REVIEW ARTICLE

Respiratory Health and Its Associated Factors Among Petrol Station Workers : A Review

Md Faizul Abd Razak [1], Nurul Ainun Hamzah[2], Ahmad Filza Ismail[1]

[1] Department of Community Medicine, School of Medical Sciences, Health Campus, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan
[2] Environmental and Occupational Health Programme, School of Health Sciences, Health Campus, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan

ABSTRACT

Petrol station workers remain a significant workforce for petrol stations due to high fuel demand, especially in developing countries where self-service policy is not implemented. In their daily working process, they are exposed to many air pollutants from air traffic and fuel itself. This review was done to explore the previous studies conducted to look into the prevalence of lung function impairment, most common respiratory symptoms, lung function parameters, and factors associated with lung function impairment among petrol station workers. After searching in the databases using specific keywords, fifty-seven articles were thoroughly assessed, and thirty-eight articles were eligible and included in the review. From the review, the prevalence of lung function impairment among petrol station workers is ranging between 26.83% and 85.00%, where the obstructive pattern is the most common finding. Cough is the most common reported respiratory symptom in these articles. All studies show a reduction of lung function parameters among petrol station workers in which FVC, FEV_1, and PEFR showed consistent significant reductions as compared to the control group. Duration of employment, smoking, age, job description, and BMI are factors that have been associated with the development of lung function impairment among petrol station workers. There is an urgent need for a more confirmatory study to be done so that proper safety and health programmes specified to petrol station workers can be formulated.

Keywords: Petrol station, Gas station, Respiratory illness, Lung function, Spirometry

Corresponding Author:
Ahmad Filza Ismail. MCommMed
Email: afilza@usm.my
Tel: +609 - 767 6643

INTRODUCTION

Accelerated urbanisation and population growth have resulted in a rapid rise in traffic volumes despite numerous initiatives and efforts to reduce them, such as enhancing public transport facilities and carpooling campaigns (1). An increase in traffic volume will cause more vehicle emission that contributes to air pollution. It also will trigger more new petrol stations to be built as vehicle fuel demand rises rapidly. As predominantly outdoor workers, petrol station workers are exposed to many air pollutants in their working environment. The sources of air pollutants are not only from traffic-related air pollutants but also from the emission of volatile organic compounds (VOCs) from the fuel itself. The air pollutant includes particulate matter (PM), carbon monoxide (CO), oxides of nitrogen (NOx), and VOCs, which include benzene, xylene, and toluene (2). Also, other studies showed some of the pollutants present in the petrol station environment with the concentration above the permissible limits. For example, a study by Adebiyi et al. (2015) using continuous area sampling for 11 hours in 4 petrol stations in Nigeria revealed that the mean (SD) concentration of PM_{10} and $PM_{2.5}$ was 100.5 (21) μg/m^3 and 30.75 (12.26) μg/m^3 respectively, which exceed the World Health Organization's 24-hours standard (3). This warrants the need to look at the petrol station workers' health, particularly in developing countries where safety and health legislations and services are not enforced and limited (4).

Previous studies have shown that being exposed to

hazardous air pollutants can lead to detrimental effects on health. For example, due to its size, the particulate matter can penetrate and deposit on the respiratory tract, which will subsequently cause respiratory illness through various mechanisms (5). Apart from that, various toxic chemicals that are easily evaporated from the fuels that are known as VOCs, known to have both short- and long-term health effect which includes irritation to respiratory systems, gastrointestinal discomfort, central nervous system dysfunction and narcosis, developmental effects and carcinogenic (6–11). Due to inhalation is the predominant route of exposure, the respiratory systems are heavily affected by these toxic chemicals causing the reduction in lung function parameters and development of respiratory symptoms among petrol station works (12).

A closer look at the literature reveals several gaps and shortcomings. There is an increasing need and scope for research on the effects of air pollutants on the respiratory health of petrol station workers. This review was done with the aim to explore the previous studies to look into the prevalence of lung function impairment, most common respiratory symptoms, lung function parameters, and factors associated with lung function impairment among petrol station workers.

MATERIALS AND METHODS

Online search from various databases like Science Direct, PubMed, Elsevier, British Medical Journal (BMJ), and Google Scholar was done using a specific set of keywords. The keywords used for the search include a "gas station", "petrol station", "service station", "fuel station", "pump station", "filling station", "lung function", "pulmonary function", "respiratory symptoms", "spirometry", and "respiratory illness". The inclusion criteria were an original article published between 2000 until 2021 that assessed lung function and respiratory illness among petrol station workers. Articles based on case reports, case series, review articles, or written in other than English languages were excluded from the review. The search found a total of 1204 articles and screened using the title and abstract. Fifty-seven articles were fully assessed, of which thirty-eight of them were eligible and included in the review.

RESULTS

Study locations

The studies were conducted in eight countries, of which twenty-one were from India, six from Indonesia, four from Nigeria, two from Pakistan, and one each from Malta, Senegal, Iraq, Nepal, and Zambia. All these countries were identified as developing countries by the United Nations except Malta, a developed country (13).

Respiratory symptoms

Eight studies reported the respiratory symptoms experienced by the petrol station workers, including cough (with or without sputum), dyspnoea, wheezing, chest trouble, asthma, chest tightness, sneezing, runny nose, and shortness of breath. Six studies showed cough was the most common respiratory symptom among their respondents, and the prevalence can be as high as 75% (14–19). Other than that, two studies reported other symptoms to be more common than cough among their respondent, which shortness of breath (20) and sneezing (21).

Prevalence of lung function impairment and its pattern

The range of abnormal lung function tests among the petrol station workers reported in the studies can be as low as 26.83% (22) and as high as 85.00% (19). Only eight studies reported the pattern of abnormal lung function tests, in which 5 of them showed the obstructive pattern to be the most common (16,19,22–24) while the other three studies showed the restrictive pattern to be the most common (14,25,26).

Lung function parameters

Various lung function parameters were used to demonstrate the reduction of lung function among petrol station workers as compared to the control group. Table I summarises the mean value of the most common parameters used, which are forced vital capacity (FVC), forced expiratory volume in 1 second (FEV_1), FEV_1/FVC, and peak expiratory flow rate (PEFR). Descriptively, all parameters' mean values were reduced among petrol station workers as compared to the control group in all studies. A total of twenty-two studies compares the mean value of FVC between petrol station workers and the control group, in which eighteen of them were statistically significant ($p<0.05$). For FEV_1, seventeen out of twenty-two studies showed a significant reduction of FEV_1 among petrol station workers than the control group. Eighteen articles included FEV_1/FVC in their comparison, and eight of them showed a significant result. PEFR was often widely used to assess lung function, and fifteen of the seventeen articles that measured PEFR found that petrol station workers had a significantly lower PEFR than the control group.

Apart from FVC, FEV_1, FEV_1/FVC, and PEFR, few other parameters were used in assessing the lung function of petrol station workers. Three studies found that petrol station workers had significantly lower maximal voluntary ventilation (MVV) than the control group ($p<0.05$). (16,36,39). The same pattern was also seen in two other studies; however, the reduction was not statistically significant ($p>0.05$) (23,28). As for forced expiratory flow at 25–75% (FEF 25% - 75%), nine studies reveal significant reduction in petrol station workers (9,16,26,30,32,37,39,40,42) and only one study reveal otherwise (22).

Table I: Summary of the mean (SD) of lung function parameters among petrol station (exposed) workers as compared to the control group (unexposed)

Author (Reference)	Location	Sample Size		FVC (Litre)		FEV_1 (Litre)		FEV_1/FVC		PEFR (Litre/second)	
		Expose	Unexposed	Expose	Unexposed	Expose	Unexposed	Expose	Unexposed	Expose	Unexposed
Okemuo et al. (15)	Enugu, Nigeria	64	64	1.43 (0.52) *	2.75 (0.67)	1.37 (0.48) *	2.41 (0.65)	0.96 (0.07) *	0.88.97 (0.13)	3.45 (1.20) *	6.26 (1.30)
Mandal and Mukherjee (16)	West Bengal, India	52	20	2.70 (0.78) *	4.2 (0.87)	2.74 (0.88) *	3.4 (0.66)	-	-	6.02 (1.62) *	6.80 (0.94)
Zafar (17)	Karachi, Pakistan	150	150	2.03 (0.84) *	3.06 (0.79)	2.43 (0.89) *	2.81 (0.81)	0.83 (0.18) *	0.90 (0.10)	-	-
Dissi GM (21)	Kano, Nigeria	56	59	3.77 (1.34) *	5.66 (1.11)	2.93 (1.20) *	5.10 (1.14)	0.78 (0.16) *	0.91 (0.14)	-	-
Deora et al. (22)	Bhopal, India	41	45	3.68 (0.86)	3.61 (0.60)	3.14 (0.77)	2.99 (0.55)	0.84 (0.09)	0.86 (0.06)	6.71 (1.94)	6.72 (1.95)
Al-jadaan and Jabbaralkinany (23)	Basra, Iraq	53	60	2.48 (0.53) *	3.93 (0.49)	1.78 (0.61) *	2.81 (0.38)			6.32 (0.9) *	9.19 (1.5)
Jaiswal (24)	Puducherry, India	84	84	4.16 (0.58)	4.30 (0.60)	3.47 (0.64)	3.61 (0.63)	0.83 (0.10)	0.84 (0.10)	6.24 (1.12) *	6.56 (0.99)
Rahul et al. (26)	Jaipur city, India	40	40	3.43 (0.35) *	3.76 (0.19)	2.84 (0.39) *	3.17 (0.18)	0.83 (0.06)	0.85. (0.03)	7.16 (1.33) *	8.16 (1.11)
Srivastava and Barkule (27)	Aurangabad, India	32	64	-	-	-	-	-	-	5.49 (1.79) *	6.80 (1.39)
Begum and Rathna (28)	Mysore, Pakistan	28	28	2.86 (0.37) *	3.33 (0.50)	2.58 (0.46) *	3.01 (0.33)	-	-	7.47 (1.40)	8.05 (1.59
Adeniyi (29)	Ile-Ife, Nigeria	99	95	3.27 (0.7)	3.24 (0.7)	2.9 (0.7)	2.8 (0.6)	0.9 (0.1)	0.9 (0.07)	-	-
Chakraborty et al. (30)	Agartala, India	32	32	3.07 (0.56) *	3.42 (0.52)	2.54 (0.49) *	3.14 (0.54)	0.83 (0.06) *	0.92 (0.08)	7.42 (1.38) *	8.27 (1.40)
Vella and Borg (31)	Malta	30	30	-	-	-	-	0.76 (0.05) *	0.81 (0.04)	-	-
Solanki et al. (32)	Ahmedabad, India	227	227	3.02 (0.56) *	3.61 (0.46)	2.73 (0.50) *	3.12 (0.36)	0.90 (0.10) *	0.85 (0.06)	7.28 (1.72) *	8.22 (1.1)
Patil et al. (33)	Western Maharashtra, India	60	50	-	-	-	-	-	-	6.49 (1.60) *	8.91 (1.02)
Pandit (34)	Kathmandu, Nepal	40	40	3.44 (0.23) *	3.94 (0.25)	2.64 (0.20) *	3.24 (0.29)	0.77 (0.01) *	0.82 (0.01)	6.35 (0.27) *	7.62 (0.45)
Anuja et al. (35)	Chennai, India	50	51	2.77 (0.84) *	3.03 (0.49)	2.39 (0.71)	2.80 (0.49)	-	-	5.00 (2.19) *	6.41 (1.48)
Dube et al. (36)	Nanded, India	80	80	2.59 (0.42) *	3.42 (0.68)	2.47 (0.61) *	3.29 (0.57)	-	-	5.61 (1.53) *	6.39 (1.69)
Salvi et al. (37)	Pune, Maharashtra, India	30	30	2.06 (0.66) *	4.01 (0.82)	3.78 (0.32) *	7.38 (27.5)	-	-	-	-
Shonga and Siziya (38)	Ndola, Zambia	69	121	3.65 (0.92) *	4.02 (0.88)	3.26 (0.75) *	3.53 (0.76)	0.83 (0.01)	0.83 (0.02)	-	-
Batta and Dhir (39)	Punjab, India	100	100	2.88 (0.27) *	3.77 (0.33)	2.67 (0.23) *	3.19 (0.30)	0.90 (0.01)	0.90 (0.01)	5.98 (0.58) *	7.89 (0.74)

CONTINUE

Table I: Summary of the mean (SD) of lung function parameters among petrol station (exposed) workers as compared to the control group (unexposed) (CONT.)

Author (Reference)	Location	Sample Size		FVC (Litre)		FEV_1 (Litre)		FEV_1/FVC		PEFR (Litre/second)	
		Expose	Unexposed	Expose	Unexposed	Expose	Unexposed	Expose	Unexposed	Expose	Unexposed
Madhuri et al. (40)	Kanchipuram, India	30	30	2.24 (0.44) *	1.97 (0.35)	2.15 (0.39) *	1.68 (0.29)	3.85 (0.76)	3.68 (1.02)	5.05 (0.70) *	4.30 (0.85)
Sharma and Agarwal (41)	Jhalawar and Jhalarapatan, India	30	30	2.52 (0.68) *	3.12 (0.30)	2.17 (0.71) *	2.85 (0.23)	0.86. (0.12) *	0.91 (0.08)	-	-
Sumathi and Neelambikai (42)	Coimbatore, India	50	50	2.40 (0.60) *	3.186 (0.76)	2.28 (0.54) *	2.92 (0.64)	-	-	5.1 (1.86) *	6.88 (1.97)
Prasetyo et al. (43)	Semarang, Indonesia	34	34	3.07 (0.86)	3.36 (0.97)	2.83 (0.57)	2.93 (0.72)	0.90 (0.07)	0.88 (0.07)	-	-

* p-value < 0.05 when compared to unexposed group
FVC = Forced Vital Capacity
FEV_1 = Forced Expiratory Volume in 1 Second
PEFR = Peak Expiratory Flow Rate

Factor associated with the lung function impairment

Duration of employment was the most common factor evaluated for lung function impairment. Significant reduction in lung function parameters was reported as early as one year of employment (36,44,45) or as late as sixteen years of employment (46). However, most of the studies showed a significant reduction of FVC, FEV_1, or PEFR among workers within two to ten years of employment (31,32,35,42). Table II summarises the findings in the articles that correlate the lung parameters with years of employment. The results showed a negative correlation where the higher the employment duration, the lower the lung function parameters.

Apart from that, five articles included smokers in their study population to explore the effect of smoking on lung function impairment among petrol station workers. Four studies showed a significant reduction in FVC, FEV_1, FEV_1/FVC, or PEFR among workers who smoke as compared to those who are a non-smoker (21,31,46,47).

In terms of age, the study by Mandal and Mukherjee (2020) revealed that FVC, FEV_1, FEV_1/FVC, MVV, PEFR, FEF 25% - 75% was significantly lower in workers age 34 and above as compared to less than 34 years old. The same study also found a significant correlation between FEV_1 (r = -3.52) and PEFR (r = -2.27) with age (p<0.005) (15). The same pattern of correlation was found between age and PEFR in another study by Ifeyinwa et al. (2016) (r = -0.226, p<0.005) (18). However, three studies cannot replicate any significant association between age and lung function parameters (25,48,49).

The job description also may play an important role as it affects the level of exposure to air pollutants. A study among petrol station workers in Indonesia showed that 96.9% of outdoor petrol station workers having abnormal lung function test as compared to indoor petrol station workers (20%) (p <0.001) (50). In another study, petrol pump attendants who were directly exposed to air pollutants had significantly reduced FVC, FEV_1, PEFR, and MVV as compared to the control group. In contrast, indoor petrol station workers exposed to air pollutants indirectly only had a reduced PEFR than the control group (51).

Workers who have a lower body mass index (BMI) are more likely to develop lung function impairment. It is

Table II: Summary of correlation analysis between duration of employment and lung function parameters among petrol station workers

Author (References)	FVC		FEV1		FEV1/FVC		PEFR	
	r*	p-value	r*	p-value	r*	p-value	r*	p-value
Ramadhany et al. (14)	-	-	-	-	-	-	#	0.011
Okemuo et al. (15)	- 0.718	< 0.001	- 0.657	< 0.001	- 0.344	< 0.001	- 0.727	< 0.001
Ifeyinwa et al. (18)	-	-	-	-	-	-	- 0.261	<0.05
Mbengue et al. (19)	-	-	- 0.36	0.0193	-	-	-	-
Srivastava and Barkule (27)	-	-	-	-	-	-	- 0.233	#
Patil et al. (33)	-	-	-	-	-	-	- 0.651	0.001

* Pearson's correlation
# Not reported
r = Correlation coefficient
FVC = Forced Vital Capacity
FEV1 = Forced Expiratory Volume in 1 Second
PEFR = Peak Expiratory Flow Rate

evident in the study by Shonga and Siziya (2015) where workers with BMI less than 18.5 kg/m2 were more likely to develop abnormal lung function as compared to BMI of 25 kg/m^2 or more (OR = 2.87; 95% CI: 1.18, 6.99) (38). However, it is contradicted in another study where FVC and FEV_1 were negatively correlated with BMI (r = -2.10 and r = -2.43, respectively, p<0.05) (16).

DISCUSSION

In this review, most of the studies were conducted in developing countries. This may be due to, in these countries, the self-service policy was not regulated or fully enforced. As a result, petrol station workers are continuously exposed to air pollutants, especially petrol pump attendants who involved in refuelling activities. Currently, most developed countries like United States, United Kingdom, Canada, and Germany imposed the self-service policy where vehicle refuelling activity was done by consumers, thus reducing the exposure of air pollutants to petrol station workers (52).

Even though the cough is the most reported respiratory symptom among petrol station workers, only two studies used a standardised questionnaire to assess the symptoms (16,24). Most of the studies were using their own definition of respiratory symptoms, which may differ from each other. The lack of standardisation will cause different interpretations between studies, and appropriate comparisons cannot be made. There are several methods, including questionnaires that can be used to assess respiratory symptoms, which include the ATS-DLD questionnaire by the American Thoracic Society (ATS), the British Medical Research Council (BMRC) questionnaire, and the National Heart and Lung Institute (NHLI) questionnaire (53).

The huge range of the prevalence of lung function impairment among petrol station workers between studies is due to the differences in inclusion and exclusion criteria for each study. The studies that exclude workers who are a smoker and have a history of respiratory illness will likely have a smaller prevalence. In contrast, the higher prevalence was seen in studies that only include workers who have experienced more than two years and at least eight hours per day of work duration. More studies show obstructive respiratory impairment pattern as compared to restrictive pattern due to exposure to pollutants, such as particulate matter, can induce the onset and exacerbation of chronic obstructive pulmonary disease, which will see as an obstructive pattern in spirometry (54).

Based on the studies, when compared to unexposed control groups, the FVC, FEV_1, FEV_1/FVC, MVV, and FEF 25% - 75% among petrol station workers were significantly reduced. FVC, FEV1, and PEFR show the most consistent association with the petrol station workers as it produces the most significant reduction as compared to other parameters. This may be due to these three parameters is the most common parameters that were measured in the studies.

This review identified several factors associated with the development of respiratory illness among petrol station workers, including duration of employment, smoking, age, job description, and BMI. However, several other factors are essential and not reported in the articles that may be associated with respiratory illness development. For example, exposure level or air pollutants concentration and seasonality were not reported in any of these articles. Rice et al. (2015) found a link betwee n long-term exposure to traffic pollution and lung function decline among the third generation of the Framingham Heart Study, suggesting that $PM_{2.5}$ is a predictor of respiratory illness. According to the findings, each 2 μg/m^3 rise in $PM_{2.5}$ was linked to a 13.5 ml (95% CI: 26.6, 0.3) lower FEV_1 and a 2.1 ml/year (95% CI: 4.1, 0.2) faster reduction in FEV_1 (54). Apart from that, other factors like personal protective equipment (PPE) (56) and training (57), which have proven to contribute to the development of respiratory illness in other workplaces, were not explored.

CONCLUSION

Respiratory illness is quite prevalent among petrol station workers, and lung function parameters, especially FVC, FEV1, and PEFR, are significantly reduced. Duration of employment, smoking, age, job description, and BMI are among the factors that contribute to respiratory illness development among petrol station workers. However, most of the studies were exploratory and need more research to establish a causal relationship between air pollutants and respiratory illness among petrol station workers.

ACKNOWLEDGEMENT

The authors would like to express their gratitude to the Department of Community Medicine, School of Medical Sciences, Universiti Sains Malaysia, as well as the Environmental and Occupational Health Program, School of Health Sciences, Universiti Sains Malaysia, for their assistance and advice in the preparation of this article. This review is funded by Tabung Insentif Pembangunan Pengajian Siswazah (TIPPS) Universiti Sains Malaysia.

REFERENCES

1. Zhang XQ. The trends, promises and challenges of urbanisation in the world. Habitat Int [Internet]. 2016;54(13):241–52. Available from: http://dx.doi.

org/10.1016/j.habitatint. 2015.11.018
2. Chaurasia S, Tiwari A. Status of Benzene, Toluene and Xylene near petrol pumps of Satna city MP Int J Appl Res Technol. 2017;2(6):257–63.
3. Adebiyi FM, Ezeh GC, Adeyemi FA, Obioh IB. Trace elements in particulate matter of ambient air at petroleum filling stations. Toxicol Environ Chem [Internet]. 2015;97(7):847–56. Available from: http://dx.doi.org/10.1080/02772248.2015.1071377
4. Lucchini RG, London L. Global occupational health: Current challenges and the need for urgent action. Vol. 80, Annals of Global Health. Elsevier USA; 2014. p. 251–6.
5. Kim KH, Kabir E, Kabir S. A review on the human health impact of airborne particulate matter. Environ Int [Internet]. 2015;74:136–43. Available from: http://dx.doi.org/10.1016/j.envint.2014.10.005
6. World Health Organization [WHO]. Exposure to Benzene: A Major Public Health Concern [Internet]. Geneva; 2010 [cited 2020 Nov 14]. Available from: https://www.who.int/ipcs/features/benzene.pdf
7. International Agency for Research on Cancer [IARC]. Benzene. Vol. 120, IARC Monograph on the evaluation of carcinogrnic risks to humans. 2019.
8. US Environmental Protection Agency [EPA]. Toluene. 2012;(1):1–5. Available from: https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/toluene.pdf
9. Rajan ST, Malathi N. Health hazards of xylene: A literature review. J Clin Diagnostic Res. 2014;8(2):271–4.
10. U.S. Environmental Protection Agency [EPA]. Acetonitrile [Internet]. 2000 [cited 2020 Nov 14]. Available from: https://www.epa.gov/sites/production/files/2016-09/documents/acetonitrile.pdf
11. Occupational Safety & Health Administration [OSHA]. OSHA Fact Sheet: Ethylene Oxide [Internet]. 2002 [cited 2020 Nov 14]. Available from: https://www.osha.gov/ethylene-oxide
12. Anand SS, Philip BK, Mehendale HM. Volatile Organic Compounds [Internet]. Third Edit. Vol. 4, Encyclopedia of Toxicology: Third Edition. Elsevier; 2014. 967–970 p. Available from: http://dx.doi.org/10.1016/B978-0-12-386454-3.00358-4
13. United Nations. World Economic Situation and Prospects. J Chem Inf Model. 2020;53(9):1689–99.
14. Ramadhany PS, Yunus F, Susanto AD. Lung Function and Respiratory Symptoms of Petrol Station Attendants in Central and North Jakarta and Its Contributing Factors. 2020;1(1):46–60.
15. Okemuo A, Ominyi L, Ojukwu C, Uchenwoke C, Chukwu C, Ezugwu U. Assessment of respiratory symptoms and cardiopulmonary indices among petrol pump attendants in Enugu Metropolis. Int J Med Heal Dev. 2020;25(2):106.
16. Mandal A, Mukherjee N. Pulmonary Function of Petrol filling Workers from West Bengal, India. Int J Occup Saf Heal. 2020;10(1):28–37.
17. Zafar M. Correlation of respiratory symptoms and spirometric lung pattern among petrol pump workers Karachi, Pakistan: Cross-sectional survey. Int J Heal Syst Disaster Manag. 2016;4(1):36.
18. Ifeyinwa AE, Co E, An A, Johnkennedy N. Gasoline fumes exposure and risk of respiratory disease among fuel pump attendants in Owerri Municipal Council , Nigeria. 2016;
19. Mbengue A, Coly MS, Faye SH, Sow AK, Diaw M, Sarr FB. Impact of Fuel Exposure on Ventilatory Function among Petrol Pump Attendants in Thies , Senegal. 2020;8(1):130–5.
20. Toyibah A, Hamarno R, Solikhah FK. Analysis of air pollutant exposure toward the breathing function of gas station employees in Malang Raya. 2020;6759(December):6751–9.
21. Dissi GM. Assessment of Cardiopulmonary Function and Respiratory Symptoms among Petrol Pump Attendants in Kano Metropolis. Dutse J Pure Appl Sci. 2018;4(2).
22. Deora K, Hulke S, Bhargava D. Comparison of Pulmonary Function Test in Petrol Pump Worker and Auto-rickshaw Driver. Adv Biomed Res. 2019;8(1):44.
23. Al-jadaan SAN, Jabbaralkinany AS. Impact of benzene exposure on lung functions of fuel stations workers in Basra City , Southren of Iraq. 2017;2(7):31–6.
24. Jaiswal A. Effect of petrol fumes on an anthropometry and ventilatory function among petrol pump workers of Puducherry , India. 2020;(November).
25. Ahmad H, Akbar F, Askur A. Total Suspended Particulate and Impaired Lung Function at Operators of Public Fuel Filling Stations in Mamuju Regency. J Info Kesehat. 2020;18(2):137–48.
26. Rahul R, Vyas S, Sankhla M, Gupta J. Spirometric evaluation of the pulmonary functions in the petrol pump workers of Jaipur city, Rajasthan, India. Int J Community Med Public Heal. 2016;3(11):3256–60.
27. Srivastava A, Barkule S. Airway function and mental health status of petrol pump workers of Aurangabad (Maharashtra) city. – An analytical cross-sectional study. Clin Epidemiol Glob Heal [Internet]. 2020;8(3):661–5. Available from: https://doi.org/10.1016/j.cegh.2019.12.022
28. Begum S, Rathna M. Pulmonary Function Tests in Petrol Filling Workers in Mysore City. Pak J Physiol [Internet]. 2012;8(1):12–4. Available from: http://www.pps.org.pk/PJP/8-1/Sadiqua.pdf
29. Adeniyi BO. Pulmonary Function and Symptoms Among Petrol Pump Attendents in Nigeria. Int J Biol Med Res. 2014;5(1):3780–4.
30. Chakraborty D, Aggarwal M, Paul D. A Comparative Evaluation Of Respiratory Indices In Petrol Station Workers Of Agartala. Int J Basic Appl Physiol.

2016;5(1):173–7.
31. Vella J, Borg M. Spirometry in fuel station attendants: A comparative study. Malta Med J. 2015;27(2):4–10.
32. Solanki R, Bhise A, Dangi B. A study on spirometry in petrol pump workers of Ahmedabad, India. Lung India. 2015;32(4):347–52.
33. Patil S V., Patil S, Kanitkar S. Study of peak expiratory flow rate as the assessment of lung function in occupationally exposed petrol pump workers of western Maharashtra. J Krishna Inst Med Sci Univ. 2016;5(2):95–100.
34. Pandit R. Assessment of vital respiratory indices of petrol pump workers of Kathmandu. Acta Medica Int. 2019;6(2):65.
35. Anuja A V, Veeraiah V, Johnson P, Subashini AS. Evaluation and comparison of pulmonary function tests in petrol pump workers Vs individu- als unexposed to petrol fumes. J Clin Biomed Sci. 2014;4(2):276–81.
36. Dube S, U MS, Kulkarni M, Professor A. Evaluation of Respiratory Functions in Petrol Pump Workers at Nanded. Int J Recent Trends Sci Technol. 2013;8(2):149–52.
37. Salvi S, Prasad NB, Bhandari N. Pulmonary function test in petrol pump workers and garage workers : A long drawn peril. Int J Allied Med Sci Clin Res. 2016;4(2).
38. Shonga T, Siziya S. Association between exposure to fuel and respiratory health among fuel attendants in Ndola, Zambia. Asian Pacific J Heal Sci. 2015;2(4):27–32.
39. Batta M, Dhir SK. Effect of Automobile Exhaust on Pulmonary Function Tests in Petrol Pump Workers. 2015;1:1–4.
40. Madhuri B, Chandrashekar M, Kondam A, Qairunnisa S, Suresh M, Lalitha A. A study on pulmonary function test in petrolpump workers in kanchepuram population. Int J Biol Med Res Int J Biol Med Res [Internet]. 2012;2(4):1712–4. Available from: www.biomedscidirect.com
41. Sharma H, Agarwal S. Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 st Second (FEV1) and Forced Expiratory Ratio (FEV1/FVC) In Petrol Pump Workers at Jhalawar and Jhalarapatan (Rajasthan). Indian J Clin Anat Physiol. 2015;2(4):177.
42. Sumathi P, Neelambikai N. Evaluation of pulmonary functions in petrol pump workers. Indian J Clin Anat Physiol. 2016;3(2):189.
43. Prasetyo A, Darry S, Samuel, Redyaksa D, Sadhana U, Sigit A. Occupational exposure on gasoline station workers not affect the nasal mucociliary clearance time and pulmonary function test. Adv Sci Lett. 2017;23(4):3406–8.
44. Hulke SM, Patil PM, Thakare AE, Vaidya YP. Lung function test in petrol pump workers. Natl J Physiol Pharm Pharmacol. 2012;2(1):71–5.
45. Aprajita, Panwar NK, Sharma RS. A study on the lung function tests in petrol-pump workers. J Clin Diagnostic Res. 2011;5(5):1046–50.
46. Chawla A, Lavania AK. Air pollution and fuel vapour induced changes in lung functions: Are fuel handlers safe? Indian J Physiol Pharmacol. 2008;52(3):255–61.
47. Bhardwaj P. Peak Expiratory Flow Rate (PEFR) in Smoker and Non-Smoker Petrol Pump Workers in Haldwani. J Med Sci Clin Res. 2018;6(3):967–70.
48. Soeroso NN, Intan TK, Ichwan M. Factors associated decrease of forced vital capacity on gas station employees exposed to sulfur dioxide (SO2). IOP Conf Ser Earth Environ Sci. 2019;245(1).
49. Uzma N, Salar BMKM, Santhosh Kumar B, Aziz N, David MA, Reddy VD. Impact of organic solvents and environmental pollutants on the physiological function in petrol filling workers. Int J Environ Res Public Health. 2008;5(3):139–46.
50. Eso A, Ariansyah T, Martisa E. Workplace and Lung Capacity of Petrol Gas Station Workers in Kendari City. 2019;(January 2019):1–6.
51. Sinha A, Patil SN. Pulmonary function tests in Petrol pump workers in Karad town. Int J Biomed Res. 2014;5(4).
52. Atkinson RD. Self-Service Gas as an International Development Indicator? [Internet]. Information Technology and Innovation Foundation; 2019 [cited 2021 Mar 23]. Available from: https://itif.org/publications/2019/07/29/self-service-gas-international-development-indicator
53. Helsing KJ, Comstock GW, Speizer FE, Ferris BG, Lebowitz MD, Tockman MS, et al. Comparison of three standardised questionnaires on respiratory symptoms. Am Rev Respir Dis. 1979;120(6):1221–31.
54. Li J, Sun S, Tang R, Qiu H, Huang Q, Mason TG, et al. Major air pollutants and risk of COPD exacerbations: A systematic review and meta-analysis [Internet]. Vol. 11, International Journal of COPD. Dove Medical Press Ltd.; 2016 [cited 2021 Mar 23]. p. 3079–91. Available from: /pmc/articles/PMC5161337/
55. Rice MB, Ljungman PL, Wilker EH, Dorans KS, Gold DR, Schwartz J, et al. Long-term exposure to traffic emissions and fine particulate matter and lung function decline in the Framingham Heart Study. Am J Respir Crit Care Med. 2015;191(6):656–64.
56. Nurul AH, Shamsul Bahri MT, Noor Hassim I. Metal dust exposure and lung function deterioration among steel workers: an exposure-response relationship. Int J Occup Environ Health. 2016;22(3):224–32.
57. Gizaw Z, Yifred B, Tadesse T. Chronic respiratory symptoms and associated factors among cement factory workers in Dejen town, Amhara regional state, Ethiopia, 2015. Multidiscip Respir Med. 2016;11(1):1–9.