

Preliminary Report

On

The Health Effects of Air Pollution on School Children in Murree



September, 2006

Pakistan Environmental Protection Agency
Pakistan Environment Programme (PEP)

The Health Effects of Air Pollution on School Children in Murree

Pakistan Environmental Protection Agency (Pak-EPA) had designed a comprehensive study to carry out in Murree (a hill resort) to see an impact of air pollution on school going children. This study was carried out during five days from 18 – 22 September 2006. The main objectives of this study were:

1. To monitor the ambient concentration of NO₂ (Nitrogen Dioxide) at different locations in Murree to know the spatial variation of this important traffic related air pollutant.
2. To expose the two types of (SO₂ and NO₂) personal passive samplers on 37 pre-selected students of three different schools of Murree.
3. Information on potential confounding variables was also assessed by completing questionnaires from the subject school children.
4. To conduct the Vehicular Emission Testing (VET) at five different locations on all types of incoming and outgoing vehicles from Murree to know the fitness or otherwise of the vehicles in and around Murree.
5. To analyze drinking water samples collected from different supply sources to the public for both bacteriologically and chemically to ascertain the potability of water supply. *(This additional work was carried out in public interest. It is not directly related to the subject study).*

Study Area: Murree is a very popular hill station. It is the largest of resort towns of Galyat region and tehsil of Rawalpindi district. Murree is situated at an altitude of 2300 meters from the sea level. Murree is just an hour's drive from Islamabad.

A) Ambient Air Monitoring

Nitrogen oxides are produced during most combustion processes. Mobile sources are the major contributors in Pakistan. About 80% of the immediately released nitrogen oxide is in the form nitric oxide (NO). Nitric oxide reacts with oxygen in the ambient air to produce nitrogen dioxide. Therefore, monitoring of NO₂ is becoming increasingly important for air quality assessment and management.

Passive or Diffusion samplers were used during this study. The method used in the present study has been developed by a Japanese Scientist, Kazuyuki Aoki in 1978. This method has application for outdoor measurements, due to an improvement of diffusion path.

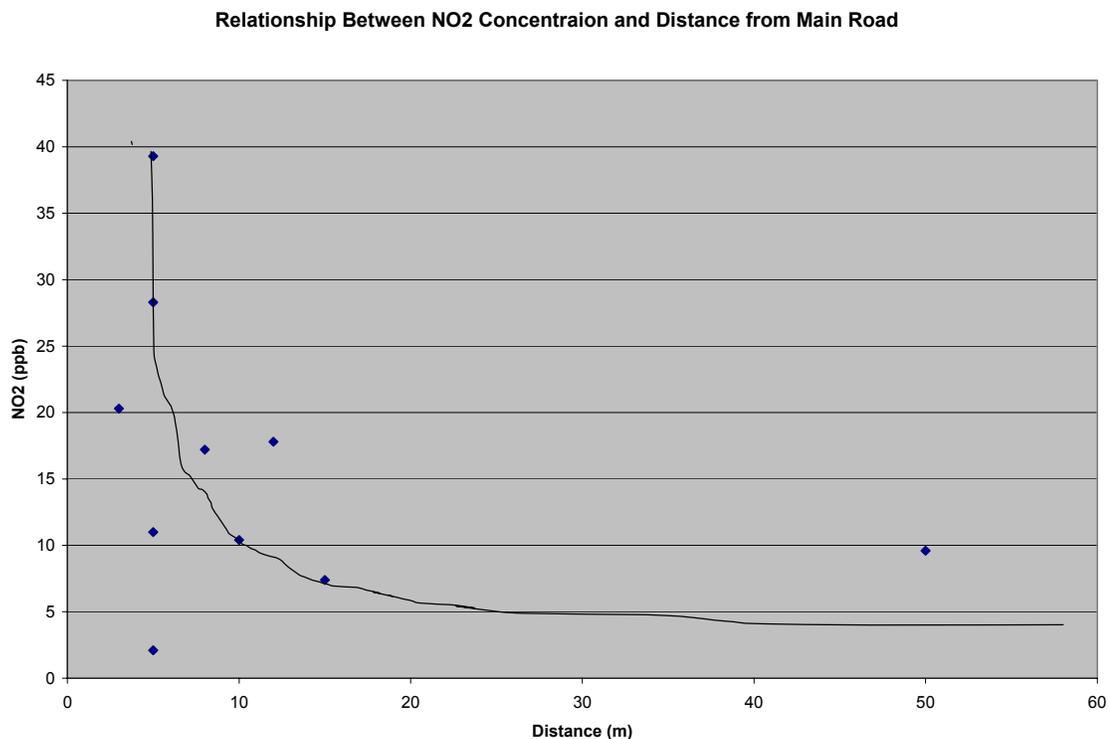
Fifteen (15) locations were selected for the monitoring of NO₂, in which three locations were the same schools, which were selected for epidemiological study. The ambient air quality monitoring was carried out at kerbside, key tourists' venues and schools.

Ambient air NO₂ concentration at various locations in Murree is given in table 1. The maximum concentration 76.9 µg m⁻³ was found on the Mall Road near Red Onion Restaurant. The main reason of this high concentration around this area is quite few numbers of restaurants, which are using coal for Bar-B-Q at outside area and the

Mall, was also opened for light traffic. The second highest concentration of NO₂ 74.4 µg m⁻³ was observed at Ghora Gali, which is due to the high concentration of traffic at this location. The minimum concentration 5.1 µg m⁻³ was detected at the Government Boys High School Murree. The school is on the hill top and about 1 Km away from the main busy road.

Figure 1 shows relationship between NO₂ concentration and the installed sampler's distance from the main road.

Figure 1: Relationship between NO₂ Concentration and Distance from Main Road



Following information have been retrieved from the above figure:

- (a) NO₂ concentration decreases according to the distance from road
- (b) The samplers, which installed more than 30 meters from the road, their NO₂ concentration are more or less stable.
- (c) It means background NO₂ concentration of Murree city is ≈ 5 ppb.

B) Epidemiological Study

Advantec Personal Passive samplers manufactured by Toyo Roshi Kaisha Ltd. Japan were used for personal monitoring of NO₂ and SO₂ in school children. Three schools were selected for the present study. 12 students each from Government High School Samli Tajal Murree and Government Boys High School Murree and 13 students from Federal Government Secondary School Murree were selected for personal exposure study to the air pollutants. Among 37 students, 8 female students were selected to compare the exposure levels between genders. Table 2 shows the personal exposure to NO₂ of school

children in Murree. NO₂ personal samplers were analyzed in CLEAN (Central Laboratory for Environmental Analysis) at Pak-EPA, Islamabad by using spectrophotometric technique. SO₂ personal samplers are being extracted at CLEAN but due to non-availability of Ion Chromatography, possibility to analyze these samples are being explored in some other reputed laboratory. NO₂ results have given fair good idea about the personal exposure of each student to the criterion air pollutant.

Nitrogen dioxide is the most important nitrogen oxide compound with respect to acute adverse health effects. Under most chemical conditions it is an oxidant, as is ozone. However, it takes about 10 times more nitrogen dioxide than ozone to cause significant lung irritation and inflammation.

Nitrogen dioxide differs from ozone in that it suppresses the immune system to a much greater degree. Some epidemiological studies have shown that children exposed to high levels of ambient nitrogen dioxide may be at increased risk of respiratory infections. Studies with laboratory animals have indeed shown that if mice are exposed first to nitrogen dioxide and later to bacteria at a level that would not infect a healthy control animal, their normal lung defense mechanisms are suppressed and the bacteria are able to infect the host.

One study relating respiratory illnesses and changes in lung function to ambient nitrogen dioxide concentrations reported that children living in areas with high nitrogen dioxide concentrations had greater incidences of lung-related illness than children living in areas with lower concentrations. Since then, other epidemiological studies have suggested that children with asthma are more likely than children without asthma to have reduced lung function and symptoms of respiratory irritation, such as cough and sore throat, when outdoor average nitrogen dioxide concentrations exceed about 0.02 ppm or 20ppb or 38 µg/m³.

Long-term exposures to high concentrations of nitrogen dioxide can produce chronic damage to respiratory tract tissue that resembles the lung disease emphysema.

Preliminary results which are shown in table 2 revealed that some students of Government High School Samli Tajal and Federal Government Secondary School Murree are more exposed to the NO₂ level than the students of Government Boys High School Murree. One of the obvious reasons among others is that the ambient NO₂ concentration at Government Boys High School Murree was very low compared to the levels of NO₂ at other two schools. Individual students will be discussed in more detail along with confounding variables collected in the shape of questionnaire to ascertain his exposure to the air pollutants in detail report.

C) Vehicular Emission Testing (VET)

VET activities were carried out at five different locations in Murree. Total number of vehicles examined during this period was 717. Among these, 188 Petrol vehicles and 529 diesel vehicles were tested for fitness or otherwise. Detail daily activity data are shown in Table 3.

Figure 2 shows the percentage of unfit vehicles both petrol and diesel during VET activities period. Figure shows that petrol vehicles are more polluting the environment than diesel vehicles. Petrol vehicles are mostly comprised of cars and

small vans. It shows that tourists vehicles are more polluting than the public transport, which are all most all comprised of diesel vehicles. Cars are mostly running on CNG in Pakistan. Tourists coming to Murree, when switch over their cars to petrol might not maintain the air/fuel ratio required for lean burning of fuel, result the emission of pollutants.

Figure 2: Unfit Vehicles in Murree

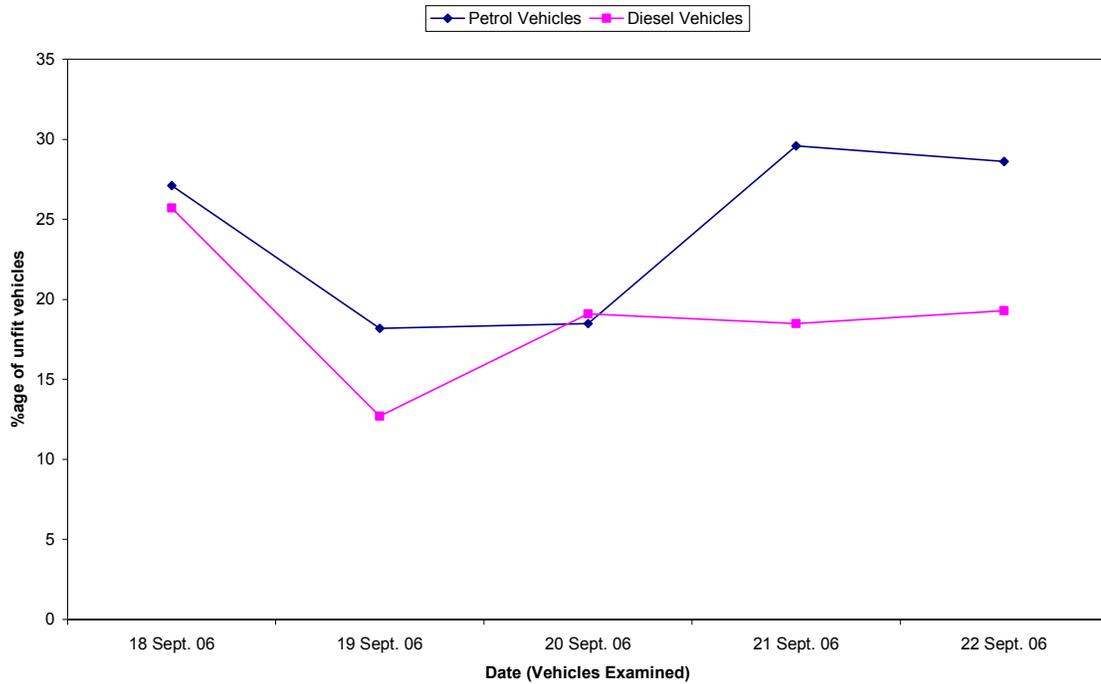
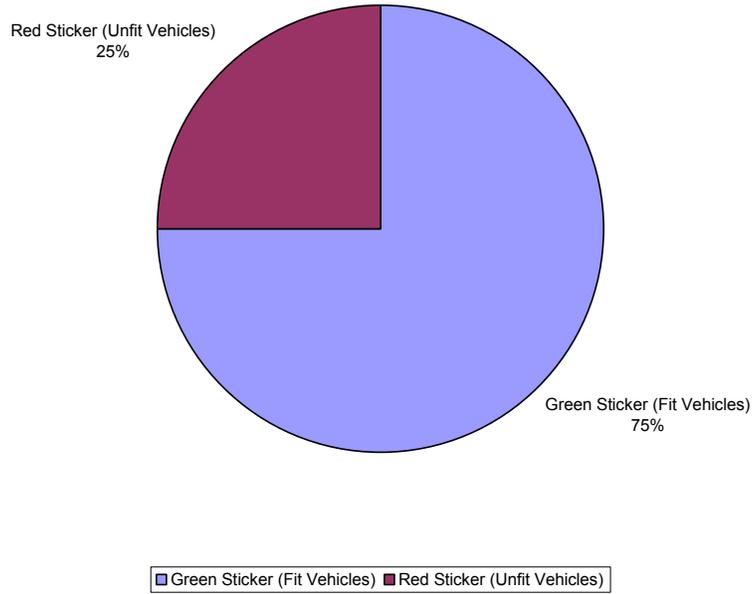


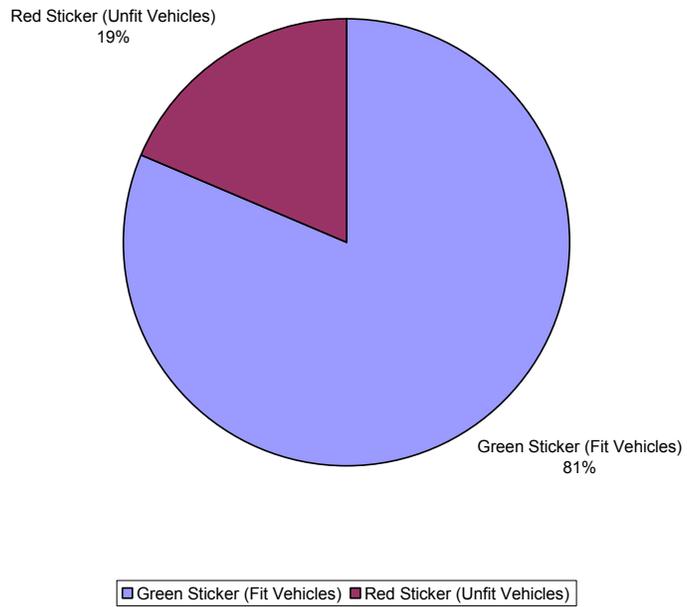
Figure 3 shows the VET results in Murree for both petrol and diesel vehicles. According to figure, 25% petrol vehicles are emitting more pollution, where as 18.5% diesel vehicles are emitting smoke above the permissible limit of NEQS.

Figure 3: VET Result for Both Petrol and Diesel Vehicles in Murree

Testing Result of Petrol Vehicles in Murree



Testing Result of Diesel Vehicles in Murree



D) Drinking Water Quality

This part of the work was not included in the main digest of the planned study but this work was undertaken in public interest. Water samples were collected at nine different locations. Sample # 01200906-B was taken from the Filtration Plant installed under Clean Drinking Water Initiative (CDWI) project of Pak-EPA. No bacteriological contamination was detected in this sample even though the UV lamp was off during sampling. Team has inspected the plant room and found that there was leakage in the fitting and the UV lamp was never turned on. On our query to the operator, he responded that he didn't know about this and nobody has told me to turn on this switch. Next to the filtration plant, there is a water reservoir, from where the water is being supplied to Murree area. The reason of no bacterial contamination in the water is that during the sampling time, we have seen a person from Tehsil Municipal Administration (TMA) bleaching the water reservoir.

The matter of concern in the water supply to Murree is Lead. Very high lead contamination has been detected in seven out of nine samples. As high as 0.32 mg/l, lead contaminations were found both in water reservoir and CDWI filtration plant, where as WHO permissible limit is only 0.01 mg/l. This high concentration of lead in drinking water is due to piping system from water source to reservoir. The water supply system to Murree had been laid more than 70 years back during English rule in subcontinent. Water is being supplied to Murree from Donga Gali in Galyat. Iron galvanized, lead or copper fixtures and piping system are the main source of lead contamination. This old piping system is highly corrodible and susceptible to the chemicals found in tap water.

It is observed that before installing the Water Filtration Plant under CDWI, raw water has not been analyzed for quality check. It is recommended that detail water quality check of Murree with respect to lead contamination may be carried out and in the light of those results appropriate measures may be taken to safe guard the public from the lead poisoning.