship between chronic exposure to gases and air pollutants issued from landfills and low rates and indicators of lung function, in addition to increasing rates of various respiratory diseases, especially cases of bronchial constriction. An increase in respiratory diseases associated with low FVC values was also found and FEV1 in landfill workers (Chlebnikovas

**Table 7: The total No. of allergens for the study groups according to the landfill sites**

<i>Landfill sites</i>	<i>Dust</i>	<i>Plants</i>	<i>Molds</i>	<i>Odours</i>	<i>Burning smoke</i>	<i>Cool Moist air</i>	<i>Hot humid-air</i>	<i>P-value</i>
Kadhimia landfill	6	0	0	6	7	2	1	0.0084 **
Shualaa landfill	11	1	2	9	11	0	1	0.0001 **
Adhamiya landfill	6	0	0	6	7	1	1	0.0078 **
Abu Dashir landfill	7	0	2	5	5	2	1	0.0065 **
Baghdad Aljadeeda landfill	9	3	2	8	9	1	0	0.0001 **
P-value	0.127 NS	0.375 NS	0.671 NS	0.659 NS	0.033 *	0.431 NS	0.839 NS	---

\*( $P \leq 0.05$ ), \*\* ( $P \leq 0.01$ ).

**Table 8: The total No. of respiratory diseases for the study groups according to the landfill sites**

<i>Landfill sites</i>	<i>Cough</i>	<i>Sneezing</i>	<i>Sputum</i>	<i>Hard breathing</i>	<i>Sensitive</i>	<i>Sinus</i>	<i>Nose irritation</i>	<i>Suffocation</i>	<i>P-value</i>
Kadhimia landfill	3	3	3	2	1	1	13	2	0.0001 **
Shualaa landfill	7	7	7	0	7	7	7	7	0.0063 **
Adhamiya landfill	6	5	5	0	5	5	8	6	0.0001 **
Abu Dashir landfill	8	7	8	5	6	10	8	5	0.035 *
Baghdad Aljadeeda landfill	9	8	9	3	5	9	10	7	0.0074 **
P-value	0.023 *	0.049 *	0.046 *	0.045*	0.0095 **	0.0001**	0.034 *	0.025 *	---

\* ( $P \leq 0.05$ ). \*\* ( $P \leq 0.01$ ).

and Jasevičius 2022; Mostafa et al., 2021). The relationship between longer duration of work in landfills and greater lung function impairment is consistent with (Li et al., 2023) who showed that duration of exposure greater than 15 years was associated with clinically significant reductions in FEV1. The results also showed a correlation between the severity of respiratory diseases, the duration of chronic exposure to pollutants, and the degree of air pollution in the work environment. The variability between landfill sites reflects (Batterman et al., 2023) evidence tying site-specific waste composition, gas control, and monitoring practices to risk levels for workers. They emphasized proper landfill operation and air quality monitoring to mitigate exposure threats. The use of spirometry for objective lung function measurement is supported by Duncan (2021), who advocated regular spirometric screening of landfill workers to enable early diagnosis of occupational respiratory diseases. While most studies have focused on landfill gas exposure, Maung et al. (2022) highlighted the respiratory risks of inhaling particulates around landfills.

Seasonal differences were also evident, with increased exposure to allergens and respiratory illnesses most common in the summer months. The relationship between climate and increased risk of lung diseases has been proven in many studies, such as the study presented by Ayres et al. (2009). The seasonal differences in this study by Mustafa et al. (2021) also reflect worse lung function outcomes in summer, which is attributable to higher landfill gas emissions at higher temperatures.

One of the most prominent findings of this study is the significant impact of landfill location and season on respiratory diseases among waste collectors. The results clearly showed a relationship between working in landfill sites with higher pollution levels, such as Shualaa and Baghdad Aljadeeda, and an increased prevalence and severity of respiratory diseases including

obstructive and restrictive lung dysfunction. In addition, an increase in allergen exposure and respiratory symptoms occurred in the summer season at all sites.

Continuous monitoring and protection measures are recommended, especially for residents living near poorly managed landfills that contain a high percentage of hazardous waste. Continuous monitoring of air quality near landfills is also recommended to determine sources of pollution and trends over time. Further research could examine specific relationships between exposure to irritants and allergy outcomes in communities near landfills (Upperman et al., 2017).

This study is among the few examining the health risks of solid waste workers in Iraq. Prior research shows dumpsites can contaminate soil, water, and air, harming the environment and public health (Al-Gubori and Saleh, 2019; Gardi, 2017). Consequently, this study delineated the impacts of chronic landfill CO<sub>2</sub> gas exposure on respiratory health and highlighted the need for preventive measures to protect this vulnerable occupational population. Key findings are expected to raise awareness of respiratory risks waste workers face and emphasize the importance of improving waste management and worker safety practices in Iraq.

## Conclusion

This spirometry-based study demonstrated significant declines in lung function among waste scavengers related to landfill site pollution levels, years of exposure, and summer season climate factors. The results highlight the need for improved waste management and targeted protective measures to mitigate occupational respiratory health risks. Regular medical screening of this vulnerable population is advised to enable early diagnosis and intervention for landfill gas-induced lung diseases.



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