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Assessment of Air Pollution Associated Self-Reported Symptoms on General Population of Rawalpindi and Islamabad

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ABSTRACT

Objectives: To assess the air pollution-associated self-reported symptoms among the general population of Rawalpindi and Islamabad.

Study Design: Analytical cross-sectional study.

Place and Duration of Study: Study was conducted at Pak Emirates Military Hospital & Combined Military Hospital, Rawalpindi Pakistan, from Nov 2021 to Apr 2022.

Methodology: The data was collected using a pre-formed questionnaire and was distributed among the general population that reported to Pak Emirates Military Hospital and Combined Military Hospital OPD, Rawalpindi Pakistan and the students of varying colleges of Islamabad and Rawalpindi Pakistan. People were thoroughly explained about the content and the purpose of our study. The data was collected after their consent and were told about their right to fill whole or part of the form and that they can withdraw or drop out of the study at any point. Data were analyzed in SPSS version 23.

Results: Mean age of the population was 29.41±12.41 years. The physical effects were categorized according to their scores as mild 54(21.3%), moderate 122(48.2%) and severe 77(30.4%). About 150(50.8%) participants reported positive behavioral and psychological effects of air pollution. About 160(63.4%) people reported that they've been using preventive measures to avoid the air pollution associated health effects. While 174(68.8%) people had sufficient awareness regarding air pollution and its effects (p<0.05).

Conclusion: The general population of Rawalpindi and Islamabad reported significant physical, and psychological, behavioral effects of air pollution. An association was found between occupation and physical effects of air pollution. Psychological effects like aggressive behavior and anxiety were found to have association with occupation. Facemask was found the most prevalent preventive measure. Participants had sufficient knowledge about air pollution and effects.

Keywords: Air pollution, Awareness, Behavioral effects, Physical effects, Prevention.

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INTRODUCTION

People are persistently advancing to be better adjusted and fit to their environmental elements; nonetheless, contamination has been an obnoxious variable for them. Air contamination got more extreme and undermining with material and innovative headways. These formative methodologies prompted substance, physical, and organic changes of the climate. These changes are in various angles including air, water, and general ecological arrangements, which thusly upset nature's equilibrium and its regenerative capacities. Fast and constantly expanding industrialization, motorized transportation, populace development, and disturbing urbanization present and add many new components, which accordingly upset the climate.[1] Industry and autos are the essential and auxiliary supporters of air contamination worldwide. The automobiles, for each gallon of fuel made, circulated, and afterward consumed in a vehicle, 25 pounds of carbon dioxide are delivered, alongside carbon monoxides, sulfur dioxide, nitrogen dioxide, and particulate matter; these discharges add to expand a dangerous atmospheric deviation.[2]

Contaminated air antagonistically influences the strength of people, creatures, plants, soils, harm structures and other property. There are five principal classes of poisons: carbon monoxide, hydrocarbons, nitrogen oxides, sulfur oxides and particulates. At the point when the convergence of the contaminations in the air turns out to be exceptionally high, many individuals experienced issues of breathing and accordingly couple of deaths might happen.[3] Air contamination contributes the occurrence of Bronchitis, emphysema and other respiratory sicknesses. Among kids air contamination has been demonstrated to be related with the rate of asthma, intense respiratory diseases, sensitivities and different sicknesses.[4] In metropolitan urban areas, boundless utilization of inferior quality fuel, joined with a sensational extension in the number of vehicles. On

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Pakistani streets, had driven huge air contamination issues. Lead and Fossil fuel byproducts are significant air toxins in metropolitan communities like Karachi, Lahore, Faisalabad and Islamabad.[5] The scenario remains the same globally and a 29% increase has been recorded in the atmospheric CO^2 since the start of industrialization, while its production reached 6–8 billion tons per year.[2]

Air contamination is the aftereffect of presenting new natural materials, particulate matter, and synthetic compounds that can hurt or unfavorably influence people and different living beings. These can genuinely harm the assembled climate or regular habitat and upset the environment, which is an intricate powerful arrangement of flammable gases and fundamental forever. Man-made progressions prompted the consumption of the Strato spherico zone, recognized as grave undermining for earth's environment by and large and for human wellbeing specifically. Notwithstanding, the worries and dangers are consistently expanding with various natural decaying factors, for instance, the expansion of new machines, compound plants, vehicles, production lines, modern smoke, and nuclear radiations. Air contamination antagonistically influences the biosphere (people, creatures, and plants) and harm human property like their homes or different structures. The significant classes of contaminations are hydrocarbons, carbon monoxide, sulfur oxide, nitrogen oxides, and particulate matter (i.e., PM2.5, PM10, and so forth.). An expansion in the grouping of these poisons prompts various issues for human wellbeing. These issues might be as a health related crisis (various sicknesses and problems) or a monetary weight. A few investigations have investigated and examined the relationship of various issues with air contamination.[6] Because of the compromising outcome of air contamination across the globe, all the more explicitly around the creating areas including Pakistan, advancement research, colossal positive information, mass mindfulness, and contamination moderating advances are essentially required. Control measures are accessible that can give clean air to Pakistan and increment prosperity in actual terms, notwithstanding the normal expansion in material government assistance from the continuous monetary turn of events. Such measures incorporate specific substitution of the most dirtying energizes by cleaner energy transporters and compelling execution of committed finish of-pipe control innovations.

Based on various approach situations considered in this review, it is recommended that if there should arise an occurrence of ACT situation, the PM2.5 outflows, taken for instance, are decreased by 66% in 2030 when contrasted with the situation accepting a continuation of present status of emanation control. Different arrangement of innovation measures chose for the situations under assessment bring about various degrees of medical advantages and include various degrees of monetary assets.[7]

During the recent Coronavirus lockdown across the globe a huge decline in air contamination was noticed, ongoing reports uncovered an expansion in air contamination in Pakistan even in the capital city, Islamabad (The Express Tribune, 2020). Keeping in view situation, the ongoing review was done in Rawalpindi and Islamabad to know oneself announced physical and mental impacts of air contamination on the understudies. The concentrate additionally assessed the degree of mindfulness, reception of preventive measures against air contamination, and wellsprings of information on the selected subjects.[1]

METHODOLOGY

An analytical cross-sectional study was carried out in the OPDs of tertiary care hospitals Pak Emirates Military Hospital & Combined Military Hospital in Rawalpindi Pakistan. Research was conducted over a period of 6 months from November 2021 to April 2022. Using Openepi, online sample size calculator, with 95% confidence interval, the sample size was taken as 253.

Inclusion Criteria: participants of age 15 and above among general population of Rawalpindi and Islamabad and of both genders were included.

Exclusion Criteria: While people not resident of Rawalpindi and Islamabad, not giving consent were excluded.

Non probability samp-ling technique was used. A validated questionnaire taken from a study conducted in Malakand Division Pakistan,[1] was used for assessment of self-reported effects of air pollution by the general population of Rawalpindi and Islamabad.

Our questionnaire has four parts; after the demographic details of the participant, the first part deals with the physical effects of air pollution on one's health. It has 6 parts with each part with a ranking of 0-4 (0=Never, 1=Rarely, 2=Sometimes, 3=Often, 4=Always) .People were given scores on a scale of 0-24 (0-8= Mild physical effects, 9-16=Moderate physical effects, 17-24=Severe physical effects). Next part deals with the behavioral and psychological effects. It has 7 parts each with a ranking of 0-1 (0=No effect, 1=Effect present).The next part is concerned with the preventive measures taken by the people. It has 4 parts each with a ranking

of 0-1(0=No effect, 1= effect present). The last part is regarding the level of awareness among people regarding air pollution. It has 4 parts each with a ranking of 0-1(0=No awareness, 1=awareness present).

Consent was taken from the participants and the whole research purpose was explained to them. Questionnaires were filled online through google forms as well as via surveys (printed forms). Only the people of Rawalpindi & Islamabad were asked to fill the forms.

Data collected were entered and analyzed using the SPSS-23. Relevant frequency and percentages were calculated for qualitative variables whereas Means±SD will be calculated for quantitative variables. Test of significance Chi-square was used to find association. A *p*-value <0.05 was found to be significant whereas as a value greater than 0.05 was considered insignificant and no relation was drawn. MicroSoft excel and Word was used to draw tables and graphs.

RESULTS

A total of two hundred and fifty three people were recruited for the study of self-reported effects of air pollution on the general population of Rawalpindi and Islamabad and demographic details shown in Table-I.

Table-I: Demographics details

	Frequency	Percent
Gender		
Male	133	52.6
Female	120	47.4
Occupation		
Student	126	49.8
Housewife	23	9.1
Driver	26	10.3
Office workers	53	20.9
Laborers	2	0.8
Traffic warden	2	0.8
Others	21	8.3
Residence		
Rawalpindi	129	51.0
Islamabad	124	49.0
Education		
Primary	11	4.3
Middle	14	5.5
Matric	20	7.9
Intermediate	43	17.0
Higher	165	65.2

The first part of the questionnaire deals with the physical effects of air pollution on people's health. The frequency of participants response was categorized according to their scores as mild 54(21.3%), moderate 122(48.2%) and severe 77(30.4%). The statistics showed that a major portion of participants i.e., 67(26.1%) experienced sleeping disorders oftenly, 47(18.2%) sometimes and 42(16.6%) always. Reduced energy levels were often observed in 90(35.2%), sometimes in 60(23.7%), rarely in 42(16.2%), never in 32(13.4%) and always in 29(11.5%). Headache and dizziness was observed to be less common among participants, about 27(10.7%) had them always while 84(32.4%) and 74(28.9%) had them often and sometimes respectively. Wheezing and coughing were observed to be lesser as compared to the previous question, i.e., 18(6.7%) always and 85(33.2%) often, reported them. Similarly 26(10.3%) people reported that they always suffer from ENT/respiratory problems, however 83(32.0%) and 58(23.3%) suffered often and sometimes respectively. 57(22.1%) people always felt air pollution effects relative to 94(37.2%) that felt them often and 51(20.2%) that felt sometimes as shown in Figure-1(a).

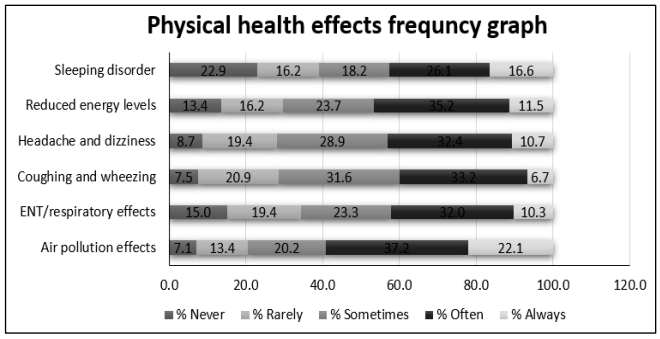

Figure-1(a): Frequency graphs for physical Heath Effects

The second part of the questionnaire deals with the behavioral and psychological effects of air pollution. A total of 153(60.5%), 105(41.5%), 164(64.8%), 118(46.6%), 136(53.8%), 93(36.8%) and 113(51.4%) participants reported that they felt depressed, could jog faster for a short time, could walk faster, suffered from anxiety, were aggressive to others, aggressive during cold days & during hot days respectively as depicted Figure-1(b).

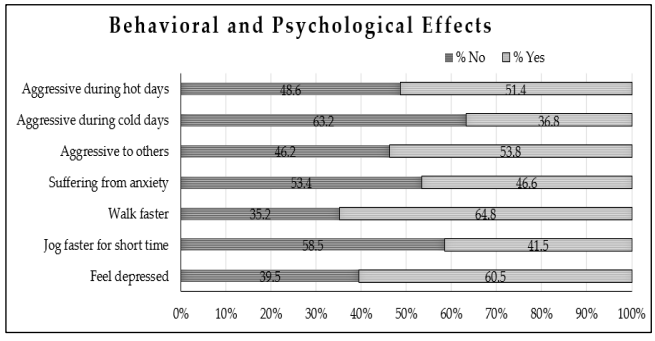

Figure-1(b): Frequency graphs for Psychological Effects

The third part is concerned with the preventive measures taken by people to safeguard themselves from the harmful effects of polluted air. Of the total respondents, 162(64%) ate healthy foods, 161(63.6%) drank

more water, 102(40.3%) wore glasses/goggles and 217(85.8%) used face masks as Figure-1(c) shows the statistics.

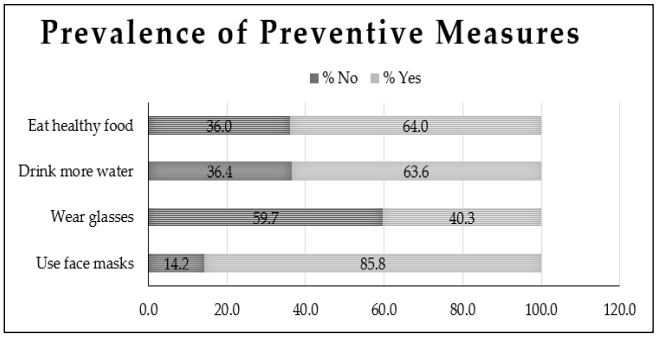

Figure-1(c): Frequency graphs for Preventive Measures

The fourth and last part of the questionnaire was concerned with the knowledge and perception of recruited participants about air pollution. 208(82.2%) were of the view that smoking should be prohibited and it has adverse effects. 124(49.0%) had idea about the deaths caused by air pollution, 175(69.2%) had knowledge about the diseases caused by air pollution and 189(74.7%) had awareness what air pollutant is and about its adverse effects as shown in Figure-1(d).

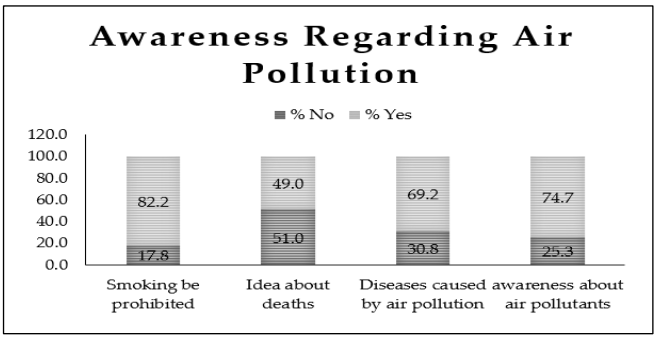

Figure-1(d): Frequency graphs for Awareness

Table-II shows occupation dependent physical effects of air pollution. A significant *p*-value ($p<0.05$)

Table-II: Occupation Dependent Physical Effects of Air Pollution

		Student		Housewife		Driver		Office workers		Laborers		Traffic warden		Others		*p*-value
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	
Air pollution effects	Never	10	7.9	2	8.7	1	3.8	2	3.8	0	0.0	0	0.0	1	4.8	0.164
	Rarely	21	16.7	1	4.3	0	0.0	11	20.8	0	0.0	0	0.0	2	9.5	
	times	30	23.8	4	17.4	1	3.8	12	22.6	0	0.0	0	0.0	4	19.0	
	Often	44	34.9	12	52.2	11	42.3	17	32.1	1	50.0	1	50.0	8	38.1	
	Always	21	16.7	4	17.4	13	50.0	11	20.8	1	50.0	1	50.0	6	28.6	
ENT problems	Never	26	20.6	1	4.3	0	0.0	5	9.4	0	0.0	0	0.0	3	14.3	0.000
	Rarely	30	23.8	0	0.0	2	7.7	16	30.2	0	0.0	1	50.0	2	9.5	
	times	31	24.6	6	26.1	3	11.5	8	15.1	1	50.0	0	0.0	9	42.9	
	Often	31	24.6	9	39.1	18	69.2	18	34.0	1	50.0	1	50.0	5	23.8	
	Always	8	6.3	7	30.4	3	11.5	6	11.3	0	0.0	0	0.0	2	9.5	
Coughing / wheezing	Never	8	6.3	0	0.0	0	0.0	5	9.4	0	0.0	0	0.0	3	14.3	0.055
	Rarely	33	26.2	2	8.7	2	7.7	12	22.6	1	50.0	0	0.0	3	14.3	
	times	45	35.7	9	39.1	4	15.4	16	30.2	1	50.0	2	100.0	4	19.0	
	Often	32	25.4	10	43.5	16	61.5	18	34.0	0	0.0	0	0.0	9	42.9	
	Always	8	6.3	2	8.7	4	15.4	2	3.8	0	0.0	0	0.0	2	9.5	
Headache and dizziness	Never	9	7.1	0	0.0	0	0.0	4	7.5	1	50.0	0	0.0	4	19.0	0.046
	Rarely	31	24.6	3	13.0	1	3.8	11	20.8	0	0.0	0	0.0	4	19.0	
	times	38	30.2	10	43.5	5	19.2	15	28.3	0	0.0	1	50.0	5	23.8	
	Often	38	30.2	8	34.8	13	50.0	19	35.8	1	50.0	1	50.0	4	19.0	
	Always	10	7.9	2	8.7	7	26.9	4	7.5	0	0.0	0	0.0	4	19.0	
Sleeping disorder/ Insomnia	Never	36	28.6	2	8.7	1	3.8	10	18.9	1	50.0	0	0.0	4	19.0	0.033
	Rarely	22	17.5	5	21.7	2	7.7	11	20.8	0	0.0	0	0.0	3	14.3	
	times	24	19.0	2	8.7	4	15.4	10	18.9	0	0.0	2	100.0	5	23.8	
	Often	28	22.2	7	30.4	10	38.5	17	32.1	1	50.0	0	0.0	4	19.0	
	Always	16	12.7	7	30.4	9	34.6	5	9.4	0	0.0	0	0.0	5	23.8	
Reduced energy levels	Never	10	7.9	3	13.0	0	0.0	8	15.1	1	50.0	0	0.0	10	47.6	0.002
	Rarely	23	18.3	3	13.0	1	3.8	13	24.5	0	0.0	0	0.0	2	9.5	
	times	30	23.8	8	34.8	7	26.9	12	22.6	1	50.0	1	50.0	1	4.8	
	Often	47	37.3	7	30.4	15	57.7	16	30.2	0	0.0	1	50.0	4	19.0	
	Always	16	12.7	2	8.7	3	11.5	4	7.5	0	0.0	0	0.0	4	19.0	

** Bold value represents p-value <0.05 i.e. significant*

was found between ENT/ respiratory problems, coughing and wheezing, headache dizziness, sleeping disorders and reduced energy levels with values 0.001, 0.005, 0.046, 0.033 and 0.002 respectively.

Table-III shows district specific physical effects of air pollution. The *p*-values for physical effects like ENT/ respiratory problems (*p*-2.971), headache dizzi-ness (*p*-8.791),coughing/wheezing (*p*-6.464), sleeping disorders (*p*-2.214), reduced energy levels (*p*-3.096) were not significant (*p*>0.05).

Table III: District Specific Physical Health Effects Of Air Pollution

		Residence				*p*-value
		Rawalpindi		Islamabad		
		n	%	n	%	
Have you ever felt air pollution effects?	Never	11	8.5	5	4.0	9.081
	Rarely	22	17.1	13	10.5	
	Sometimes	18	14.0	33	26.6	
	Often	48	37.2	46	37.1	
	Always	30	23.3	27	21.8	
How often you suffer from ENT/Respiratory problems?	Never	22	17.1	13	10.5	2.971
	Rarely	24	18.6	27	21.8	
	Sometimes	31	24.0	27	21.8	
	Often	39	30.2	44	35.5	
	Always	13	10.1	13	10.5	
How often you suffer from coughing / wheezing?	Never	11	8.5	5	4.0	4.464
	Rarely	27	20.9	26	21.0	
	Sometimes	35	27.1	46	37.1	
	Often	46	35.7	39	31.5	
	Always	10	7.8	8	6.5	
How often you suffer from headache and dizziness?	Never	14	10.9	4	3.2	8.791
	Rarely	30	23.3	20	16.1	
	Sometimes	33	25.6	41	33.1	
	Often	39	30.2	45	36.3	
	Always	13	10.1	14	11.3	
Are you having sleeping disorder/insomnia?	Never	25	19.4	29	23.4	2.214
	Rarely	26	20.2	17	13.7	
	Sometimes	24	18.6	23	18.5	
	Often	34	26.4	33	26.6	
	Always	20	15.5	22	17.7	
How often you feel reduced energy levels?	Never	20	15.5	12	9.7	3.096
	Rarely	19	14.7	23	18.5	
	Sometimes	33	25.6	27	21.8	
	Often	43	33.3	47	37.9	
	Always	14	10.9	15	12.1	

Table-IV shows district specific psychological and behavioral effects. Values calculated were insigni-ficant (>.5) as psychological effects as feel depressed (*p*-0.998), jog faster (*p*-0.347), walk faster (*p*-0.870), anxiety (*p*-0.833) and aggressive behavior (*p*-0.554) along with aggression during either hot (*p*-0.747) or cold days (*p*-0.158).

Table-V represents occupation dependent psychological and behavioral effects of air pollution. The *p*-value for anxiety is found to be 0.034 i.e., significant. Aggressive behavior *p*-value is significant as is 0.017. The *p*-values for feeling depressed (*p*-0.185), jogging faster (*p*-0.088), walking faster (*p*-0.383), and aggressive behavior during hot (*p*-0.273) or cold days (*p*-0.80) are insignificant.

Table-IV: District-dependent psychological and behavioural effects of air pollution

		Rawalpindi		Islamabad		*p*-value
		n	%	n	%	
Feel Depressed	No	51	39.5	49	39.5	0.998
	Yes	78	60.5	75	60.5	
Jog Faster And For A Short Time	No	79	61.2	69	55.6	0.347
	Yes	50	38.8	55	44.4	
Walk Faster	No	46	35.7	43	34.7	0.870
	Yes	83	64.3	81	65.3	
Suffering From Anxiety Of Any Kind	No	68	52.7	67	54.0	0.833
	Yes	61	47.3	57	46.0	
Have Been Aggressive To Others	No	62	48.1	55	44.4	0.554
	Yes	67	51.9	69	55.6	
Show Aggressiveness During Cold Days	No	87	67.4	73	58.9	0.158
	Yes	42	32.6	51	41.1	
Show Aggressiveness During Hot Days	No	64	49.6	59	47.6	0.747
	Yes	65	50.4	65	52.4	

DISCUSSION

Pakistan is one of the fastest growing economies in Asia. But as we know increase in advancement comes at a price and thus due to rapid industrialization and urbanization pollution is increasing day by day. Several atmospheric pollutants like NOx, SO^2, CO, particulate matter, etc. have high concentrations in Pakistan. Studies have linked the presence of these atmospheric pollutants to different sectors. For NOx, primary sources include the transportation and industrial sectors, responsible for around (43.2% and 39.6%) of the total annual emissions. Major Sources of SO^2 and CO include industrial and thermal power generation, residential and transportation sectors, responsible for around (75.6% and 14.6%) and (62.9% and 23.6%) of total annual emissions,[1] respectively. Looking at the statistics taken over 2019, Rawalpindi came in with a PM 2.5 average of 40.8µg/m^3, placing it into the 'unhealthy for sensitive groups' bracket, which requires a PM 2.5 reading of anywhere between 35.5 to 55.4µg/m^3 to be classified as such. This reading places Rawalpindi into 8th place out of all cities registered in Pakistan, as well as 224th place in all cities ranked worldwide in terms of their pollution levels. In regards to the levels of pollution in the air,

Islamabad came in with PM 2.5 readings of 35.2µg/m³ as a yearly average over 2019. This put it as the cleanest city in the whole of the country, coming in at 10th place out of all cities currently ranked in Pakistan[20].

Table-V: Occupation-dependent psychological and behavioural effects of air pollution

		Student		House-wife		Driver		Office workers		Laborers		Traffic warden		Others		*p*-value
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	
Feel Depressed	No	48	38.1	10	43.5	6	23.1	27	50.9	0	0.0	0	0.0	9	42.9	0.185
	Yes	78	61.9	13	56.5	20	76.9	26	49.1	2	100.0	2	100.0	12	57.1	
Jog Faster And For A Short Time	No	80	63.5	12	52.2	16	61.5	31	58.5	2	100.0	1	50.0	6	28.6	0.088
	Yes	46	36.5	11	47.8	10	38.5	22	41.5	0	0.0	1	50.0	15	71.4	
Walk Faster	No	41	32.5	9	39.1	11	42.3	23	43.4	1	50.0	0	0.0	4	19.0	0.383
	Yes	85	67.5	14	60.9	15	57.7	30	56.6	1	50.0	2	100.0	17	81.0	
Suffering From Anxiety	No	76	60.3	8	34.8	11	42.3	32	60.4	1	50.0	0	0.0	7	33.3	0.034
	Yes	50	39.7	15	65.2	15	57.7	21	39.6	1	50.0	2	100.0	14	66.7	
Aggressive To Others	No	60	47.6	11	47.8	7	26.9	33	62.3	1	50.0	0	0.0	5	23.8	0.017
	Yes	66	52.4	12	52.2	19	73.1	20	37.7	1	50.0	2	100.0	16	76.2	
Aggressiveness During Cold	No	82	65.1	13	56.5	10	38.5	39	73.6	2	100.0	1	50.0	13	61.9	0.080
	Yes	44	34.9	10	43.5	16	61.5	14	26.4	0	0.0	1	50.0	8	38.1	
Aggressiveness During Hot Days	No	63	50.0	14	60.9	8	30.8	29	54.7	1	50.0	1	50.0	7	33.3	0.273
	Yes	63	50.0	9	39.1	18	69.2	24	45.3	1	50.0	1	50.0	14	66.7	

** Bold value represents p-value <0.05 i.e., significant*

The current study assessed the self-reported physical and behavioral or psychological effects of air pollution. Participants response was categorized according to their scores as mild (21.3%), moderate (48.2%) and severe (30.4%) affects. The physical effects statistics showed that a major portion of participants i.e., 26.1% experienced sleeping disorders oftenly, 18.2% sometimes and 16.6% always. Reduced energy levels were often observed in 35.2%, sometimes in 23.7%. Headache and dizziness was observed to common among participants, about 10.7% had them always while 32.4% and 28.9% had them often and sometimes respectively. Wheezing and coughing were observed to be lesser as compared to the previous question, i.e., 6.7% always and 33.2% often. Similarly 10.3% people reported that they always suffer from ENT/respiratory problems, however 32.0% and 23.3% suffered often and sometimes respectively. As compared to previous study,physical effects are found to be less severe among the population of Rawalpindi and Islamabad. In the Twin Cities of Minnesota (2008), air pollution was a contributing cause for an estimated 2-5% of respiratory and cardiovascular hospitalizations and ED visits and between 6% and 13% of premature deaths,[17] which in harmony with this study. Due to different levels of pollution in both cities, district specific health effects were determined using test of significance between physical effects and residence. The *p*-values ENT/respiratory problems (*p*-2.971), headache dizziness (*p*-8.791), coughing/whee-zing (*p*-6.464), sleeping disorders (*p*-2.214), reduced energy levels (*p*-3.096) were not significant (*p* Pakistan is one of the fastest growing economies in Asia. But as we know increase in advancement comes at a price and thus due to rapid industrialization and urbanization pollution is increasing day by day. Several atmospheric pollutants like NOx, SO^2, CO, particulate matter, etc. have high concentrations in Pakistan. Studies have linked the presence of these atmospheric pollutants to different sectors. For NOx, primary sources include the transportation and industrial sectors, responsible for around (43.2% and 39.6%) of the total annual emissions. Major Sources of SO^2 and CO include industrial and thermal power generation, residential and transportation sectors, responsible for around (75.6% and 14.6%) and (62.9% and 23.6%) of total annual emissions,[1] respectively. Looking at the statistics taken over 2019, Rawalpindi came in with a PM 2.5 average of 40.8µg/m³, placing it into the 'unhealthy for sensitive groups' bracket, which requires a PM2.5 reading of anywhere between 35.5 to 55.4µg/m³ to be classified as such. This reading places Rawalpindi into 8th place out of all cities registered in Pakistan, as well as 224th place in all cities ranked worldwide in terms of their pollution levels. In regards to the levels of pollution in the air, Islamabad came in with PM 2.5 readings of 35.2µg/m³ as a yearly average over 2019. This put it as the cleanest city in the whole of the country, coming in at 10th place out of all cities currently ranked in Pakistan.[20]

A *p*-value less than 0.05 was found to be significant and positive association was established between the

parameters, whereas as a value greater than 0.05 was considered insignificant and no relation was drawn.

The current study assessed the self-reported physical and behavioral or psychological effects of air pollution. Participants response was categorized according to their scores as mild (21.3%), moderate (48.2%) and severe (30.4%) affects. The physical effects statistics showed that a major portion of participants i.e. 26.1% experienced sleeping disorders oftenly, 18.2% sometimes and 16.6% always. Reduced energy levels were often observed in 35.2%, sometimes in 23.7%. Headache and dizziness was observed to common among participants, about 10.7% had them always while 32.4% and 28.9% had them often and sometimes respectively. Wheezing and coughing were observed to be lesser as compared to the previous question, i.e. 6.7% always and 33.2% often. Similarly 10.3% people reported that they always suffer from ENT/respiratory problems, however 32.0% and 23.3% suffered often and sometimes respectively. As compared to previous study,physical effects are found to be less severe among the population of Rawalpindi and Islamabad. In the Twin Cities of Minnesota (2008), air pollution was a contributing cause for an estimated 2% to 5% of respiratory and cardiovascular hospitalizations and ED visits and between 6% and 13% of premature deaths,[17] which in harmony with this study. Due to different levels of pollution in both cities, district specific health effects were determined using test of significance between physical effects and residence. The *p*-values ENT/respiratory problems (*p*-2.971), headache dizziness (*p*-8.791), coughing/wheezing (*p*-6.464), sleeping disorders (*p*-2.214), reduced energy levels (*p*-3.096) were not significant (>0.05) so, association wasn't found between residence and physical effects. This could be attributed to comparable levels of air pollution in twin cities and inter city mass public mobility. An association between occupation and physical effects was determined as significant *p*-value ($p<0.05$) was found between ENT/respiratory problems, coughing and wheezing, headache dizziness, sleeping disorders and reduced energy levels with values 0.000, 0.005, 0.046, 0.033 and 0.002 respectively with drivers, housewives and traffic wardens most affected ones as depicted in Table-II.

Regarding psychological and behavioral effects, a high percentage 60.5%, 41.5%, 64.8%, 46.6%, 53.8%, 36.8 and 51.4% participants reported that they felt depressed, could jog faster for a short time, could walk faster, suffered from anxiety, were aggressive to others, aggressive during cold days and during hot days respectively shown by Figure-1(b). Regarding the district specific results, no *p*-value was significant so no association is there in residence and psychological effects as compared to study in Malakand.[1] Concerning occupation specific effects, *p*-value was significant for anxiety and aggressive,[19] behavior as suggested by a previous study. This association suggests different level of pollutant exposure to different occupational groups. The *p*-values for feeling depressed, jogging faster, walking faster, and aggressive behavior during hot or cold days were insignificant ,which is in accordance with a previous study,[16] suggesting evidence on the relationship between cold temperatures, traffic-related pollution, and related health outcomes is lacking.

The perception of the general population regarding air pollution and their level of awareness regarding air pollution were investigated. 82.2% were of the view that smoking should be prohibited and it has adverse effects. 49.0% had idea about the deaths caused by air pollution, 69.2% had knowledge about the diseases caused by air pollution and 74.7% had awareness what air pollution is and about its adverse effects. So, general population of Rawalpindi and Islmabad had sufficient knowledge that can be contributed to higher literacy, electronic, print and social media use. A similar study was also conducted in Malakand Division,[1] Pakistan with the target group being the students studying in different universities in that area had sufficient knowledge. A survey was conducted in Muscat/ Oman,[14] between February and May of 2020, with a total of 1289 respondents to investigate public knowledge, behavior, and attitudes about the air pollution via online questionnaire. The results show that most of the respondents (over 90%) were aware of air quality and related issues and they also expressed willingness to change their behavior to reduce air pollution.

Since the vast majority of the pollutants enter the body through the respiratory routes, the respiratory framework is in the principal line of fight in the beginning and movement of sicknesses came about because of air contaminations. In the upper respiratory passage, the principle impact is irritation, particularly in windpipe which prompts voice aggravations. Air contamination is likewise viewed as the major natural gamble factor for a few respiratory infections like asthma and lung cancer.[9] This study showed that 64.0% ate healthy foods, 63.6% drank more water, 40.3% wore glasses/goggles and 85.8% used face masks, also same depicted in previous study.[1] The high percentage

of mask use can be attributed to ongoing Corona pandemic.

The results of the current study are consistent with earlier studies, demonstrating similar adverse impacts of polluted air on the health of the recruited subjects.[1,11,12,13] Moreover, it's one of study done in Rawalpindi and Islamabad for assessing air pollution effects. Its came up with some new findings along with supporting previous studies done in other areas.

More awareness regarding air pollution is essential and it is obligatory to know about the perception of general population regarding this so suitable measures can be taken by the competent authorities to prevent the harmful effects caused by this,[15] and the resultant mortality.

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RECOMMENDATION

The negative impacts of air pollution can be minimized by mass awareness; spreading knowledge regarding the hostilities of air pollution; its mitigation, reduction, or prevention; and rectifying the misunderstandings and misperceptions regarding air pollution among the general public. Informal communications, discussion, public conversations, and exchange of information about air pollution among relatives, family members, colleagues, and friends can play a key role in mass awareness and infuencing risk perceptions of the public.

LIMITATIONS OF STUDY

In the current study, it was tried to approach as many groups of general population as possible and equally from both districts of the study area. However, we had some limitations regarding the duration of the study, and time management while recruiting new participants. During the current study, the OPD visiting patients and students of medical colleges were selected. However, it is suggested that the air quality parameters of the all areas of the districts should be assessed. The baseline physiological conditions at the individual level were not adjusted for mental and behavioral health, due to the limited time frame and of campus recruitment of the participants through Google form. Moreover, the administered questionnaire was closed-ended. Therefore, for conducting the same survey in the future in another area, we recommend the inclusion of open-ended questions. Moreover, due to limited sample size results cannot be generalized. This will extend the level of understanding regarding public perceptions, preventive measures, and the level of awareness regarding air pollution. These key points should be considered and the findings of the current study should be applied to another area or population.

CONCLUSION

The general population of Rawalpindi and Islamabad reported significant physical (ENT and respiratory problems, headache and dizziness, coughing and wheezing, reduced energy levels and sleep disruptions), and psychological (feel depressed, anxiety and aggressiveness during hot and cold days), behavioral (jogging faster, walk duration) effects of air pollution.

Conflict of Interest: None

Author's Contribution

Following authors have made substantial contributions to the manuscript as under:

AH: Supervision, Conception, Study design, analysis and Interperitation of data, Critically reviewed manuscript & approval for the final version to be published.

SFM: Co-supervision, Data entry, analysis and interpretation, manuscript writing & approval for the final version to be published.

L:, ZR:, MS: Critically reviewed, Drafted manuscript & approval for the final version to be published.

SA:, HB: Data colllection, Entry and analysis of data, preparation of rough draft & approval for the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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