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Assessing impact of Air Pollution on behavior of school children in Greater Noida, India

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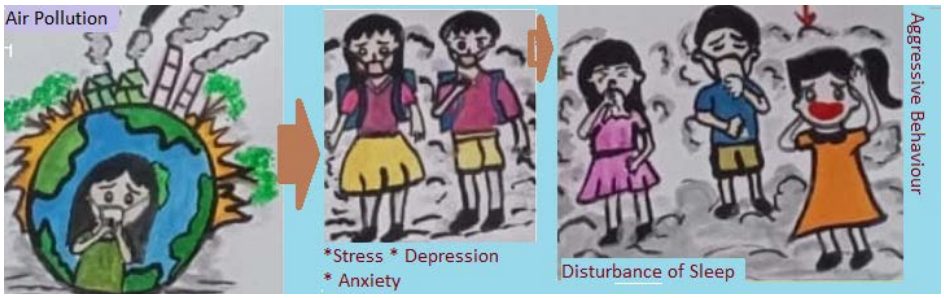
ABSTRACT



Pollution has become one of the most prevalent issues faced by all the countries around the world. Air pollution, the leading form of pollution, is known to cause many diseases like lung problems, early stroke, pulmonary diseases, and respiratory infections. Along with physical problems, pollution leads to numerous behavioral and psychological issues. Children are the most vulnerable population that are effected by prolonged exposure to pollution. The relevance of worst effects of pollution on children is evident from number of studies that have been conducted over the decades. Despite the availability of vast literature about effects of pollution, there are less studies that focus on an in-depth analysis of psychological effects of pollution on children. There is lack of structured measures that can be followed to deal with harmful effects of pollution on children. The current study intends to evaluate the psycho-social implications of air pollution on the behavior of adolescents. It was a descriptive observable cohort study conducted on a sample of 85 school children by using structured interview schedule. The findings of the study indicates significant influence of air pollution on the behavioral aspects of the children including dependency, confusion, cries a lot, required attention, restlessness and hyper-activeness.

Keywords: Air Pollution, Behavior, Psychosocial, PSI, AQI, Mental Health, Child behavior

INTRODUCTION

Over the decades, various studies have assessed the clinical implications of air pollutions. All of these studies majorly focused on physical problems and a broad range of diseases that are caused by exposure to pollution. A very less number of studies relate to psychological implications of exposure to air pollution. The earlier research reports indicate that certain psychological reactions like mood swings, motivation, and interpersonal relations are affected by air pollutants besides other neurological and psychological reactions.[1] The children are more vulnerable and comparatively affected more by the air pollution.[2]

Air pollution is expected to be main threat for health and environment. It has worst impact on the children's health. D.A. Vallero (2019)[3] defined air pollution as all ruinous impacts of any sources which add to the contamination of the climate or potentially weaken the biological system.[3] Air contamination is carried out by human impedances and various other factors. It's a combination of a variety of toxic materials for solid, liquid, and gaseous stages.

The Pollutant Standard Index (PSI) is a mathematical worth and marker of toxins that is regularly used to work with hazard appraisal. It is a numeric worth between zero to 500.[4] PSI is a rule for detailing air quality which was first presented by Thom and Ott in 1974.[5] Consequently, it will give a technique for looking at

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the general commitment of every toxin to add up to hazard. The computation of PSI depends on the grouping of five significant air poisons including particulate (PMs), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), and ozone (O_3) noticeable all around. The "air quality index (AQI) is characterized as a proportion of the state of air comparative with the necessities of at least one biotic animal types or to any human need".[6] The Air Quality Index is divided into ranges, each of which is numbered, and each span is distinguished by concealment codes. This gives a digit from solid standard degree of zero to an exceptionally dangerous degree of over 300 to demonstrate the degree of wellbeing hazard related with air quality.[4]

Air pollution has now emerged in agricultural countries as a result of mechanical activities and an increase in the number of discharge sources such as inappropriate automobiles.[7] The lack of good governance in control measures[8] for air pollution is added contributing factor. About 4.3 million people die from family air pollution and 3.7 million die from encompassing air pollution, with the majority (3.3 and 2.6 million, respectively) living in Asia. As a non-industrial country, India's level of air pollutants has steadily increased since the 1970s, when industrialization began, but it has now reached exceedingly dangerous levels in several megacities.[9] Subsequently, it is critical to portray the issue, especially its poisonous consequences for human wellbeing and give suggestions as a premise to ecological rules and standard conventions in the field of air contamination in India.

Growing air pollution has emerged as a major environmental and health hazard among other forms of pollution including water pollution which also affect flaura and fauna.[10–12] The extent of damage can be understood from the fact that owing to air pollution around seven million premature mortalities occur annually in different parts of the world. Besides human loss, it also causes tremendous economic loss worldwide along with impact on global climate.[13] An intensive literature review has been made to learn about specific psychosocial aspects of children that are directly or indirectly influenced as a result of day-to-day exposure to air pollution in Delhi. There is a need to help in motivating individuals and build collective strategies on health care to reverse the damage and prevent the worsening of impact on children's health from air pollution.[14] The Sustainable Development Goals also stress the significance of social and environmental factors as core health determinants.[15]

Children, particularly in developing countries, have very fragile health scenarios. Air pollution's effect on children's health is a special concern due to their higher minute ventilation, immature immune system,[16] involvement in extensive physical activities, being outdoor for lengthier time over the day etc. The effects on children are therefore different as compared to those seen in adults. Both long-term and short-term exposure to air pollution has negative consequences. The methods by which air quality affects health, on the other hand, are commonly assumed to be impaired pulmonary function, which leads to acute respiratory symptoms.While assessing the impact of air pollution on people's psychological distress, the author observed air particulate matter 2.5 is statistically significantly linked with elevated psychological distress. This association also remains in position despite controlling for demographic, socioeconomic, and health-related covariates.[1]

Impact of Air Pollution on Children

Air pollution is an increasing problem that impact the lives of billions of people worldwide.[4] As per World Health Organization, the major air pollutants constitutes ground-level ozone, particle pollution, sulfur oxides, carbon monoxide, lead and nitrogen oxides.[4] According to a recent estimation, due to pollution around 1.6 million of human lives are lost annually in India.[17]

Childhood is a transient stage. It is crucial for overall mental health and well-being. It is estimated that around half of all neuro-psychiatric problems among adults have an origin by the age of 14 years. There are wide gaps in understanding the causes of deviant behaviours. It is learnt that genetic variants only account for 5–25% of behavioural problems in common population. Studies on environmental factors causing behavioral disorders have observed multi-layered impact of social and physical environment. Such exposures especially during prenatal and early childhood phases are impactful at the time of critical brain development.[18]

Children are one of the largest sections in a society whose physical and mental health is profoundly affected by air pollution. Unfortunately, air pollution impact on children especially on their health has not received adequate attention around the world. It is estimated that low-income societies in developing countries faced massive child deaths as a result of disclosure to air pollution. Children encounter exposure to air pollution within their households as well as in external settings. From a broader perspective, air pollution could partitioned into ambient air pollution (AAP)[19] and household air pollution (HAP).[20] The AAP is primarily caused by agricultural practices, industrial processes, waste incineration, fossil fuel combustion, and natural activities like widespread wildfires, climatic dust storms, and big volcanic eruptions. It is believed that 4.2 million premature casualties including 0.3 million under 5 children occurred due to ambient air or outdoor pollution (AAP) in 2016.[21]

Many studies reflect harmful effects of air pollution on cognition abilities of the children.[22] A decline in IQ, memory and other cognitive abilities with neurological behaviour has been associated with air pollution. The studies found that air pollutants inhaled during pregnancy could not only affect the developing brain of the foetus but also have long lasting effect on child's development. Furthermore, prenatal acquaintance to higher degree of air pollution may not only delay the process of development at the age of three but can also affect child psychologically and behaviorally. Later on, the symptoms of attention deficit hyperactivity disorder (ADHD), anxiety and depression may also occur. Though there are many studies that show poor air quality can harm human health, but very few show the impact of air quality on the behaviour of children. These studies highlight that certain psychological reactions like mood swings, motivation, and interpersonal relations are affected by air pollutants. Studies have also revealed that acute pressure due to air pollution may lead to psychiatric problems. Pollution may be the cause of Psychological

distress in children and depict problems like obsessive thoughts, aggressive behavior and lack of coping skills.[22]

Air pollution adversely affects mental health of adolescents. A broad assemblage of exploration shows that air contamination is related with expanded lawbreaking and untrustworthy conduct.[17] Dissecting a nine-year board study of 9360 U.S. urban areas, Lu et al. (2018) discovered that air contamination anticipated both vicious wrong doings, thievery, engine vehicle burglary.[17] Additionally, further studies gave semi trial proof with the impacts of air contamination on both savage and vandalism related misdemeanors in London by abusing every day wind bearing as an exogenous wellspring of irregular variety in air contamination.

In the context the impact of air Pollution on the psychology and behavior of school children in Greater Noida, India was undertaken in the form of an observational cohort study. The complete data for analyses were gathered through Non Probabilistic Convenient Sampling on eighty five (85) school children (adolescents) studying at Greater Noida. Information of participants, related to socio-demography, medical history, attendance, psychological symptoms, and clinical implications, were collected through the questionnaire/ interview schedule/ CBCL and focused group discussion with the assistance of parents and teachers. Air pollution was predicted through transport, travel patterns, children's activity profiles, and urbanization. A standardized child behavior checklist (CBCL) for ages 4-16 was used to assess children's psychological implications. Multivariate analyses were performed to evaluate the relationship between exposure to air pollution and child behavior checklist outcomes, adjusting for potential confounders. The children exposed to higher pollution showed a decrease in the general cognitive functions and decreases in working memory and physical health. However, except for physical health, associations were not statistically significant.

RESEARCH METHODOLOGY

The purpose of the current study was to assess the impact of air pollution on psychology and behavior of school children as earlier studies indicated that the family background plays a significant role in dealing with stress of the children that occurred due to air pollution. Also the coping mechanism varies from person to person. Thus, the present study was conducted in consideration of the following goals:

- To Study the family background of children in Greater Noida who were suffering from many issues due to poor Air Quality.
- To study the most significant problems amongst the School Children which have been caused due to the Poor Air Quality in Greater Noida region.
- To find the significant association between the family background of Children and the behavior of them due to poor Air Quality in Greater Noida.

The main aim of this study was to find out the numerous issues in the school children due to poor air quality in Greater Noida Region. So the data was collected from the schools of Greater Noida to check the different problem faced by the children residing in this region.

Sources of the Data

In this study, the data was collected from the Parents of the school children who can address the problems of their child for the study. For this purpose the structured questionnaire was designed and the data was gathered by asking numerous open ended and close ended questions to the parents.

The research Hypothesis of this study have been mentioned below:

- Various problems caused by the children in the Greater Noida region don't differ among the family status of the children.
- Various problems caused by the children in the Greater Noida region don't differ among the different age of the children.
- Various problems caused by the children in the Greater Noida region don't differ among the Gender of the children.

Few Statistical Hypothesis of this study have been mentioned below:

- There is no significance association between the family status of the children in Greater Noida and various problem faced by them due to poor air quality.
- There is no significance association between the Age of the children in Greater Noida and various problem faced by them due to poor air quality.
- There is no significance association between the Sex of the children in Greater Noida and various problem faced by them due to poor air quality.
- In this study Non Probabilistic convenient sampling method have been used to see the effect of poor air quality on the behavior of school children.

Sample Size determination

Sampling Plan

Method of Sampling	Non Probabilistic Convenient Sampling
Elements of Sampling	Responses have been collected from the schools of Greater Noida region to check the impact of poor air quality on children behavior.
Sample Size	85
Target Population	Greater Noida, India

Data Interpretation and Analysis

The responses were collected from the parents of the children in Greater Noida region. Responses were reserved in the form of physical questionnaire of socio demographic attributes and Child Behavior Checklist. The data was first coded and all these responses were systematically coded in the Microsoft Excel 2017 and then this data was moved to the IBM SPSS 21.0 Software for the detailed analysis. Due care was taken to split the data into various categories i.e. Nominal Data, Ratio Data, Interval Data and Ordinal Data for the analysis with reason. Coding will deliver benefit to the research out of the large amount of data into simply getable data to process the analysis. For Data cleaning process, simple descriptive analysis was applied to find the missing frequency among the responses which have been removed the overall responses.

RESULT AND DISCUSSION

The air pollution has been a prominent factor behind the ill health effects of individuals including more severe effect on children. The sources of toxic materials that reaches to children are diverse,[23] the direct inhalation (via polluted air) is more noted and relevant. Further, the other factors come in role while evaluating the impact of air pollution. In this context, Cakmak et al.[24] worked on socio-demographic variable subgroups that were more vulnerable to the impact of air pollution to explore the influence of socio-demographic variables mortality and morbidity caused by air pollution.[24] The core emphasis was kept on age, gender, educational attainment, and the effect on mortality. The study observed that the burden of mortality and morbidity has a strong influence on health with low education attainment. Moreover, the impact was associated with age and education but not with sex. Air quality policy guidelines that are designed to protect people including high-risk groups should consider those having lower education attainment or already suffered from some cardiac ailments.[25]

Table 1-Family Background of the Children

Family Background		No of Respondents (85 Sample)	% of Respondent (85 Sample)
Father's Profession	Business	18	21.2%
	Service	53	62.4%
	Agriculture	6	7.1%
	Retired	5	5.9%
	No Work	3	3.5%
Mother's Profession	Business	2	2.4%
	Service	9	10.6%
	Home Maker	72	84.7%
	Doctor	1	1.2%
	Beautician & Fashion Designer	1	1.2%
Age of Child	Less than 10 Years	1	1.2%
	10 – 12 Years	48	56.5%
	13 – 14 Years	36	42.4%
Sex of Child	Male	46	54.1%
	Female	39	45.9%
Education of Child	6th Standard	28	32.9%
	7th Standard	31	36.5%
	8th Standard	26	30.6%

From the above table 1, it can be interpreted that maximum responses received from the Greater Noida Children parents, maximum child's father basically engaged in the Service either in government or private service followed by the business class. Similarly, Maximum children's mother were home makers followed by the Service (Figure 1). Maximum age of the children is between the 10 – 12 Years followed by the 13 – 14 Years. The category of the students is almost similar, which the majority if the children belongs to the 7th standard student followed by the 6th standard (Figure 2).

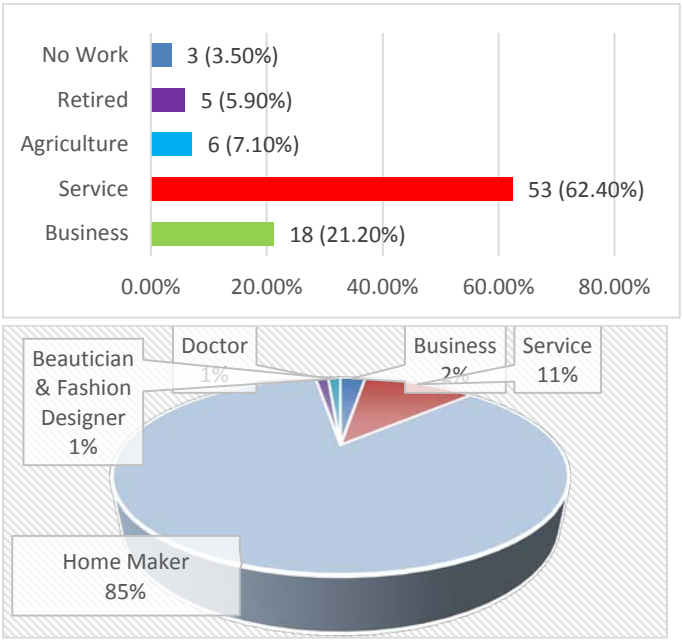

Figure 1. Profession of parents: Father (above, bar graph) and Mother (below, pie chart).

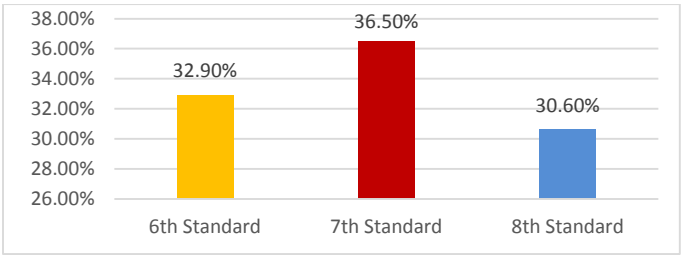

Figure 2. Education standard of children.

Profession of parents (father and mother) however did not reflect any significant influence on behavior of children. Studies reveal that behavioral issues of child have significant association with air pollution. In some other studies conducted by Saas, et al.,[1] showed that air particulate matter 2.5 is statistically major connection with increased psychological anguish. Fine particulate matter 2.5 is an air pollutant that causes harmful effects on physical health and adds on to stress of people residing the areas, where its presence is high in air. Further, it was also found that this result remains the same while controlling for demographic, socioeconomic, and health-related covariates. Profession of parents' also comes under socio-demographic variables. It has been reflected in studies that air pollution has high associations with behavioral problems, conduct issues and delinquent behaviors in children.[17] A research study examined and reflected the effect of air pollution leading to violent crimes in areas with high pollution index.

Age of child as a variable had no significant Influence on the behavior of child in this study. There is no significant influence of Age of Child on the behavior of Child in different areas of Delhi regions due to Poor Air Quality. It may be understood that almost 99% children fall under the same category of adolescence as prescribed by the NCERT.

Table 2 Mean Value of Different Problem faced by School Children in respect of air pollution in the area

Problems faced by Children	Not at all (0)	Some time True (1)	Always (2)	Mean
Allergy	68	10	07	0.282
% Out of Total Responses	80.00%	11.80 %	8.20%	
Argues	53	23	09	**0.482**
% Out of Total Responses	62.40%	27.10 %	10.60%	
Asthma	83	01	01	0.035
% Out of Total Responses	97.60%	1.20%	1.20%	
Behavior with Opposite Sex	84	01	00	0.012
% Out of Total Responses	98.80%	1.20%	0.00%	
Bowel Moments outside Toilet	80	02	03	0.094
% Out of Total Responses	94.10%	2.40%	3.50%	
Bragging/ Boasting	71	12	02	0.188
% Out of Total Responses	83.50%	14.10 %	2.40%	
Can't Concentrate for Long	48	27	10	**0.553**
% Out of Total Responses	56.50%	31.80 %	11.80%	
Obsession	53	26	06	**0.447**
% Out of Total Responses	62.40%	30.60 %	7.10%	
Restless/ Hyperactive	57	21	07	**0.412**
% Out of Total Responses	67.10%	24.70 %	8.20%	
Dependency	68	12	05	**0.259**
% Out of Total Responses	80.00%	14.10 %	3.50%	
Loneliness	70	12	03	0.212
% Out of Total Responses	82.40%	14.10 %	3.50%	
Confused	66	15	04	**0.271**
% Out of Total Responses	77.60%	17.60 %	4.70%	
Cries a lot	67	16	02	**0.235**
% Out of Total Responses	78.80%	18.80 %	2.40%	
Cruel to Animal	74	07	04	0.176
% Out of Total Responses	87.10%	8.20%	4.7%	
Cruelly Bullying	77	04	04	0.141
% Out of Total Responses	90.60%	4.70%	4.70%	
Lost in Thoughts	70	15	00	0.176
% Out of Total Responses	82.40%	17.60 %	0.00%	
Harms to Self	82	03	00	0.035
% Out of Total Responses	96.50%	3.50%	0.00%	
Required lot of Attention	67	16	02	**0.235**
% Out of Total Responses	78.80%	18.80 %	2.40%	
Destroy Things	75	09	01	0.129
% Out of Total Responses	88.20%	10.60 %	1.20%	
Destroy Belongings	81	04	00	0.047
% Out of Total Responses	95.30%	4.70%	0.00%	
Disobedient at School	67	14	04	**0.259**
% Out of Total Responses	78.80%	16.50 %	4.70%	
Disobedient at Home	79	05	01	0.082
% Out of Total Responses	92.90%	5.90%	1.20%	
Doesn't eat Well	65	14	06	**0.306**
% Out of Total Responses	76.50%	16.50 %	7.10%	
Doesn't get alone with others	76	07	02	0.129
% Out of Total Responses	89.40%	8.20%	2.40%	
No guilty after misbehaving	74	10	01	0.141
% Out of Total Responses	87.10%	11.80 %	1.20%	
Easily Jealous	75	10	00	0.118
% Out of Total Responses	88.20%	11.80 %	0.00%	
Bad Eating	71	10	04	0.212
% Out of Total Responses	83.50%	11.80 %	04.70%	
Fear of Animal	69	14	02	0.212
% Out of Total Responses	81.20%	16.50 %	02.40%	
Fear of School	85	00	00	0.000
% Out of Total Responses	100.00%	0.00%	0.00%	
Aches Pain	67	17	01	0.224
% Out of Total Responses	78.80%	20.00 %	01.20%	
Headaches Pain	65	20	00	**0.235**
% Out of Total Responses	76.50%	23.50 %	0.00%	
Nausea Feels Sick	78	07	00	0.082
% Out of Total Responses	91.80%	08.20 %	0.00%0 .247	
Eyes Problem	69	11	05	0.247
% Out of Total Responses	81.20%	12.90 %	5.90%	
Rashes	69	13	03	0.224
% Out of Total Responses	81.20%	15.30 %	3.50%	
Stomach	68	17	00	0.200
% Out of Total Responses	80.00%	20.00 %	0.00%	
Vomiting	76	09	00	0.106
% Out of Total Responses	89.40%	10.60 %	0.00%	
Others	76	08	01	0.118
% Out of Total Responses	89.40%	9.40%	1.20%	
Overall Mean Value (Standard)				**0.198**

The studies also revealed that Air pollution is a composite system, hence; require multilevel involvement for its solution. Moreover, few more studies have indicated that India ranked 30th numbers in the polluted countries and Delhi is considered as most polluted states in India.[26] In this context it became more important to find out the impact on air pollution on the behavior of children. Moreover, the students of different classes were also considered so that it could also be seen that which group is more affected.

The table 2 shows various problems, that children seem to suffer from exposure to air pollution and poor air quality in Greater Noida. There were few problems that came up to be more bothering than others, cannot concentrate for long on one particular work, obsession and restlessness depicted higher mean values as greater than 0.4 which is higher as compared to the other problems that have been visible in this study. In addition to that, problems like dependency, confused, crying a lot, requires lot of attention, disobedient at school, doesn't eat well and headaches Pain are the moderate problems which have been detected in this survey.[27] All the results were obtained on basis of opinion taken from their parents and guardian in this study.

Thus the study revealed harmful impact of air pollution on behavior of children.[28] Similar results like issues related to confusion, mood swings, violent behavior, disobedience to parents and teachers on numerous occasions, were reflected in many studies conducted in past. It has been stated in several study that openness to air contamination impacts the cognitive abilities children in a long way. The IQ, memory, scores and other neurological behavior has too been associated with air pollution.[29] In another study particulate matter 2.5 (one of the components of the air pollution) was found to be linked with prolonged behavioral issues and psychological distress.[18] The current study shows problems like headaches pains (0.306) and doesn't eat well in children (0.30). Besides these physical health related problems, behavioral issues are clearly reflected in higher mean of problems like lack of concentration (0.553), restlessness (0.412), requiring

Table 3 Chi Square Test between Family Background of Child and Behavior of them due to Effect of Poor Air Quality

Demographic Profile	Behavior of Children	P Value	Behavior of Children	P Value
Father's Profession	Time Spend on Sport	0.221	Relation with Siblings	0.622
	Efficiency in Sport	0.458	Behavior with Friends	0.204
	Time Spend on Hobbies	0.428	Number of Friends	0.854
	Efficiency in Hobbies	0.191	No of times he Plays	**0.041**
	Efficiency in Overall Behavior	0.674	Current School Performance	0.769
	Job of your Child	0.919	Child Result	0.488
	Efficiency in Job	0.411	No of time Repeated Year	0.788
			Acts too Young	0.266
Mother's Profession	Time Spend on Sport	0.168	Relation with Siblings	0.995
	Efficiency in Sport	0.204	Behavior with Friends	0.790
	Time Spend on Hobbies	0.851	Number of Friends	0.724
	Efficiency in Hobbies	0.761	No of times he Plays	0.215
	Efficiency in Overall Behavior	0.414	Current School Performance	0.489
	Job of your Child	0.203	Child Result	0.437
	Efficiency in Job	**0.000**	No of time Repeated Year	0.966
			Acts too Young	0.151
Age of Child	Time Spent on Sport	**0.014**	Relation with Siblings	**0.015**
	Efficiency in Sport	**0.037**	Behavior with Friends	**0.003**
	Time Spend on Hobbies	0.564	Number of Friends	0.313
	Efficiency in Hobbies	0.467	No of times he Plays	0.425
	Efficiency in Overall Behavior	0.257	Current School Performance	0.373
	Job of your Child	0.622	Child Result	0.629
	Efficiency in Job	0.722	No of time Repeated Year	0.546
			Acts too Young	0.988
Sex of Child	Time Spent on Sport	0.533	Relation with Siblings	0.439
	Efficiency in Sport	0.381	Behavior with Friends	0.216
	Time Spent on Hobbies	**0.016**	Number of Friends	0.325
	Efficiency in Hobbies	**0.006**	No of times he Plays	0.152
	Efficiency in Overall Behavior	0.314	Current School Performance	0.290
	Job of your Child	0.703	Child Result	0.434
	Efficiency in Job	0.688	No of time Repeated Year	0.579
			Acts too Young	0.617
Education of Child	Time Spend on Sport	0.527	Relation with Siblings	0.028
	Efficiency in Sport	0.327	Behavior with Friends	0.169
	Time Spend on Hobbies	0.640	Number of Friends	0.667
	Efficiency in Hobbies	**0.042**	No of times he Plays	**0.031**
	Efficiency in Overall Behavior	**0.045**	Current School Performance	**0.033**
	Job of your Child	0.647	Child Result	**0.040**
	Efficiency in Job	0.143	No of time Repeated Year	0.244
			Acts too Young	0.334

more attention (0.235) than normal and visible disobedience (0.259) of parents and teachers. Thus it can be concluded that the study reveals the aspect of harmful effects of pollution on behavior and psychology of children.[1] It is further noted that air pollution leads to stress,[30] exerting diffuse and non-specific impacts on an individual. However, a broad dimension of examination shows that air contamination is related with expanded lawbreaking behavior and exploitative conduct. Based upon the above discussion it could be pointed out that air pollution has significant impact on behavior of children. Moreover there is need to bridge the gap of less attention being paid towards psychological and behavioral issues in children due to air pollution impact.

The adolescent is an important stage for both physical and psychological growth and career orientation of the children. If children start suffering from ailments and psychological distress at this stage, it can be harmful for them in long term. The continuous deterioration of the air quality and increasing air pollution necessitates the need to conduct this study. This study is directly related to the air pollution and behavioral problems of the children.[31]

From the table 3 it can be interpreted that, there is significant association between the attribute of father's profession and number of times a child plays as a part of behavior. The result on this attribute attempts to link between presence of father and the time a child spends playing. There is significant association between the mother's profession and efficiency in job that they are doing it as its P value is less than 0.05 which indicates that the null hypothesis has to be rejected. This attribute focuses on the relation between presence of mothers and the level of responsibility that a child may take up. The study reflects the association between age of children with the time spent on sports, efficiency in sports, relation with siblings and behavior with friends. Age is an important attribute that is baseline for assessing behavioral issues of children. In this study relation between age of children and their social behavior, interpersonal skills and socializing time is visible in a lucid manner. Studies have indicated effect of air pollution impacts differently on different age of children. Behavioral issues and psychological problems faced by children are different at every age and the way pollution impacts them. Sex of child has the significant association with the time spent on hobbies and efficiency in hobbies. It has been observed in many researches that gender of child as an attribute has entirely different impact perceived of prolonged exposure to pollution. Education of child has the significant association with the efficiency in hobbies; efficiency in overall behavior, number of times the child plays, their current school performance and child result (figure 3). It is evident from various studies that pollution not only impacts the physical health but affects the psychological and behavioral patterns in a child's personality. This study reflects the relationship between a broad spectrum of maladaptive patterns of behavior in children, that are resulted due to exposure to air pollutants. Children reflected moderate violence and cruelty in behavior, which seemed to be due to the constant stress that accumulates in their lives. Presence of pollutants in air not only ir-regularizes their routines but adds up on the monotony

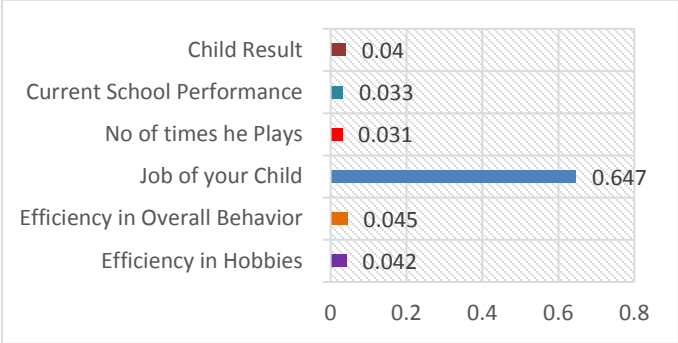

Figure 3. Behavioral changes observed with impact of air pollution

of life. The added frustration creates hindrances in growth and development of children on both physical and psychological facets. Thus the study clearly identifies the need to assess the harmful impact of air pollution on overall health of children. Problems in Psychological health for a longer period of time may lay a substantial effect on a child. Behavioral problems at an early stage may lead to chronic mental health problems in later life.[32] There is need to assess the entire cycle of pollution creating behavioral problems in children. Solutions should be generated and applied in order to eradicate harms of pollution[33,34] on children's health.[28]

Limitations of the Study

- The current study analyses the effects of air pollution on children's health. The usual pattern that the study follows has both positive and negative attributes to it. Though the study was structured in a manner to include a major part of basic behavioral and psychological profile. Still it lacked in several ways that may be discussed as limitations of the study
- The entire study is purely based on the primary analysis for which the data have been collected through physical questionnaire, which is time consuming at the same time it indulges some amount of cost to conduct any study.
- The responses have been only collected from the Greater Noida region so the result might get varied if we conduct the same research base at some other geographical location in India.
- Any other scale along with CBCL could have been used to assess the behavioral profile of the children. Since CBCL is conducted with parents of children, any scale that focused on children's outlook would have yielded better results.
- Besides the questionnaire and scale, qualitative level of data collection like interview with parents and group discussions post conduction of the tests would have been beneficial to support the results of the study.

CONCLUSION

This study concluded that air pollution does impact psychological and behavioral health of children. The results concluded that a maximum student whose father were doing business or belonged to service class background had been significantly influenced on the number of times they played. Maximum mother's profession of children was of Home maker and they have been significantly influenced as their efficiency of

jobs get affected due to poor air quality. Maximum children that participated in the study were of age range 10 to 12 and from 6th to 8th standard. The age attributed showed a relation with the time they spent on sport, efficiency in sport, relation with siblings and behavior with friends. Majority of the children were boys, hence the sex variation should be more in future studies. They were influenced on the time spent on hobbies and efficiency in hobbies. It may be summed up that the current study revealed significant impact of pollution on behavioral health and psychological aspects of children's personality. The study reveals the need to study the impact of air pollution on children in depth.

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