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Impact Assessment of Air Pollution Aspects on Street Vendors in Urban Cluster of Kathmandu City

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Abstract

Air pollution has led to significant health problems affecting millions of people. It has frequently been demonstrated to be a severe issue as the hawkers have to stay several hours a day on the roadside with heavy traffic flow, resulting in high exposure to air pollutants. The high intensity of exposure rate resulted in higher health risks to varied diseases with a lack of appropriate adaptive measures. Across-sectional study was conductedamong207 streethawkers at alength of 1.79 km, including the main road and link road of 100m around the Gongabun metro-bus park sector. Primary survey datawascollectedbya structuredquestionnaire. Data wasanalyzed with the SPSS package and Microsoft Excel tool. Many of the hawkers (95.7%) had knowledge about air pollution and its causes, but the level of practice needed to be improved. There was no significant relationship between knowledge and practices (p-0.485 and p-0.626). It was inferred that street hawkers' knowledge had not been transformed into their behavioral practice. There was a significant relationship (p-value 0.038) between exposure period and diseases. Most hawkers (51.7%) had health issues related to air pollution. Out of 207 sampled hawkers, only118 wear masks, and others have not adopted any measures for their protection. Health problems were observed even in mask users due to the poor quality of masks. The findings suggest that awareness concerning personal protective equipment (PPE), such as mask use, needs to be delivered among street hawkers with the support of the local government and private sectors. An air quality monitoring station must be installedin bus park premises to monitor air quality effectively.

Keywords: *Pollution, Hawkers, Respiratory disease, Monitoring*

1. Introduction

The world is facing the problem of air pollution and its consequences, including Nepal. The Environmental Performance Index (EPI) 2018 explored that present air quality is the leading environmental threat to public health. India and Bangladesh are near the bottom of the rankings, with Burundi, the Democratic Republic of the Congo, and Nepal rounding out the bottom five [1]. Theprimary sources of air pollution in Kathmandu are industriesandvehicles [2]. In recent years,traffic-related exposure hasincreased[3]. In the Bagmatizone,vehicles reached 1042856 in the fiscal year 2016/2017 A.D

which was ten times higher than the number of vehicles from 2006/2007 A.D.[4]. Among all the sectors, the transport sector is a significant contributor to air pollution, with PM10 of 6953 tons per year [5].The increase in vehicles and the need for more awareness are deteriorating the ambient air quality of major cities of Nepal. In addition, topography, bowl-shaped valley, climate, and the atmospheric structure of Kathmandu Valley are major contributing factors [6].There are various types of air pollutants. The dominant air pollutant of Kathmandu is particulate matter (PM), the concentration of which is observed higher during the night in the winter season. The PM concentration in Kathmandu has consistently exceeded the World Health Organization (WHO) standard and the National Ambient Air Quality Standard of Nepal [7]. These particulate matter ((PM10 and PM2.5) are small enough to enter the human respiratory system to cause serious health consequences.

It is well known to everyone that exposure to polluted airleads to health-related problems. AccordingtoGBD (2013), ambientairpollution(AAP)isthe12th responsible factor forover 5.5 million premature deaths and disability of 141.5 million[8]. The new analysis of 103 countries found that 36 people out of every 100,000 dies in Nepal from outdoor air pollution, leading to heart diseases, lung cancer, chronic obstructive pulmonary disease, and stroke [9]. Nepal needs moreresearch onhealth impacts associatedwithambientairpollution inmajorcities,including Kathmandu. According to the NHRC 2015 report, among the respiratory diseases, COPD 39.49%, pneumonia 29.13%, and ARI excluding pneumonia 15.33% were the leading causes of inpatient hospitalizations in the 13 hospitals of Kathmandu [10]. Children (0-9 years) and aged persons (50 years and above) are the most vulnerable groups to respiratory disorders, with 25.5% of patients being children and around 55% being aged persons. Chronic-
obstructivepulmonary diseasebeingthe topcause of mortality among inpatients, the number reaches 408 in the year 2015/2016 A.D.[11].

The prevalence rate of cardiovascular disease is high in Nepal, but no studies show the association of disease with air pollution [12].According to the Department of Environment, the Nepal government has set up nine monitoring stations in Kathmandu Valley for measuring air quality with varied parameters. The monthly average quality was much higher than Nepal's and WHO's air quality standards [11-12]. However, these stations are insufficient to determine the valley's air quality. Due to the lack of adequate air quality monitoring stations to assess and update on air quality status, people are unaware of possible health consequences resulting from poor air quality, and it is similar to street hawkers of the Gongabunbus park urban area, too. Street hawkers are exposed to air pollution for longer hours of the day than other people. Many street hawkers are observed carryingout their business without adopting/using any proper method to reduce the health risks of air pollution.Kathmandu Central Bus Station,also known as Kathmandu bus terminal. It is for all long, medium, and short distances running public vehicles. This siteisthe junction forvehiclesarriving in Kathmandu Valley and departing outofthe valley. Theroadisbusyforalmost 24 hours. But this area lacks air pollution. monitoring station, so air quality can't be assessed. In the study conducted in the Bishnumati River corridor, the PM10 concentration was 537.63 µg/m3, which is very high [13]. This study focused on street hawkers' knowledge of air pollution and its impact on health. It also highlighted people's practices to combat air pollution.
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Though the government plans to address the air pollution issues, these must be implemented correctly. It is expected that the result of this research will be helpful for the concerned government and non-government agencies to carry out measures to minimize air pollution and prevent its effect on street hawkers. It will also encourage the Department of Environment, Nepal, to make data related to air quality monitoring more accessible to the general public to raise awareness and create emergency plans with attainable measures to control air pollution.This study was carried out toexamine the knowledge and practices on preventing health problems from air pollution among street hawkers of the Gangabu urban

cluster at the premises of the metro bus park.

2. Materials and Methods

2.1 Study Area and Data Sets

Gongabu Bus Park, commonly known as New Bus Park is a central bus station in Gongabu on the North-East corner of Ring Road in Kathmandu, Nepal. It serves as both, a domestic hubband a local bus terminus in Northern Kathmandu. Locally. It is the biggest and busiest bus station in Nepal, connecting the capital city with various regions of Nepal. During the peak, around 1500 serve the station daily.Gangabu'sNew Bus Park area is highly polluted and densely populated by street hawkers.Thestreet hawkers include vendors of stationery goods and cell phone accessories at premises of Gangabunew bus park terminal in Kathmandu city. The data generated is completely primary data by the questionnaire survey.

2.2 Sampling frame

A preliminary survey was conducted along the roadsides where hawker have been selling their goods and services. Hawkers were mostly along the ringroad premises and its parallel roads at both sides and link roads outside as well as inwards of ringroad. The road extension leading to Balaju Bypass, Basantnagar, Milantole, Shantipathtole, were among the link roads outskirts ofRing road; and road to Pavitranagar, Mhepi of GangabuNew Nus Park were included as the link road inward of Ringroad. The preliminary survey showed that the hawkers were distributed mainly from Gangabusquare to Gangahall along the Ringroad; and about 100 metre in the link road from the Ringroad cross sections. The running length from Gangabu to Gangahall, Machhapokhari was found to be 1.19km. As presented in Table-1, the total running length to be covered by this study including the Ringroad and link roads was found to be 1.79km, considered as the sampling frame for this study.

Table 1: Length of Ringroad and link roads covered by this study

Roads and its network	Length (m)	Coverage of road extension
Gangabu bus stop to Ganga hall, Machhapokhari (main road)	1.19 km (1190 m)	1790m
Balajubiapass	100 m	
Basantanagar	100 m	
Milantole	100 m	
Santipathtole	100 m	
Pabitranagar	100 m	
Maeipi	100 m	

Enumeration of the total hawkers along the designated road length was done by researcher in two days period by tally counter.

The total population of the street hawkers was found to be 402 in those two days counting. This number (402) was considered as the population for this study within the sampling frame delineated in Table 1.

2.3 Sample Size

With this known population, sample size was calculated using equationof Arkin and Colton, 1963 [14]

$$n = \frac{NZ^2P(1-P)}{d^2(N-1)+Z^2P(1-P)} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,

n=samplesizewithfinitepopulation,

N=Population size,

Z=Zstatisticforalevelofconfidence,

P=Expectedproportion(in proportion of one), and

d = Precision (inproportionofone).

Z-statistic(*Z*); For thelevelofconfidenceof95%,whichisconventional, *Z*valueis1.96.

In thesestudies,researcher presented theresults with95%confidenceintervals(CI). Expected proportion (*P*); was 0.5 and precision (d) was 0.05. Now by using above equation, the sample size was determined as 196.79. In the preliminary survey, it was also observed that some were not responding to the research objectives and the support required from them. In order to ensure that the required number of respondents ensured at the end of

survey, a nonresponsive sample of five percent was added to the sample which was represented by "a" in the modified sample formula below.

$$n = \frac{NZ^2P(1-P)}{d^2(N-1)+Z^2P(1-P)} * a \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Where, "a" is a possible non-responsive percentage. With five percent non-responsive possibility, the total sample size was considered as 207.

2.4 Sampling

This study followed systematic random sampling. Sampling interval = total population / sample population= 402/201 = 1.94 = 2. So, at every two hawker's intervals, one hawker was selected. Starting point of selection of sample was from Pabitranagar Chowk.

Sampling was carried from September 25th to October 25thof 2018 A.D.. The questionnaire survey was done by the researchers and enumerator. The questionnaire was categorized into five sections. The first part contained information about demographic characteristics, second part about the working hour, third part about the awareness on health checkup, fourth part about the knowledge on health risk, and the health problems among the hawkers, and the fifth part contained the information about the practices adopted to combat with air pollution. Therespondents were briefedaboutthe purposeofthe study beforehand along with detailsofthequestionnaires.

2.5 Data Collection, Processing, and Analysis

Primary data collection was through a questionnaire survey. The secondary data were collected from various governmental and non-governmental research agencies and environment-related reports, journals, and news. There are few surveys and research on knowledge and practices for reducing personal health risks from air pollution among street hawkers, so it wasn't easyto find relevant data and updates.At first, there was a visit to the office of Gongabu New Bus Park Area, which is handled by Lhotse Multipurpose Company Limited and has the target of managing the bus park for 35 years. The primary purpose of visiting the bus park area was to discuss the number of vehicles moving in and out for short, medium, and long-distance routes in a day. The collected data waschecked daily for completeness.Then, all data collected was coded and entered for data processing. The data was then analyzedwith StatisticalPackage (SPSS) and Microsoft Excel.

3. Results and Discussions

The demographic information of the study area with respondents' gender and age wise distribution has been mentioned in table-2 and table-3.

Table 2: Respondent's Gender of study area

Gender	*Frequency*	*Percent*
Male	78	37.7
Female	129	62.3
Total	207	100.0

Tabl2 3: Age Distribution of Respondents

Respondent's Age	Frequency	Percent
Economically Active Population (15 to 59 years)	199	96.1
Elderly Population (60+)	8	3.9
Total	207	100.0

Table 4: Respondent's Literacy Rate

Education	Frequency	Percent
Illiterate	75	36.2
Just Literate	23	11.1
Primary Education	8	3.9
Lower Secondary Education	24	11.6
Secondary Education	42	20.3
Higher Education (+2)	26	12.6
Bachelor and Above Education	9	4.3
Total	207	100

Table 4: Respondents' awareness about air pollution and potential health risk

Variables	Frequency	Percent
Knowledge on air pollution		
Yes	198	95.7
No	9	4.3
Total	207	
Knowledge on health risk		
Yes	185	89.4
No	22	10.6
Total	207	
Knowledgeof air pollution-relateddiseases (Multiple responses)		
Asthma	57	13.3
Pneumonia	86	20.1
Lung Cancer	15	3.5
Common Cold	101	23.6
Heart disease	3	0.7
Skin problem	89	20.8
TB	11	2.6
Eye irritation	65	15.22
Total	427	100

In table 4 above, out of 207 respondents 198 respondents had knowledge on air pollution and 185 respondents had knowledge that air pollution causes diseases, and 22 respondents had no knowledge on it. Because of the working experiences also hawkers had knowledge on different health problem. In the multiple response questions, 23.6% knew about common cold, followed by 20.8% skin problem, 20.1% pneumonia, 13.3% asthma, 3.5% lung cancer, 2.6% TB, and 0.7% heart disease. They get information about air pollution through communication media as man y of them listen to radio This finding was similar with the findings of Shakya, Noyes, Kallin & Peltier study in which the level of knowledge was good among the traffic policeman [15]. As more than 50% of respondents had suffered from the air pollution related disease, information about the disease might be known to them.

Table 5: Practices adopted by hawkers for the prevention of air pollution impacts

Practices	Number	Percent
Respondent's wearing Facemask	118	55.9
Respondent's going for regular check up	2	1.0
Respondent's working in less polluted areas	25	12.1
Respondent's do nothing	66	31.90
Total (multiple responses)	211	100.9
Regular wearing mask	41	34.7
Occasional wearing mask	77	65.3
Total	118	100
Reasons for Occasional Wearing (out of 77)		
Do not feel comfortable	15	19.5
Disturb in communication	58	75.3
No Reason	2	2.6
While there is dust around	2	2.6
Total	77	100

Table 5 represented the practices adopted by hawkers for the prevention of impact of air pollution. Out of 207 respondents 55.9% wear masks, 31.9% do nothing, 12.1% work in less polluted areas and 1% go for regular checkup. Among the mask wearing respondents 34.7% wear it regularly and 65.3% wear it occasionally. Respondents have certain reasons for wearing the mask occasionally. 75.3% said that it disturbs in their communication, 19.5% do not feel comfortable, 2.6% wear it when there is dust and rest of the respondents that is 2.6% have no reason to wear it.

Hawkers wearing facemask regularly were nearly half than the occasional wearing. In the study of Shendel &Noomnual, hawkers wearing mask regularly were zero and this might be due to the less sample size of 30 [16]. Most of the hawkers think that wearing mask during communication drop down their business. So, to make good communication with the customer they don't wear the mask and this increases their exposure resulting in increased health risks. Only few hawkers (2 in number) those having high risk problem go for regular checkup. As their saving is minimum, they can't afford for a regular checkup. Hawkers also preferred to work in less polluted areas and for them linked road is less polluted area so few of them do their business in linked road. They said that effect of air pollution is low in these roads compared to main roads. This statement is not supported by the study of HEIthat the distances within 300–500m of roadways are the most relevant for effects on human health [17]. In large North American cities, 30–45% of people live within this distance of a major roadway, and the burden of near-roadway exposure seems to be even higher in many European cities 18.

Table 6: Distribution of health related diseases among Hawkers

Diseases	Frequency	percentage
Asthma	19	9.2
Pneumonia	17	8.2
Upper respiratory tract infection	34	16.4
Heart disease	1	0.5
Skin related health issues	21	10.1
Tuberculosis	5	2.4
Eye irritation	10	4.8
Total	107	51.7

In table 6, out of 207 hawkers, 107 suffered from health problems. 16.4% had suffered from upper respiratory tract infection, 10.1% suffered from skin problems, 9.2% suffered from asthma, 8.2% from pneumonia, 4.8% from eye irritation, 2.4% from TB, and 0.5% from heart attack. The entire health problem islinked to the effect of air pollution, as represented in the article [18]. In the study of Lin et al. 2019, a link between ambient air pollution and the risk of active tuberculosis was found [19]. Research on the skin has provided evidence that traffic-related air pollutants can cause skin allergies and even skin cancer [20]. Traffic-related air pollution is associated with an increased risk of asthma, as mentioned in the journal of Guarnieriv & Balmes[21]. This is further corroborated by the study of Kenyon & Liuin, in which inhalation of diesel-exhaust particles leads to a typical asthma phenotype characterized by pulmonary inflammation and airway hyperresponsiveness [22]. As adaptive measures become weak, exposure to polluted areas increases vulnerability. In addition to the airways, the eyes *c*an also be affected by air pollution. The ocular surface is directly in contact with the environment and is the most exposed to air pollutants. Allergic conjunctivitis is mainly seen in people exposed to air pollution [23].

Table 7: Relationship between working hour per day and diseases among the respondents

			Respondent's suffering from any of the diseases mentioned while working
Spearman's rho	Working hour per day	Correlation Coefficient	0.144
		Sig. (2-tailed)	0.038
		N	207

Table 7 represented the weak positive relationship between exposure period and the diseases. It indicates that increase in exposure period increases health risk. The relationship is statistically significant at 95% confidence with p- value 0.038. This study corroborates with the study of Volpino et al, 2004 and with Gehring et al, 2010 in which long term exposure to traffic related air pollutants results in asthma[24,25].

Another interesting epidemiological observation includes a possible link between chronic PM exposure during childhood and vulnerability to COPD in adulthood [26].Research has shown that exposure to air pollution over the long term, can have negative impacts on the lungs and hearts, and potentially the brain as well [27]. Exposure level for the hawkers is expected to be almost the same throughout a year. It wouldn't change much in other months/seasons of the year.

Table 8: Health problem in different facemask users and the appropriateness of mask use

			Types of Mask Respondent's wearing								
			Anti-pollution mask		Normal cloth mask		Surgical mask		Cover with Shawl		
			Properness		Properness		Properness		Propernes s		
			Crt	Incrt	Cr	Incrt	Crt	Incrt	Crt	Incrt	
			F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	Total
Respondent's suffering from diseases	N	Face mask User	Y	3 (7.31%)	0	23(56.09%)	9(21.95%)	3(7.31%)	0	3(7.31%)	0	41 (34.74%)
	Y	Face mask User	Y	0	1 (1.29%)	46 (59.74%)	7 (9.09%)	18 (23.37%)	0	5 (6.49%)	0	77 (65.2%)
		total facemask user		3	1	69	16	21	0	8	0	118

N= No, Y = Yes, Crt =Correct, Incrt = Incorrect, F = frequency

In Table 8, out of 207 respondents, 107 had health problems. In a total of 118 facemask users, 77 (65.2%) of the respondents had a health problem. Among them also, 1.29% of antipollution mask users had health problems with inappropriateness in use. 59.74% of normal cloth mask users had health problems with properness in use, and 9.09% within proper use. Similarly, 23.37% of surgical mask users had health problems with appropriate use.

Most hawkers use simple cloth masks as they are washable, reusable, and cheaper, and medical masks as they are disposable. They believe these masks protect them from air pollution, but the lab test shows they are ineffective inprotecting health. Therefore, the hawkers are getting health problems even if they wear it correctly. All normal cloth masks performed worse for diesel combustion particles as tested in the lab [28]. Moisturereretention, reuseofclothmasks, and poor filtration may result in an increasedriskofinfection.Furtherresearchis needed to inform the widespread use of cloth masks globally [29]. In the same way, surgical masks also don't give protection to health, as Neilson mentions in his journal [30]. So,this kind of mask does not protect the health. They feel like they are doing something good for their body to

protect themselves from air pollution. But in reality, it's not doing anything at all, or it's doing very little. Wearing a shawl also doesn't tight fit to the face, so it also doesn't give protection.

Table 9: Relationship between knowledge and practices (Facemask use and regular checkup)

			Facemask	Regular check up
Spearman's rho	Respondent's knowing about air pollution causing diseases	Correlation Coefficient	0.049	0.034
		Sig. (2-tailed)	0.485	0.626
		N	207	

Table 9represents the relationship between knowledge and practice. Though a positive relationship was found between knowledge and practice, the study found no significant relationship between knowledge and practice ($r = 0.049$, $p = 0.485$ for mask users, $r = 0.034$, $p = 0.626$ for regular checkups). This indicates that knowledge alone doesn't translate into practice, so practical measures should be taken to enhance their level of knowledge. This finding corroborated the findings of Wylen & Mckenna (2008) and Yilmaz & Morrison (2008), where there is a divergence in knowledge and practice [31,32].

4. Conclusion

The findings of this investigation led to the conclusion that the amount of pollution was significantly greater and would be highly hazardous to occupational work. Although most of the vendors (95.7%) were aware of the causes of air pollution and the factors that contribute to it, their degree of practice needed to be improved. Even though there are 207 sample hawkers, only 118 wear masks, and the rest do nothing to protect themselves. The p-values for the association between knowledge and practice were 0.485 and 0.626, respectively, and neither was significant. When it comes to this point, knowledge does not convert into practice. Based on the findings of this study, there is a requirement for a program that raises awareness about the impact of air pollution on street vendors. A significant connection (p-value of 0.038) was found between the duration of exposure and the occurrence of illnesses. The health issue that was associated with air pollution was experienced by a significant number of hawkers (51.7%). Several ailments were prevalent among hawkers, including upper respiratory tract infections, asthma, pneumonia, skin diseases, and eye discomfort. Even among those who wore masks, health problems were observed, which is evidence that the masks they wore did not serve their intended purpose of providing protection.

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Declaration of Competing Interest

The authors declare no conflicts of Interest.

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