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Assessing the Impact of Exposure to Polluted Air on the Pulmonary Systems of Service Personnel Using a Peak Flow Meter

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Abstract: Air pollution is an important public health concern in most cities around the world. Millions of people die or suffer from serious health problem such as respiratory disease including asthma, chronic obstructive pulmonary disease, and lung cancer every year. In developing countries, air pollution has not received adequate attention. Bangladesh is a densely populated developing country where air pollution controlling measures has not been described until 2006. The situation is especially serious in Dhaka, the capital of Bangladesh; because of uncontrolled motor vehicle increase huge traffic congestion and multiple economic activities. As a result air pollution may be one of the main causes of pulmonary disorder of city dwellers in the Dhaka City. The study was focused to assess how the exposure in Dhaka City air affects to the pulmonary system of traffic police. Peak Flow Meter was used and Peak Expiratory Flow (PEF) value was taken as the parameter that indicates the status of the pulmonary system. PEF data were collected from 50 traffic police who are working at road site and/or intersections of Dhaka City. The rate of decrease in standard PEF values is small compared to field PEF values of the subjects. There is a significant difference between the standard and the field PEF values which means that age is not the only parameter affecting lung function. Analysis shows that the height of the person and length of service also affect the pulmonary function in addition to age. A comparative analysis shows that the length of service is the major factor to deteriorate lung function. Only 10% of total sample subjects who have been working as traffic police less than 5 years need immediate medical attention, whereas, the subjects having length of service 5 to 10 years, about 50% need emergency medical attention and rest of them fall in potential warning range. Finally, two-thirds of the traffic police working for more than 10 years are in potentially alarming state and may need immediate treatment. Thus it is evident that length of service, i.e., exposure to Dhaka City air is likely to affect the pulmonary system of service personnel like Traffic Police.

Key words: PEF, Polluted air, Peak flow meter, Impact of exposure.

INTRODUCTION

1.1. General:

Air pollution is an important public health concern in most cities around the world (Moschandreas *et al* 2002). Every year millions of people die or suffer from serious health problem such as respiratory disease including asthma, chronic obstructive pulmonary disease, and lung cancer and also from cardiovascular disease (A.J.Hickman). Air pollution is now considered to be a serious environmental health hazard (K.Gwilliam *et al* 2003). In developing countries, air pollution has not received adequate attention (Azad and Kitada 1998). As a consequence it may be a cause for diseases among city dwellers (K.Gwilliam *et al* 2003). The rate of increase of air pollutants in the cities of developing countries is higher than that of developed countries. Bangladesh is a densely populated developing country. No appropriate air pollution controlling has been described until 2003 (DOE, 2003). This is due to lack of awareness, absence of proper motor vehicle monitoring, and poor application of legislation through Local Government. The situation is especially serious in Dhaka, the capital of Bangladesh; because of uncontrolled motor vehicle increasing (Karim 1999) in Dhaka, is now recognized as one of the most polluted cities in the world (K.Gwilliam *et al* 2003). The city is suffering from industrial and vehicular air pollution due to over-crowding, huge traffic congestion and multiple economic activities (BRTC, 2001). Vehicles congestion is leading to traffic jams and may be keeping the city

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air more polluted (Stein and Toselli, 1996). Previous studies by various researchers and institutions have shown that what sort of pollutants mostly exist on Dhaka City air. CO, PM and NO_2 had already exceed the international representative guideline values (Karim, 1999). But none of their studies was extended to the significance of exposure and vulnerability. Also all the studies were focused on the level of pollution but no one has correlated it with human health. It is found by the USEPA and WHO that, air pollution has adverse effects on human health. World Bank study 1998, found that in Dhaka City alone, 8000 people were dying each year from air pollution. Apart from this more than 114,000 peoples fell ill with chronic bronchitis and 1,530,000 with asthma, while 225,080 other needed emergency hospital treatment (Azad and Kitada 1998).

So investigation of the correlation between air pollution and human health problems may provide some insights towards management of occupational health.

1.2. Objectives of the Study:

The aim of this study is to investigate the impact of air pollution on human health covering specially the effect on pulmonary system among people who working at street side. It will cover not only the technical aspects related to air pollution, but also human resources development, awareness campaigning, surveillance and control, all of which are essential components in sustaining the operation of air pollution controlling system. The main objectives of this study are:

1. To explore the effect of exposure to polluted air on the status of pulmonary systems.
2. To identify the factors governing the deterioration of lung function of exposed personnel.

The study area, Dhaka City is divided by 22 administrational boundaries that are known as Thana. Emissions from mobile sources, is most important factor for air pollution of Dhaka City. The level of air pollution in Dhaka City is high as it's rapidly increasing population and motorization vis-à-vis (Karim, 1999). The central city (down town) area is seriously effected due to high traffic congestion; small industries associated with the high densely population and their activity pattern (Karim, 1999). To maintain the traffic control system regulated and dynamic, every traffic polices are working at least 10 hours each at different road intersections under various Thana's of Dhaka City. So, among the city dwellers people like traffic polices spend most of the time of their daily work in the polluted air of the city having maximum exposure in the outdoor air pollution. Therefore, study regarding their health hazard due to air pollution was our greatest interest. The research topic selection is concurrent with the risk of air pollution associated with the pulmonary systems of traffic police. It is expected that the overall study findings would also render better perception of the effect of long term exposure in the polluted air.

2. Data Collection Methods and Analysis:

This chapter presents an overview of how the actual fieldwork was staged and also includes sampling procedures and the details of the data collection and analysis. To meet the research objectives mixed methods had been followed for collecting information. Background data had been collected from published journals, thesis and books. Science direct was the main search engine for web base information and other secondary information. To select the appropriate site and to identify the study area field visits were conducted at different road intersections of Dhaka City. Interview of traffic police on duty at these intersections were conducted to determine their willingness to participate in this study.

2.1. Description of the Study Area:

Primarily some critical road intersections of Dhaka city were selected giving priority for traffic congestion and environmental pollution. Prior to the survey, it was assumed that traffic polices from several road intersections would serve as participants as their duty at road intersections changes on weekly basis.

Data were collected from traffic polices working at Shahabag, Azimpur, New Market, Polashi and traffic police barrack located at Paltan using questionnaire survey and a peak flow meter at different periods of a day namely morning, noon and afternoon.

Shahabag is one of the critical road intersections of the Dhaka city. Significant traffic congestion and vehicular emission cause air pollution in the adjacent area. New Market and Nilkhet intersection was selected as another study point where traffic congestion is significant in the afternoon. A Few sampling was done at Polashi intersection located near BUET campus.About 50% data were collected from the traffic police barrack located near Paltan area. At barrack, data was collected in two periods of a day-

- In morning when some traffic police are at rest.
- At noon when some traffic polices return from their duty.

2.2. Data Collection Scheme:

Fieldwork was started by social network mapping (Jorgensen, 1989) which is a systematic technique for becoming quickly adjusted to a field site. This technique is normally used in field based data collection procedure to discover areas within a community. Social network mapping was used in this study as a mean to build rapport, to gain an initial understanding of the social dynamics within the study area, and to get to know the physical layout of the field site.

This procedure was done by walking around the study area. All type of information was recorded every day which were used for final data analysis and interpretation. Participatory observational approach helped to improve the quality of structured and semi-structured interviews (Gubrium and Holstein, 1995). The intent was to learn as much one could about the issues of air pollution, and views of the participant Interesting and unanswered questions also recorded. This list of questions and ideas were invaluable during the data analysis.

Two weeks were spent to collect the initial information for scouring the environment. Moreover, Bangladesh Bureau of Statistics (BBS) reports were collected to get some idea of the demographical information of the study area.

2.3. Field Survey Design:

The field survey planning was designed as a data collection procedure to identify the air pollution related health hazard in the study area. The primary data were collected by field observations, questionnaire survey, interviews, and group discussion through relevant participatory methods. The secondary information was collected through a literature survey on air pollution study, relevant published and unpublished reports, documents, newspaper, magazine, etc.

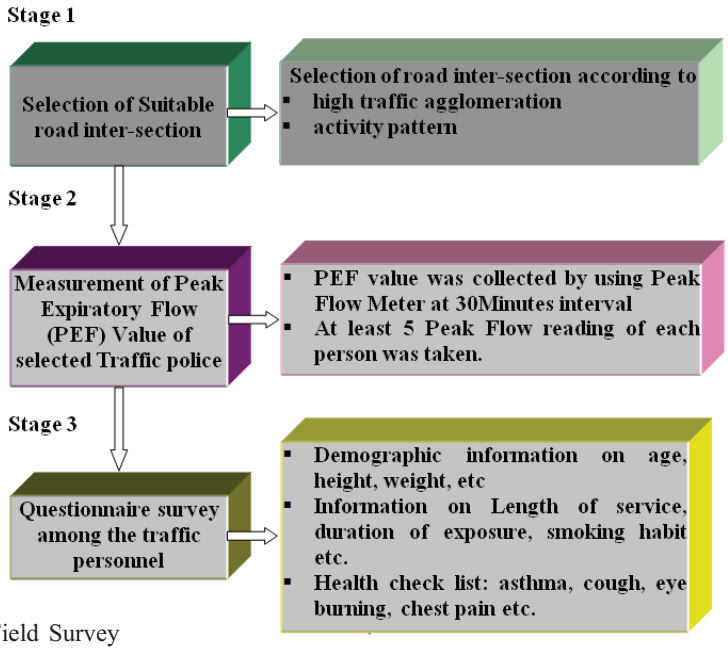


Fig. 1: Flow Chart Field Survey

2.4. Selection of Informants for Questionnaire Survey:

The authors had easy access to the participants and target people in the study area. Therefore a targeted sampling approach was applied to collect qualitative data. A knowledgeable key informant is one, who

- Has the knowledge with experience the researcher requires
- Has the capability to replicate
- Has the time to be interviewed and
- Is passionate about participating in the study.

Purposive sampling can capture more information as possible as study requires. This sampling system is very much consistent with the research philosophy, approach, and strategy and data collection methodology of this study. By using this method 50 questionnaire surveys and observations were performed for qualitative data and also for crosschecking the information gathered from survey.

2.5. Questionnaire Survey Method in Sequence:

Questionnaire survey gathers a wide range of participation of the direct victims of all hazardous circumstances. To verify and find out the disease pattern majoring pulmonary systems of the traffic police working at road intersections was interviewed as a participatory method with predetermining close-end questionnaire (Table B). The information collected by questionnaire survey was of both qualitative and quantitative in nature depending on the variables.

People who are working near the road side like traffic police are directly affected by the exposure to airborne pollutants. To investigate the relation with pollution and health the standardized health questionnaire survey was initiated by interviewing traffic police on duty at around the sample points. Information on responses of demography, activity pattern (length of service, daily working hours) and health (PEF value, cough, chest/shoulder pain, tiredness etc.) were recorded for each participant at each sampling location. To find out the information from Dhaka city traffic police as they are always very busy during their working period, is tough as they avoid the direct answer. So that, we had to make a questionnaire with considering recheck options. In this questionnaire

- ○ Respondents personal and demographic information
- ○ Activity pattern and time schedule for each events
- ○ Information about the health majoring pulmonary system

Figure 2 shows the flow chart of collecting qualitative and quantitative data and process of interpretation.

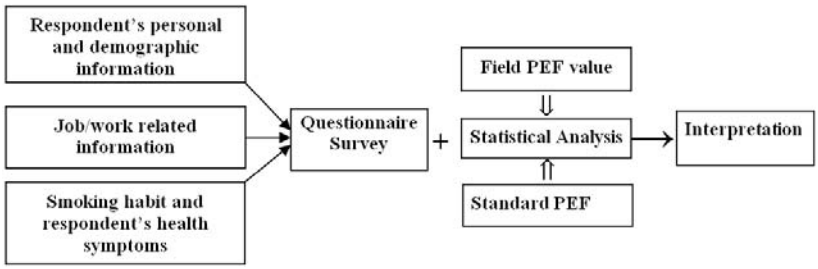


Fig. 2: Data Collection and Process of interpretation

2.6. Quantitative Data Collection Procedure:

At the end of the qualitative data collecting part, the participants were encouraged to blow air out of the lungs into the mouthpiece of the peak flow meter. As a person blows into peak flow meter (see following Figure 3) the pointer moves along the scale and gives expiratory reading.

During field survey, peak expiratory flow (PEF) of 50 traffic police working at different road intersections had been collected using a Peak Flow Meter to assess their lung function. For each traffic police at least 5 Peak Flow Meter readings were taken and were temporarily recorded.

Peak Expiratory Flow (PEF) is a measurement of how fast one can blow air out of his lungs. Peak flow score will be higher when pulmonary system is sound and lower when airways of pulmonary system get narrower. Therefore, Peak flow score is a useful guide to the openness of airways of pulmonary system at any given moment that can show accurately how the breathing pattern changes.

The pointer moves along the calibrated scale attached onto the front side of the Peak Flow Meter when a subject blows air out of his lungs into the mouthpiece of the meter as hard as possible to obtain his best, i.e., peak expiratory flow reading (L/min).

The flow value is then projected to the label marked with three distinguished coloured categories (Green, Yellow and Red) attached onto the reverse of the pick flow meter (see figure 3 below). These coloured zones provide a visual indication of the status of pulmonary system as follows:

Green Category (PEF>600 L/min):

PEF scores reached over green zone said to be green category indicate sound pulmonary system and no asthma symptoms are present.

Yellow Category (600<pef<350 L/min):

Between Green and Red zones, the yellow category shows warning of asthma attack. In this zone, threshold value PEF is typically 60% of one's best.

Red Category (350<pef<100 L/min):

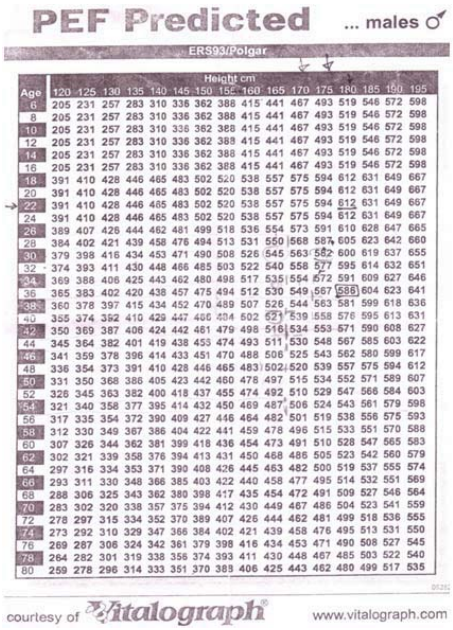
PEF values projected over red zone indicate that state of pulmonary system when emergency medical attention is required.

Front Side of Peak Flow Meter Back Side of Peak Flow Meter

Fig. 3: A Peak Flow Meter

2.7. Field Data Analysis:

Standard peak expiratory flow data had been obtained from the standard calibrated chart (see Figure A) provided by the manufacturer of the Peak Flow Meter (Vitalograph, Ennis, Ireland). The standard peak expiratory flow varies with age and height whereas field peak expiratory flow may be impacted by additional parameters such as exposure time (service years) in polluted air, smoking habit and other major demographic physiological parameters. Field data (see in Table A,) were analysed and plotted then compared with standard PEF value which are included in this subsection. The Figure 4 shows the decrease of standard peak expiratory flow value with the increase in age. Data is given in Table 1 in Appendix. The range of variation in standard peak expiratory flow value is from 612 to 495 L/min, a difference of 117 L/min for age range of 22-55 years. Thus, the illustration shows a smooth decreasing trend in standard peak expiratory flow value with the natural aging.



PEF Predicted ... males ♂

ERS93/Polgar

Age	Height cm: 120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195
6	205	231	257	283	310	336	362	388	415	441	467	493	519	546	572	598
8	205	231	257	283	310	336	362	388	415	441	467	493	519	546	572	598
10	205	231	257	283	310	336	362	388	415	441	467	493	519	546	572	598
12	205	231	257	283	310	336	362	388	415	441	467	493	519	546	572	598
14	205	231	257	283	310	336	362	388	415	441	467	493	519	546	572	598
16	205	231	257	283	310	336	362	388	415	441	467	493	519	546	572	598
18	391	410	428	446	465	483	502	520	538	557	575	594	612	631	649	667
20	391	410	428	446	465	483	502	520	538	557	575	594	612	631	649	667
22	391	410	428	446	465	483	502	520	538	557	575	594	612	631	649	667
24	391	410	428	446	465	483	502	520	538	557	575	594	612	631	649	667
26	389	407	426	444	462	481	499	518	536	554	573	591	610	628	647	665
28	384	402	421	439	458	476	494	513	531	550	568	587	605	623	642	660
30	379	398	416	434	453	471	490	508	526	545	563	582	600	619	637	655
32	374	393	411	430	448	466	485	503	522	540	558	577	595	614	632	651
34	369	388	406	425	443	462	480	498	517	535	554	572	591	609	627	646
36	365	383	402	420	438	457	475	494	512	530	549	567	586	604	623	641
38	360	378	397	415	434	452	470	489	507	526	544	563	581	599	618	636
40	355	374	392	410	429	447	466	484	502	521	539	558	576	595	613	631
42	350	369	387	406	424	442	461	479	498	516	534	553	571	590	608	627
44	345	364	382	401	419	438	456	474	493	511	530	548	567	585	603	622
46	341	359	378	396	414	433	451	470	488	506	525	543	562	580	599	617
48	336	354	373	391	410	428	446	465	483	502	520	539	557	575	594	612
50	331	350	368	386	405	423	442	460	478	497	515	534	552	571	589	607
52	326	345	363	382	400	418	437	455	474	492	510	529	547	566	584	603
54	321	340	358	377	395	414	432	450	469	487	506	524	543	561	579	598
56	317	335	354	372	390	409	427	446	464	482	501	519	538	556	575	593
58	312	330	349	367	386	404	422	441	459	478	496	515	533	551	570	588
60	307	326	344	362	381	399	418	436	454	473	491	510	528	547	565	583
62	302	321	339	358	376	394	413	431	450	468	486	505	523	542	560	579
64	297	316	334	353	371	390	408	426	445	463	482	500	519	537	555	574
66	293	311	330	348	366	385	403	422	440	458	477	495	514	532	551	569
68	288	306	325	343	362	380	398	417	435	454	472	491	509	527	546	564
70	283	302	320	338	357	375	394	412	430	449	467	486	504	523	541	559
72	278	297	315	334	352	370	389	407	426	444	462	481	499	518	536	555
74	273	292	310	329	347	366	384	402	421	439	458	476	495	513	531	550
76	269	287	306	324	342	361	379	398	416	434	453	471	490	508	527	545
78	264	282	301	319	338	356	374	393	411	430	448	467	485	503	522	540
80	259	278	296	314	333	351	370	388	406	425	443	462	480	499	517	535

courtesy of Vitalograph® www.vitalograph.com

Fig. A : Standard Peak Expiratory Value compare with Age and Height

A graphical representation similar to the above, showing the variation of average field peak expiratory flow of traffic police with their age, is shown in Figure 5. The corresponding data is given in Table 2.

As at least five peak expiratory flows of each subject were taken in the field during survey, the best and worst PEF values of each sample are also plotted in Figure 5. It shows that, for age range of 22-55 years field peak expiratory flow varies from 235 to 610 L/min, a difference of 380 L/min. This difference between maximum and minimum field PEF value with age is higher than that of the standard values shown in figure 4.

Besides, Figure 5 shows inconsistencies in field average PEF value with the change in age. If we compare the trend lines shown in Figure 4 and Figure 5, it is evident that although field data show a decreasing trend with age similar to the standard values, the rate of decrease in PEF with age for field samples is considerably higher. Thus inference can be made that age is not the single parameter to reduce PEF value.

Figure 6 shows the average field PEF and standard PEF value compare with age of traffic police and service years in parenthesis where corresponding data have been shown in Table 3(b). The bar diagram shows that, although there exists a clear decreasing trend for PEF with age; length of service contributes additionally to its decreasing trend.

The PEF data were collected from fifty traffic police having different age, height and service years (see Table 3(a)). People having lowest PEF in each age group were given priority and 23 data were screened out to draw this figure (see Table 3(b)).

Table A: Field Data Using a Peak Flow Meter

	NAME	AGE (years)	H (cm)	W (kg)	E T (hrs)	L S (years)	SMOKING HABIT	PREDICTED STANDARD PEF VALUE	LOWEST PEF VALUE	BEST PEF VALUE	AVERAGE PEF VALUE
1	HARUNUR RASHID	22	180	66	10	1	Y	612	600	620	610
2	RAZIB ALI	26	165	68	10	2	Y	554	440	500	460
3	MEHEDI HASAN	28	168	65	10	1	N	560	480	500	495
4	SHAFIQUL ISLAM	30	175	90	10	2	Y	582	480	560	520
5	ENAMUL HAQUE	30	172	65	10	8	Y	570	250	350	295
6	ABDUS SALAM	30	173	67	10	6	Y	572	350	400	365
7	RAFIQUL ISLAM	31	173	68	10	5	N	582	380	440	415
8	MAFIZ MULLAH	31	169	61	10	4	N	563	460	570	535
9	BELAL HOSSAIN	32	170	74	10	4	N	558	450	530	495
10	ENAMUL ISLAM	32	166	78	10	5	N	542	350	480	420
11	REZAUL KARIM	32	168	62	10	3	N	549	340	440	395
12	MUJIBUR RAHMAN	32	170	62	10	3	N	558	420	520	465
13	WALI ULLAH	32	169	65	10	2	N	554	250	430	380
14	RAFIQUL ISLAM	33	168	70	10	3	N	510	290	380	350
15	ASHRAF ALI	33	172	70	10	6	N	560	530	550	540
16	AFZAL HOSSAIN	34	174	75	10	5	N	570	500	530	515
17	ABDUL MANNAN	34	170	75	10	6	N	554	340	350	345
18	FARUK AHMED	34	168	75	10	4	N	545	300	450	375
19	FIROZ HOSSAIN	34	173	70	10	2	N	564	350	450	400
20	SAKIL AHMED	34	170	72	10	5	N	520	260	350	300
21	BASHIR MIA	36	180	65	10	4	Y	586	480	520	500
22	ANISUR RAHMAN	35	170	80	10	12	Y	552	350	550	485
23	HABIBULLAH	35	170	80	10	7	N	552	420	520	445
24	RUSTOM ALI	36	170	76	10	2	Y	549	350	400	375
25	KABIRUL HAQUE	36	175	82	10	5	N	567	450	510	480
26	HAFIZ KHAN	37	166	70	10	7	N	535	280	400	350
27	NAZRUL ISLAM	37	173	85	10	2	N	557	350	600	500
28	MANIK MIA	38	169	85	10	8	N	540	380	500	460
29	ABUL KALAM AZAD	38	174	85	10	7	Y	560	220	320	275
30	MONIRUZZAMAN	40	170	75	10	15	N	539	250	350	275
31	ZUBAYEDUL	39	168	80	10	4	Y	533	350	500	430
32	ISMAIL HOSSAIN	39	169	70	10	10	N	534	350	450	415
33	SAGIR AHMED	40	173	67	10	8	N	552	390	430	400
34	AKHTER ALI	40	172	75	10	10	N	549	320	350	330
35	LUTFAR RAHMAN	42	170	65	10	9	N	534	300	360	330
36	AMJAD HOSSAIN	41	167	72	10	1	N	528	500	530	520
37	KALILUR RAHMAN	42	169	80	10	10	N	530	300	360	335
38	BACHCHU MIA	42	168	68	10	8	N	526	250	300	265
39	FAROOK HOSSAIN	42	168	80	10	10	Y	528	300	320	310
40	ROIS UDDIN	43	167	66	10	8	Y	520	450	500	475
41	ABUL KALAM	43	167	70	10	6	N	525	280	480	400
42	MONIR HOSSAIN	43	168	75	10	9	N	525	300	300	300
43	AMIR UDDIN	45	177	78	10	17	N	552	230	350	250
44	SORBESH ALI	45	168	85	10	9	N	518	430	550	485
45	FARUQ HOSSAIN	48	170	82	10	10	N	520	380	440	410
46	MOKBUL HOSSAIN	48	167	68	10	10	N	510	420	460	445
47	ATAUR RAMAN	50	165	75	10	8	N	497	360	400	380
48	ALTAF HOSSAIN	52	175	`95	10	12	Y	529	220	300	250
49	HARUNUR RASHID	53	167	75	10	29	N	500	200	320	235
50	ABDUR ROUF	55	168	85	10	5	N	495	350	500	440

H=Height

W=Weight

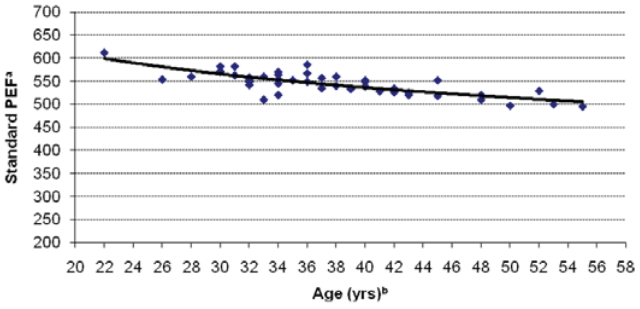
D W=Daily Working Period

L S=Service period as Traffic Police

Table B: Field Data Using Questionnaire

	NAME	AGE(years)	H(cm)	W(kg)	D W(hrs)	L S(years)	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
1	HARUNUR RASHID	22	180	66	10	1	Y	N	II	Y	I	III	III	II
2	RAZIB ALI	27	165	68	10	2	Y	N	II	Y	I	II	I	II
3	MEHEDI HASAN	28	168	65	10	1	N	N	II	N	I	III	II	III
4	SHAFIQUL ISLAM	29	175	90	10	2	Y	N	I	Y	I	II	III	II
5	ENAMUL HAQUE	30	172	65	10	8	Y	N	II	N	I	II	III	II
6	ABDUS SALAM	30	173	67	10	6	Y	Y	III	N	I	II	III	II
7	RAFIQUL ISLAM	31	173	68	10	5	N	N	II	N	I	II	III	I
8	MAFIZ MULLAH	31	169	61	10	4	N	N	I	N	I	II	II	II
9	BELAL HOSSAIN	32	170	74	10	4	N	N	II	Y	I	III	III	I
10	ENAMUL ISLAM	32	166	78	10	5	N	Y	II	Y	I	II	II	I
11	REZAUL KARIM	32	168	62	10	3	N	N	I	Y	I	III	III	I
12	MUJIBUR RAHMAN	32	170	62	10	3	N	N	II	Y	I	II	III	III
13	WALI ULLAH	32	169	65	10	2	N	N	II	Y	I	III	III	I
14	RAFIQUL ISLAM	33	168	70	10	3	N	Y	II	Y	I	I	II	I
15	ASHRAF ALI	33	172	70	10	6	N	N	II	N	I	II	III	II
16	AFZAL HOSSAIN	34	174	75	10	5	N	Y	III	Y	I	II	III	I
17	ABDUL MANNAN	34	170	75	10	6	N	N	I	Y	I	II	II	I
18	FARUK AHMED	34	168	75	10	4	N	N	II	N	I	I	I	III
19	FIROZ HOSSAIN	34	173	70	10	2	N	N	II	Y	I	II	II	II
20	SAKIL AHMED	35	170	72	10	5	N	Y	II	Y	I	I	II	I
21	BASHIR MIA	35	180	65	10	4	Y	N	I	Y	I	II	III	I
22	ANISUR RAHMAN	35	170	80	10	12	Y	N	II	Y	I	III	III	III
23	HABIBULLAH	35	170	80	10	7	N	Y	I	Y	I	II	III	I
24	RUSTOM ALI	36	170	76	10	2	Y	N	II	Y	II	I	I	I
25	KABIRUL HAQUE	36	175	82	10	5	N	N	II	N	I	II	II	II
26	HAFIZ KHAN	37	166	70	10	7	N	N	II	Y	I	III	III	I
27.	NAZRUL ISLAM	37	173	85	10	2	N	N	I	N	I	II	III	I
28.	MANIK MIA	38	169	85	10	8	N	Y	III	Y	I	I	III	I
29.	ABUL KALAM AZAD	38	174	85	10	7	Y	Y	III	Y	II	I	I	I
30.	MONIRUZZAMAN	39	170	75	10	15	N	Y	II	Y	I	I	III	II
31.	ZUBAYEDUL	39	168	80	10	4	Y	Y	III	Y	I	I	I	I
32.	ISMAIL HOSSAIN	39	169	70	10	10	N	N	II	Y	I	II	III	I
33.	SAGIR AHMED	40	173	67	10	8	N	N	III	Y	I	I	III	I
34.	AKHTER ALI	40	172	75	10	10	N	N	II	N	I	II	III	III
35.	LUTFAR RAHMAN	41	170	65	10	9	N	Y	III	Y	I	I	I	I
36.	AMJAD HOSSAIN	41	167	72	10	1	N	N	II	Y	I	III	I	III
37.	KALILUR RAHMAN	42	169	80	10	10	N	Y	III	N	II	I	II	II
38.	BACHCHU MIA	42	168	68	10	8	N	Y	II	Y	I	II	III	I
39.	FAROOK HOSSAIN	42	168	80	10	10	Y	N	I	Y	I	I	III	II
40.	ROIS UDDIN	43	167	66	10	8	Y	Y	III	Y	I	II	I	I
41.	ABUL KALAM	43	167	70	10	6	N	N	II	Y	I	I	I	I
42.	MONIRUZZAMAN	43	168	75	10	9	N	Y	II	Y	I	II	III	I
43.	AMIR UDDIN	45	177	78	10	17	N	Y	II	N	I	II	II	I
44.	SORBESH ALI	45	168	85	10	9	N	Y	II	Y	I	I	II	I
45.	FARUQ HOSSAIN	48	170	82	10	10	N	Y	III	Y	I	II	II	I
46.	MOKBUL HOSSAIN	48	167	68	10	10	N	N	I	Y	I	II	III	III
47.	ATAUR RAMAN	50	165	75	10	8	N	Y	II	N	I	I	III	II
48.	ALTAF HOSSAIN	53	175	`95	10	12	Y	Y	III	Y	I	I	II	II
49.	HARUNUR RASHID	53	167	75	10	29	N	Y	III	Y	II	I	II	II
50.	ABDUR ROUF	55	168	85	10	5	N	Y	III	Y	I	II	I	I

H=Height
W=Weight
D W=Daily Working Period
L S=Length of Service as Traffic Police



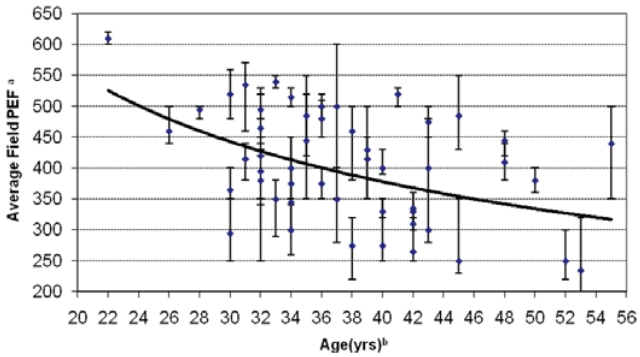
a. Standard Peak Expiratory Flow Values obtained from Standard calibrated chart (see Figure A)
b. Age (years) of traffic polices obtained from field survey (see Table 1)

Fig. 4: Standard Peak Expiratory Flow (PEF) compare with Age of Traffic Police

Table 1: Age (years) and Standard PEF value

Serial No	Age(years)	Standard PEF value	Serial No	Age(years)	Standard PEF value
1	22	612	26	37	535
2	26	554	27	37	557
3	28	560	28	38	540
4	30	582	29	38	560
5	30	570	30	40	539
6	30	572	31	39	533
7	31	582	32	39	534
8	31	563	33	40	552
9	32	558	34	40	549
10	32	542	35	42	534
11	32	549	36	41	528
12	32	558	37	42	530
13	32	554	38	42	526
14	33	510	39	42	528
15	33	560	40	43	520
16	34	570	41	43	525
17	34	554	42	43	525
18	34	545	43	45	552
19	34	564	44	45	518
20	34	520	45	48	520
21	36	586	46	48	510
22	35	552	47	50	497
23	35	552	48	52	529
24	36	549	49	53	500
25	36	567	50	55	495

Thus inference can be made that age is not the single parameter to reduce PEF value.



a. Average Peak Expiratory Flow Values of traffic polices obtained from field survey.
b. Age (years) of traffic polices obtained from field survey.

Fig. 5: Average Field Peak Expiratory Flow (PEF) (with best & worst value) compare with Age of Traffic Police

The standard PEF value for 26 years aged subject is 554 L/min, whereas, the average field PEF was found to be 460 L/min, i.e., field PEF differs from the standard by 94 L/min. The sample was of a subject a length of service of 2 years. On the other hand, for the next subject who was 28 years old, the standard PEF value should have been less than that of 26 years aged sample. However, from the field data, it is evident that 28 years age group had a higher PEF (495 L/min) but length of service was only 1 year. Therefore, the results indicate that length of service, i.e., exposure to pollutants may play a major role in pulmonary system disorder. Similarly, if we compare two subjects having age of 40 and 41 years and length of service of 10 and 1 years respectively, same inference could be made. For the subject of 40 years age with a length of service 10 years, standard PEF value is 549 L/min, whereas, average field PEF value was found to be 330 L/min (see Table

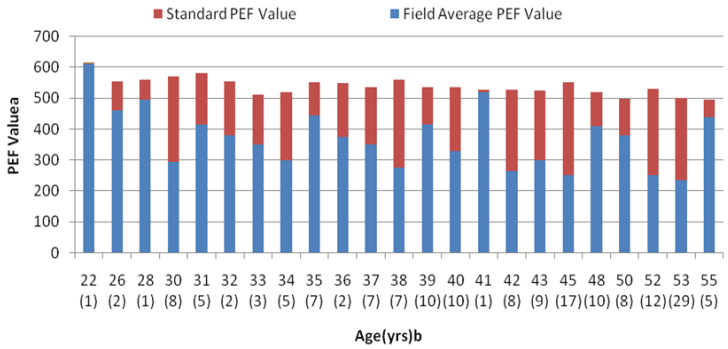
Table 2: Age (years) and Average Field PEF (With Worst and Best value)

Serial No	Age(years)	Worst Field PEF value	Best Field PEF value	Average Field PEF value
1	22	600	620	610
2	26	440	500	460
3	28	480	500	495
4	30	480	560	520
5	30	250	350	295
6	30	350	400	365
7	31	380	440	415
8	31	460	570	535
9	32	450	530	495
10	32	350	480	420
11	32	340	440	395
12	32	420	520	465
13	32	250	430	380
14	33	290	380	350
15	33	530	550	540
16	34	500	530	515
17	34	340	350	345
18	34	300	450	375
19	34	350	450	400
20	34	260	350	300
21	36	480	520	500
22	35	350	550	485
23	35	420	520	445
24	36	350	400	375
25	36	450	510	480
26	37	280	400	350
27	37	350	600	500
28	38	380	500	460
29	38	220	320	275
30	40	250	350	275
31	39	350	500	430
32	39	350	450	415
33	40	390	430	400
34	40	320	350	330
35	42	300	360	330
36	41	500	530	520
37	42	300	360	335
38	42	250	300	265
39	42	300	320	310
40	43	450	500	475
41	43	280	480	400
42	43	300	300	300
43	45	230	350	250
44	45	430	550	485
45	48	380	440	410
46	48	420	460	445
47	50	360	400	380
48	52	220	300	250
49	53	200	320	235
50	55	350	500	440

3(b)). On the other hand, for the next subject (41 years) having length of service 1 year, standard PEF value is 528 L/min and the corresponding average field PEF value was found to be 520 L/min (see Table 3(b)). However, theoretically, 41 years aged subject should have lesser PEF value than that of 40 years aged subject. Thus, higher rate of average field PEF value for 41 years aged subject may be due to the effect of length of service and height. To isolate the governing factor (height or length of service) a hypothetical analysis was performed.

In this hypothetical analysis, the height of both subjects (see Table below) was kept same at 172 cm (that of 40 years aged subject). It was observed that difference between standard and average field PEF value for 40 years aged subject is 219 L/min, having length of service 10 years which is much higher than that of 41 years aged subject having length of service 1 year only. From this comparison it is evident that the length of service plays a major role in the decrease of PEF value.

					Hypothetical Analysis		
Age (years)	Actual height (cm)	Length of service (years)	Standard PEF Value (L/min)	Average Field PEF Value (L/min)	Height (cm)	Standard PEF Value (L/min	Difference (L/min)
40	172	10	549	330	172	549	219
41	167	1	528	520	172	548	28



a. Peak Expiratory Flow Values (`Average Field PEF values' obtained from field survey and `Standard PEF values' obtained from standard calibrated chart, (see Figure A)

b. Age (years) of traffic police obtained from field survey (service years in parenthesis).

Fig. 6: Standard PEF and Field Average PEF value compare with Age of Traffic Police

Table 3(a): Age (years), Standard PEF and Average Field PEF value

Serial No.	Age (Service years in parenthesis)	Standard PEF value	Average Field PEF value	Serial No.	Age (Service years in parenthesis)	Standard PEF value	Average Field PEF value
1	22(1)	612	610	26	37(7)	535	350
2	26(2)	554	460	27	37(2)	557	500
3	28(1)	560	495	28	38(8)	540	460
4	30(2)	582	520	29	38(1)	560	275
5	30(8)	570	295	30	40(15)	539	275
6	30(6)	572	365	31	39(4)	533	430
7	31(5)	582	415	32	39(10)	534	415
8	31(4)	563	535	33	40(8)	552	400
9	32(4)	558	495	34	40(10)	549	330
10	32(5)	542	420	35	42(9)	534	330
11	32(3)	549	395	36	41(1)	528	520
12	32(3)	558	465	37	42(10)	530	335
13	32(2)	554	380	38	42(8)	526	265
14	33(3)	510	350	39	42(10)	528	310
15	33(6)	560	540	40	43(8)	520	475
16	34(5)	570	515	41	43(6)	525	400
17	34(6)	554	345	42	43(9)	525	300
18	34(4)	545	375	43	45(17)	552	250
19	34(2)	564	400	44	45(9)	518	485
20	34(5)	520	300	45	48(10)	520	410
21	36(4)	586	500	46	48(10)	510	445
22	35(12)	552	485	47	50(8)	497	380
23	35(7)	552	445	48	52(12)	529	250
24	36(2)	549	375	49	53(29)	500	235
25	36(5)	567	480	50	55(5)	495	440

The Figure 7 shows the standard PEF value and field average PEF with the best and worst values compare with age groups. Worst case in field expiratory flow of same age group was given priority to comprehend whether it follows the trend. The corresponding data is given in Table 4.

The Figure shows that the field average PEF value is always less than the standard PEF value for each of the age groups.

Figure 8 shows the average field PEF and standard PEF value compare with length of service of traffic police. PEF data collected from fifty traffic police have random service years (see Table 5 (a)). Sample having

lowest PEF in each service year group were given priority and 23 data were screened out to draw this figure (see Table 5(b)).

From the Figure 8, it is seen that the difference between standard PEF value and field average PEF value increase with the increase in length of service which show a smooth decreasing trend. Using statistical analysis of the data (see Table 5(b)) the regression co-efficient, R^2 of this trend was obtained to be 0.79 which indicate moderate correlation. So, lung function deteriorates indicated by the decrease in PEF value with length of service.

Table 3(b): Age (years), Standard PEF and Average Field PEF value

Serial No.	Age (Service years in parenthesis)	Standard PEF value	Average Field PEF value
1	22 (1)	612	610
2	26 (2)	554	460
3	28 (1)	560	495
4	30 (8)	570	295
5	31 (5)	582	415
6	32 (2)	554	380
7	33 (3)	510	350
8	34 (5)	520	300
9	35 (7)	552	445
10	36 (2)	549	375
11	37 (7)	535	350
12	38 (7)	560	275
13	39 (10)	534	415
14	40 (10)	534	330
15	41 (1)	528	520
16	42 (8)	526	265
17	43 (9)	525	300
18	45 (17)	552	250
19	48 (10)	520	410
20	50 (8)	497	380
21	52 (12)	529	250
22	53 (29)	500	235
23	55 (5)	495	440

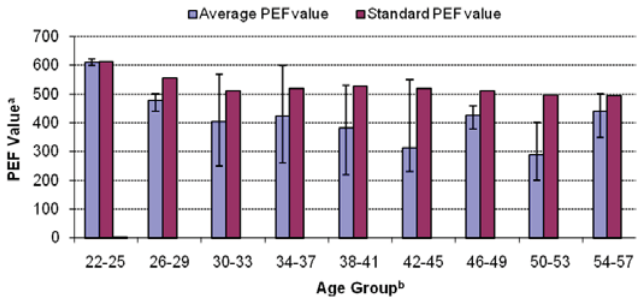
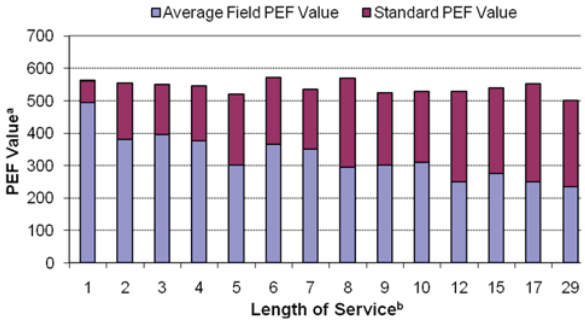


Fig. 7: Average Field PEF value (With Error Bar) and Standard PEF value compare with Age Group of Traffic Police.

Table 4: Average Field PEF value, Standard PEF value and Age (years)

Serial No.	Age Group	Minimum Standard PEF value of the Age Group	Best Field PEF value of the	Worst Field PEF value of the Age Group	Average Field PEF value of the Age Group
1	22-25	612	620	600	610
2	26-29	554	500	440	478
3	30-33	510	570	250	405
4	34-37	520	600	260	422
5	38-41	528	530	220	382
6	42-45	518	550	230	313
7	46-49	510	460	380	427
8	50-53	497	400	200	288
9	54-57	495	500	350	440



a. Peak Expiratory Flow Values (`Average Field PEF values' obtained from field survey and `Standard PEF values' obtained from standard calibrated chart,(see Table A)

b. Length of Service (years) of traffic police obtained from field survey.

Fig. 8: Average Field PEF and Standard PEF Value compare with Length of Service

Table 5(a): Average PEF value and Standard PEF value compare with Length of Service (years)

Serial No.	Length of Service (years)	Standard PEF value	Average Field PEF value	Serial No.	Length of Service (years)	Standard PEF value	Average Field PEF value
1	1	612	610	26	7	535	350
2	2	554	460	27	2	557	500
3	1	560	495	28	8	540	460
4	2	582	520	29	7	560	275
5	8	570	295	30	15	539	275
6	6	572	365	31	4	533	430
7	5	582	415	32	10	534	415
8	4	563	535	33	8	552	400
9	4	558	495	34	10	549	330
10	5	542	420	35	9	534	330
11	3	549	395	36	1	528	520
12	3	558	465	37	10	530	335
13	2	554	380	38	8	526	265
14	3	510	350	39	10	528	310
15	6	560	540	40	8	520	475
16	5	570	515	41	6	525	400
17	6	554	345	42	9	525	300
18	4	545	375	43	17	552	250
19	2	564	400	44	9	518	485
20	5	520	300	45	10	520	410
21	4	586	500	46	10	510	445
22	12	552	485	47	8	497	380
23	7	552	445	48	12	529	250
24	2	549	375	49	29	500	235
25	5	567	480	50	5	495	440

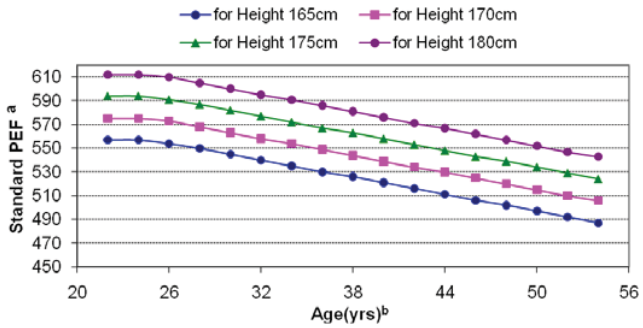
Table 5(b): Average PEF value and Standard PEF value and Service Years

Serial No.	Service Years	Standard PEF value	Average Field PEF value	Difference between Standard and Average Field PEF value
1	1	560	495	65
2	2	554	380	174
3	3	549	395	154
4	4	545	375	170
5	5	520	300	220
6	6	572	365	207
7	7	535	350	185
8	8	570	295	275
9	9	525	300	225
10	10	528	310	218
11	12	529	250	279
12	15	539	275	264
13	17	552	250	302
14	29	500	235	265

Therefore, it is evident that the length of service or exposure to polluted air has significant potential to affect pulmonary systems of traffic police of Dhaka City.

The Figure 9 shows that standard peak expiratory flow value of the traffic police of four groups of height ranges (165cm, 170cm, 175cm and 180cm). Corresponding data is given in Table 6(a).

The standard peak expiratory flow value of the subject of a fixed height decreases with the increase in age. Thus, the Figure 9 shows a smooth decreasing trend in standard peak expiratory flow value with the natural aging in case of a fixed height. Again, the standard peak expiratory flow value increases with greater height at same age.



a. Standard Peak Expiratory Flow Values obtained from standard calibrated chart (see Table A)
b. Age (years) of traffic polices obtained from field survey

Fig. 9: Standard PEF value compare with Age (years) of Traffic Police of Different Heights

Table 6(a): Standard PEF value and Age (years) of Traffic Police of Different Heights (165cm, 170cm, 175cm, 180cm)

		Standard PEF value			
Serial No.	Age (years)	For Height 165 cm	For Height 170cm	For Height 175 cm	For Height 180 cm
	22	557	575	594	612
	24	557	575	594	612
	26	554	573	591	610
	28	550	568	587	605
	30	545	563	582	600
	32	540	558	577	595
	34	535	554	572	591
	36	530	549	567	586
	38	526	544	563	581
	40	521	539	558	576
	42	516	534	553	571
	44	511	530	548	567
	46	506	525	543	562
	48	502	520	539	557
	50	497	515	534	552
	52	492	510	529	547
	54	487	506	524	543

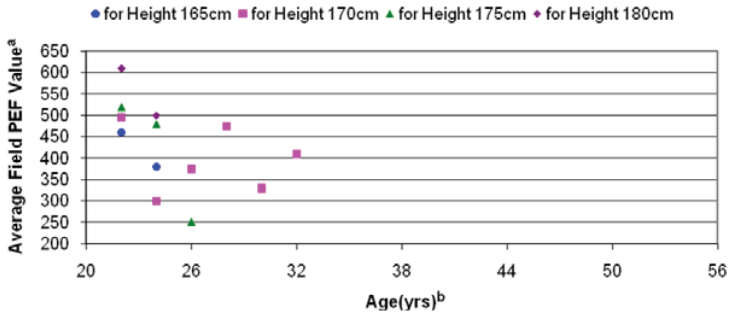
Again, average field peak expiratory flow value of the traffic police of four most frequent heights compare with age (years) was presented in Figure 10. The corresponding data is given in Table 6(b).

The standard PEF values for 165 cm height group vary from 557 to 497, a difference of 60 L/min for age range of 22-54 years (see Table 6(a)) whereas field PEF value ranges from 380 to 460 L/min, a difference of 80 L/min (see Table 6(b)).

The range of variation in standard PEF value is from 575 to 506 L/min, a difference of 69 L/min for age range of 22-54 years (see Table 6(a)) in case of 170 cm height group. But field PEF value ranges from 495 to 300 L/min, a difference of 195 L/min (see Table 6(b)).

Again, the range of variation in standard PEF value is from 594 to 524 L/min, a difference of 70 L/min for age range of 22-54 years (see Table 6(a)) for 175 cm height group, whereas, field PEF value ranges from 520 to 250 L/min, a difference of 270 L/min (see Table 6(b)).

From these comparisons, it is visible that average field PEF value is always less than the standard PEF value for a fixed height group. Same inference could be made for 180 cm height group as the standard PEF value for that height vary from 612 to 543 L/min, a difference of 69 L/min for age range of 22-54 years (see Table 6(a)) and field PEF value ranges from 610 to 500 L/min, a difference of 110 L/min (see Table 6(b)).



a. Average Peak Expiratory Flow Values of traffic polices obtained from field survey
b. Age (years) of traffic polices obtained from field survey

Fig. 10: Average Field PEF value compare with Age (years) for Different Heights

Table 6(b): Average Field PEF value and Age (years) of Traffic Police of Different Heights (165cm, 170cm, 175cm, 180cm)

		Standard PEF value			
Serial No.	Age (years)	For Height 165 cm	For Height 170cm	For Height 175 cm	For Height 180 cm
26	460				
50	380				
32		495			
34		300			
36		375			
38		475			
42		330			
48		410			
30			520		
36			480		
52			250		
22				610	
36				500	

2.8. Significance of Length of Service on Pulmonary System:

The Figure 11 was drawn by using the field average PEF values of 50 traffic police which shows that over 30% of the subjects should be taken immediate medical care whereas over 65% of them are bearing potential warning of asthma attack and only 2% are at sound state. Data is given in Table 7, taken from Table A .

Again the subjects were divided into three groups according to their length of service as (a) Length of Service up to 5 years; (b) Length of Service 5 to10 years and (c) Length of Service over 10 years. From each group, percentages of the subjects in different pulmonary condition were calculated.

Table 7: Traffic Police and Average Field PEF Value Range

Range of Average Field PEF Value	No. of Traffic Police
Red zone (100-350 L/min)	16
Yellow zone (350-600 L/min)	33
Green zone (>600 L/min)	1
Total	50

Figure 12 shows that, of the 50 sample subjects 23 falls in the category who have been working as traffic police up to 5 years, almost 90% are bearing potential warning of pulmonary disease attack. Less than 5% of them are at sound health. Unlike those, almost 10% traffic police may need emergency medical attention. The raw data is given in Table 8(a).

Figure 13 implies that, of the 50 samples 16 falls in the category who have been working as traffic police from 5 to 10 years, almost 50% risk potential Pulmonary attack and 50% may need emergency medical attention and none at green colour zone. The corresponding data is given in Table 8(b).

Figure 14 reveals that, of the 50 samples 11 falls in this category who have been working as traffic police over 10 years, almost two thirds of them may need immediate medical attention, whereas, others are at vulnerable state. The corresponding data for Figure 13 is given in Table 8(c).

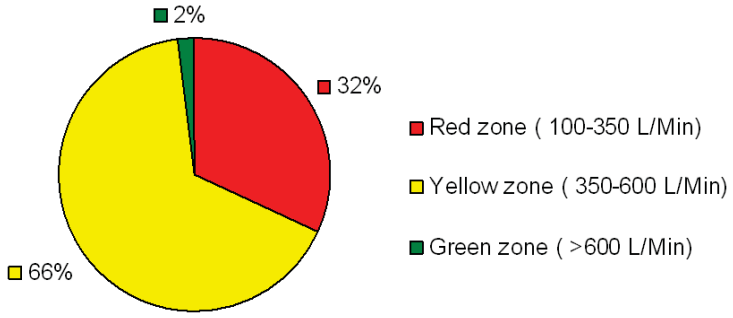


Fig. 11: Percentage of Traffic Police at Different Status of Pulmonary System(PEF colour zone)

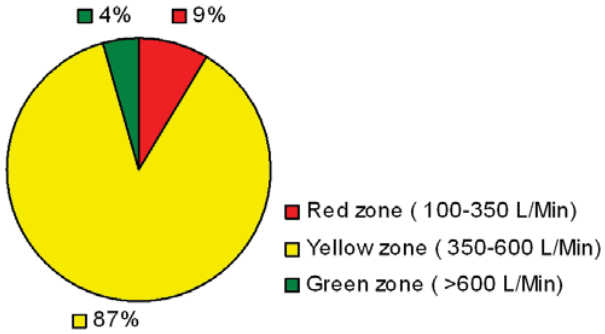


Fig. 12: Percentage of Traffic Police at Different Status of Pulmonary System (PEF zone) having Length of Service up to 5 years

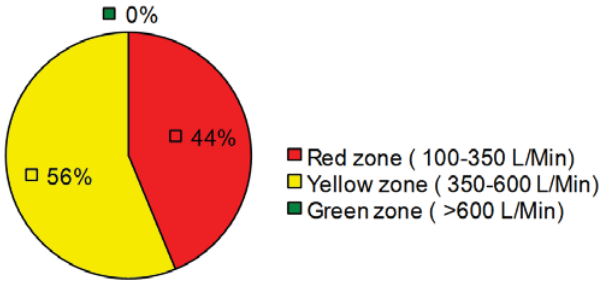


Fig. 13: Percentage of Traffic Police at Different Status of Pulmonary System (PEF zone) having Length of Service from 5 to 10 years

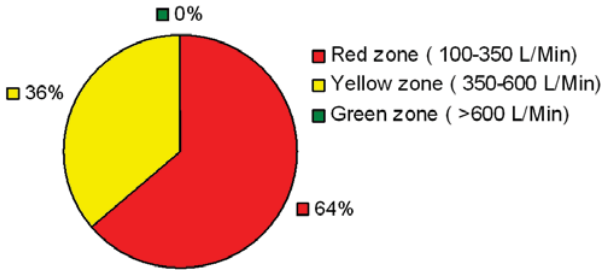


Fig. 14: Percentage of Traffic Police at Different Status of Pulmonary System (PEF zone) having Length of Service over 10 years

Table 8(a): Traffic Police Having Service Period 1-5 years (23 persons)

Range of Average Field PEF Value	No. of Traffic Police
Red zone (100-350 L/min)	2
Yellow zone (350-600 L/min)	20
Green zone (>600 L/min)	1
Total	23 persons

Table 8(b): Traffic Police Having Service Period 5-10 years (16 persons)

Range of Average Field PEF Value	No. of Traffic Police
Red zone (100-350 L/min)	7
Yellow zone (350-600 L/min)	9
Green zone (>600 L/min)	0
Total	16 persons

Table 8(c): Traffic Police Having Service Period over 10 years (11 persons)

Range of Average Field PEF Value	No. of Traffic Police
Red zone (100-350 L/min)	7
Yellow zone (350-600 L/min)	4
Green zone (>600 L/min)	0
Total	11 persons

3. Conclusion and recommendation:

3.1. Conclusion:

The study was focused regarding the impact of exposure in airborne pollutant on pulmonary system of traffic police of Dhaka City. Standard PEF value decreases compare with standard aging which have shown in analysis. But the field PEF value of the subjects varies in highly random manner with significant difference from standard value. The result stated that additional parameters may affect except age. Taking length of service under consideration, clarified that, longer the length of service rendering greater exposure to polluted air, greater the difference between field PEF value and standard PEF value. A regression co-efficient of 0.79 has also been obtained while correlating deterioration of lung function with length of service.

Moreover, the analyzed data indicate that traffic police working at various road intersections of Dhaka City are attaining emergency medical attention of disease concerning pulmonary system increasingly with longer length of service or exposure in airborne pollutants.

3.2. Recommendation:

Multivariate statistical analysis with other potential health factors may be included in the data analysis.

Attempt should be made to correlate other health effects with the exposure in polluted air. To incorporate further risk analysis, the effects of individual airborne pollutants like O3, CO, PM, NOx, SOx etc. should be analyzed in large scale.

This study could be extended to the assessment of exposure in other cities and comparison can be made with that of Dhaka City

Larger sample volume could be collected concerning this study to conceive the effect of additional parameters affecting pulmonary system other than exposure time and age.

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