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Original Research Article

Industrial pollution related health problems among residents of a rural area in central Kerala

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ABSTRACT

Background: Air pollution leads to several health effects, the major systems affected were respiratory, dermatology, neurology and ophthalmology. This study is an attempt to find out various health effects of pollution, from a food factory to the nearby residents.
Methods: A cross sectional comparative study was performed on 248 residents nearby a food factory, situated in rural area of Thrissur district and a comparative group of 266 participants taken 5km away from this factory.
Results: Both the groups were comparable in socio-demographic profile except religion and occupation. There was no statistically significant difference ($p>0.05$) between the use of firewood in both the groups. The symptoms of major systems involved were respiratory (odds ratio 3.9, 95% CI 2.2 to 6.8), dermatological (odds ratio 18.3, 95% CI 8.3 to 40.7), neurological (odds ratio 13.5, 95% CI 4.1 to 44.7) and ophthalmological (odds ratio 5.9, 95% CI 2.6 to 13.6). The major symptoms complained by them were pruritus (32.7%), skin lesions (17.7%), breathlessness (16.9%), itching eye (13.3%) watering from eye (11.7%) and headache (11.3%). All these symptoms among the case group compared to control group were very high and these associations were highly statistically significant ($p<0.001$).
Conclusions: This study showed an increased occurrence of adverse health effects among the individuals who were residing near the food factory. Therefore this study points out the possibility of environmental pollution (mainly air pollution) as a main factor for the increased prevalence of symptoms among those who reside nearby the factory.

Keywords: Industrial pollution, Comparative, Symptoms

INTRODUCTION

Air pollution is a complex mixture of different gaseous and particulate components, and can cause several health effects. The world health organization (WHO) estimates that approximately 7 million people worldwide die annually from air pollution.[1] Air pollution is caused by industrial activities and the burning of fossil fuels and waste. The pollutants emitted from industrial complexes enter human body through the respiratory system or skin and can cause allergic reactions, respiratory symptoms, and various acute and chronic diseases, such as asthma, chronic obstructive pulmonary diseases (COPD), lung dysfunctions, skin and eye diseases, acute bronchitis, cardiovascular disease (CVD), and cancer.[2,3] Air pollution is a well-known risk factor causing human ill-health. It is responsible for thousands of premature deaths, particularly in South Asia.[4] Ambient air pollution is a confirmed human carcinogen (International agency for research on cancer group 1).[5] The accelerated global

industrialisation trends during the past century have raised many concerns about the potential environmental health problems that might be caused, as a result. Also, the lack of strict environmental controls and public health systems in developing countries deteriorated environmental and public health situations.[6] In Kerala there are not many studies done on effects of pollution on health. Therefore, this study conducted in central Kerala on the health effects of pollution from a food factory among the nearby residents will provide an insight on the same.

METHODS

A cross sectional comparative study was done from the month of August to October 2019 among residents, nearby a food factory situated in rural area of Thrissur district, a part of central Kerala. As it was comparative study, first group was those people living within 2 km area around food factory, and the second group was those who were living outside 5 km area away, from this factory. Only the permanent residents those who were residing more than 6 months in that place and willing to participate in the study were included in both groups. Sample size was calculated as 200 participants in each group (air pollution in Delhi, magnitude and effects" by Rizwan et al published in 2013).[7] But we studied a sample of 248 people in group 1 and 266 people in group 2. From each group, data were collected from all members in each house hold, obtaining informed written consent consent until the required sample size was obtained. Data collected using semi structured questionnaire (reference) was entered in Microsoft excel sheet and was analysed both quantitatively and qualitatively using SPSS software and results were expressed in terms of mean, t test, proportions, 95% confidence interval, Chi square and Odds ratio. Information obtained was used for the purpose of the study only and strict confidentiality was maintained throughout.

RESULTS

Total number of people studied, within 2 km of factory (group1) were 248 (48.2%) and from more than 5 km away from factory (group2) were 266 (51.8%). The two groups were compared for characteristics including symptoms using Chi square test.

The comparison of the socio demographic profile of two groups is shown in (Table 1). It was found that the two groups are comparable for age, gender, socioeconomic status and addiction habits (Table 1). The groups were also comparable for using firewood as a cooking fuel, which may act as an indoor air pollutant (Table 2). The comparison of symptoms between two groups is shown in (Table 2). Symptoms related to environmental pollution were assessed among the study group. Presence of any one of symptoms among participants was considered as symptoms present.

Table 1: Socio-demographic profile.

Socio-demographic factors	Group 1 (within 2 km) n=248	Group 2 (5 km away) n=266	t test/ Chi square value	P value
Mean age (years)	35.4 (SD=21.3)	34.2 (SD=18.4)	0.673	0.501
Gender distribution; frequency (%)	Males 124 (50)	Males 138 (51.7)	0.146	0.702
	Females 124 (50)	Females 129 (48.3)		
Religion; frequency (%)	Muslim 125 (50.4)	Muslim 245 (91.8)	110.26	<0.001
	Hindu 108 (43.5)	Hindu 22 (8.2)		
	Christian 15 (6)	Christian 0		
Educational status; frequency (%)	Illiterate 5 (2)	Illiterate 17 (6.4)	5.952	0.015
	Literate 243 (98)	Literate 249 (93.6)		
Occupational status; frequency (%)	Employed 110 (44.4)	Employed 160 (59.9)	12.498	<0.001
	Unemployed 138 (55.6)	Unemployed 107 (40.1)		
Socioeconomic status; frequency (%)	BPL 129 (52)	BPL 141 (52.8)	0.032	0.857
	APL 119 (48)	APL 126 (47.2)		
Addictions; frequency (%)	21 (8.5)	15 (5.6)	1.606	0.205

p>0.05 suggests both groups are comparable.

It was found that symptoms were significantly higher among group 1 compared to group 2. Comparison of body systems affected based on symptoms developed is depicted in (Table 4). The main body systems involved in the study population according to the symptoms developed (Table 4). It was found that the prevalence of all the symptoms studied were higher among the participants in the area within 2 km (group 1) compared to those who were residing more than 5 km away (group 2) and it was statistically significant. Odds ratio showed a higher risk of symptom development among group 1 compared to group 2. Based on symptom development under each system it was found that all systems involvement showed a higher prevalence among group 1 compared to group 2 (Table 5). The body system affected in high prevalence among group 1 was dermatology compared to other systems involved.

Table 2: Proportion of study population using fire wood as fuel source.

Cause	Group 1	Group 2	Chi square value	P value
Fire wood	229 (92.3%)	257 (96.3%)	3.710	0.054

Table 3: Comparison of 2 groups based on the presence of any symptoms.

Symptom	Group 1 n=248 frequency (%)	Group 2 n=266 frequency (%)	Odds ratio	95% CI	Chi square value	P value
Present	116 (46.85)	34(12.7)	6.0	3.9 to 9.3	72.172	<0.001
Absent	132 (53.2)	232(87.3)				

p<0.05 signifies there is significant difference between both groups.

Table 4: Comparison of two groups in relation with the systems affected.

System involved	Group 1 n=248 frequency (%)	Group 2 n=266 frequency (%)	Odds ratio	95% CI	Chi square value	P value
Respiratory	57 (23)	19 (7.1)	3.9	2.2 to 6.8	25.735	<0.001*
Dermatology	82 (33.1)	7 (2.6)	18.3	8.3 to 40.7	83.357	<0.001*
Neurology	33 (13.3)	3 (1.1)	13.5	4.1 to 44.7	29.352	<0.001*
Ophthalmology	34 (13.7)	7 (2.6)	5.9	2.6 to 13.6	21.573	<0.001*
Musculoskeletal	11 (4.4)	3 (1.1)	4.1	1.1 to 14.8	5.333	0.021*
Gastrointestinal	10 (4)	2 (0.7)	5.6	1.2 to 25.7	6.090	0.014*
Other systems	5 (2.02)	0	0	0	0	0

*p<0.05 indicated that there is significant difference between both groups.

Dermatological symptoms both pruritis and skin lesions were significantly higher among group 1. Similarly the respiratory symptoms like breathlessness, cough, irritation and dryness of throat were also found to be significantly higher among group 1 compared to group 2. Ophthalmic symptoms were also fund to be significantly higher among group 1. Among neurological symptoms, head ache was more among group 1 compared to group 2 which was found to be statistically significant. Among the other symptoms compared only joint pain was found to be significantly higher in group 1.

DISCUSSION

In this cross sectional comparative study among the residents near a food factory both groups (within <2 km of food factory versus >5 km away from factory) were comparable for age, gender, socio economic status and addictions so that confounding effect related to these was eliminated. Both the study groups were comparable based on the use of firewood, as indoor air pollution can act as confounder in respiratory symptoms which is also one reason for air pollution. As the intention of this study was to find out the role of food factory related air pollution, bias due to indoor pollution is to be eliminated. The symptoms related to different systems regarding environmental pollution were assessed in this study. Group 1 (those residing within 2 km of factory), showed a significantly higher prevalence of symptoms (46.85%) compared to symptoms (12.7%) of group 2. As per the comparative study of air pollution done by Sagar et al also shows the mean number of symptoms experienced by exposed group was more as compared to control group (p<0.05).[8] A review on health effects of air pollution also point out, that both long- and short-term exposure, to air pollution can cause cardiovascular diseases, respiratory diseases (e.g. asthma, chronic obstructive pulmonary disease) and mortality.[9]

The main systems related with presence of symptoms involvement in our study among group one was dermatological 82 (33.1%), followed by respiratory 57 (23%), ophthalmological 34 (13.7%) and neurological 33 (13.3%) and these symptoms were significantly higher among group 1 compared to group 2. The symptoms like pruritus 81 (32.7%) vs. 6 (2.2%), breathlessness (16.95 vs. 6%), skin lesions (17.1% vs. 1.1%), eye itching (13.3% vs. 2.2%) were significantly higher among group 1 compared to group 2. As per the study of Benzy et al done in Thiruvanathapuram city, found out that 8.3% increase in respiratory diseases in industrial area, compared to other areas. She also pointed out that the people in the industrial zone also have watery discharge from eyes, skin problems and increased incidence of oral cancer compared to other areas under the study.[10]

Table 5: Comparison of individual symptoms in both groups.

Symptom	Group 1 n=248 frequency (%)	Group 2 n=266 frequency (%)	Odds ratio	95% CI	Chi square value	P value
Respiratory symptoms						
Breathlessness	42 (16.9)	16 (6)	3.2	1.7 to 5.9	15.406	<0.001
Cough	21 (8.5)	7 (2.6)	3.4	1.4 to 8.2	8.547	0.003
Running nose	9 (3.6)	3 (1.1)	3.3	0.9 to 12.4	3.546	0.06
Irritation & dryness of throat	18 (7.3)	3 (1.1)	6.9	2.0 to 23.7	12.370	<0.001
Dermatological symptoms						
Pruritis	81 (32.7)	6 (2.2)	21.1	9.0 to 49.4	84.714	<0.001
Skin lesions	44 (17.7)	3 (1.1)	19.0	5.8 to 62.0	42.816	<0.001
Neurological symptoms						
Headache	28 (11.3)	3 (1.1)	11.2	3.4 to 37.3	23.492	<0.001
Decreased sleep	8 (3.2)	2 (0.7)	4.4	0.9 to 21.0	4.142	0.042
Ophthalmological symptoms						
Eye itching	33 (13.3)	6 (2.2)	6.7	2.7 to 16.2	22.467	<0.001
Watering from eye	29 (11.7)	3 (1.1)	11.7	3.5 to 38.8	24.650	<0.001
Musculoskeletal symptoms						
Joint pain	10 (4)	2 (0.7)	5.6	1.2 to 25.7	6.090	0.014
Pedal oedema	5 (2)	1 (0.4)	5.5	0.6 to 47.2	3.009	0.083
Gastro intestinal symptoms						
Diarrhoea	2 (0.8)	1 (0.4)	2.2	0.2 to 24.0	0.414	0.520
Gastritis	2 (0.8)	1 (0.4)	2.2	0.2 to 24.0	0.414	0.520
Constipation	3 (1.2)	0				
Vomiting	4 (1.6)	0				
Others						
Earache	1 (0.4)	0				
Ear discharge	1 (0.4)	0				
Hair loss	3 (1.2)	0				

*p<0.05 indicated that there is significant difference between both groups.

The study done in Korea also shows that those living within 10 km from industrial complex showed a greater association with acute respiratory distress (ARD) (risk ratio (RR)=2.5; 95% CI=2.3 to 2.7), asthma (RR=3.7; 95% CI=3.1 to 4.5), conjunctivitis (RR=3.1; 95% CI=2.9 to 3.5) and dermatitis (RR=2.7; 95% CI=2.5 to 3.0) when compared with the control zone. In their study the incidence of atopic dermatitis was also statistically higher in the industrial area than in the control area.[11] In our study compared to control area the risk of development of dermatological symptoms were18.8 (95% CI 8.3-40.7) and neurological were 13.5 (95%CI 4.1-44.7). The dermatological and neurological symptoms are more than respiratory symptoms, in our study; it may be due to it, as it is a food factory. The development and exacerbation of atopic dermatitis due to industrial pollution is also shown in other studies.[12,13] In our study the risk of development of ophthalmological symptoms among persons residing near to food factory is 5.9(95% CI) times more than control area. The study done in Korea also found out that the risk of acute eye disorder in the industrial area was approximately 40% higher than that in the control area.[11]

Some other studies described that exposure to air pollutants such as SO_2 and O_3 on the ocular surface was associated with eye diseases such as conjunctivitis and dry eye syndrome.[14-16]

Limitations

Limitations of current study where it was done based on the symptoms only. No examination was done to confirm the symptoms. Hence subjective errors might have occurred. Influences of psychological factors on symptoms were not ruled out.

CONCLUSION

From this study, an increased occurrence of adverse health effects among the individuals who were residing near the food factory were found compared to those who were residing far away indicating the possibility of the role of factory related environmental pollution on nearby residents. Those who were residing, nearby the factory, showed a significantly higher prevalence of symptoms related to dermatological system (pruritis, skin lesions

)respiratory system (breathlessness, cough, irritation and dryness of throat), ophthalmological and neurological systems which are the proven adverse effects of air pollution by earlier studies. Therefore this study points out the possibility of environmental pollution (mainly air pollution) as a main factor for the increased prevalence of symptoms among those who reside nearby the factory.

Recommendations

Therefore it is recommended to conduct further detailed environmental studies, to find out whether there is any contamination by pollutants in air and also water which may lead, to above symptoms, which can be correlated with this study findings. The role of psychological influence, on symptoms, should also be evaluated, as some symptoms they reported, can occur due to psychological factors too.

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