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EXPOSURE OF CHITTAGONG UNIVERSITY SHUTTLE TRAIN PESSANGERS TO $PM_{2.5}$ AND PM_{10}

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Abstract-*Air pollution is a big problems in Bangladesh as it affect both human health and the environment. This paper studied about the concentration of particulate matter (PM) in the Chittagong university shuttle and its variation over times of the day.* $PM_{2.5}$ *and* PM_{10}*sampleswere collected by a high volume air sampler at an average flow rate of 2 L/min for 15 minutes. The study found that the mean concentration of* $PM_{2.5}$ *and* PM_{10} *in the shuttle train air was very high in the morning amounting to 307.91* $\mu g/m^3$ *and 689.33* $\mu g/m^3$*, respectively. Interestingly, in case of* $PM_{2.5}$*, on the right side of the shuttle, the concentration of* $PM_{2.5}$ *was higher than that on the left side.On the up the concentration was higher whereas in the down it shows lower variability. On the other hand, on the left sideof the shuttle,the concentrations have higher variability, the right shows lower variability and in the down the concentration is higher, in the up shows the lower variability. The study also found that the concentration of* $PM_{2.5}$ *and* PM_{10} *varies broadly on different direction of the train. It is expected that this study will be act a reliable source of information for taking anyair pollution control measure.*

Keywords: Pollution, Air Pllution, Particulate matter, Concentration

1. INTRODUCTION

Environmental pollution is a worldwide problem and its potential to influence the health of human populations is great (Fereidoun et al, 2007). Moe specifically, polluted water and air, mainly from the industries, are common throughout the world (European Public Health Allinace, 2009; Ashraf et al., 2010) which cause damage to human health, quality of soil, vegetation and aboveall on the whole environment (EPHA, 2009; Carter, 1985). Polluted air contains one, or more, hazardous hazy substance, pollutant, or contaminant that creates a hazard to general health (Health and Energy, 2007; Islam, 2002). Distinctive parameters are utilized to measure air quality, for example, SOx, NOx, and suspened particulate matter (SPM). Among these, SPM is more pervasive and more identified with human impedance into the ordinary nature of air. Airborne particulate matter incorporates dust, soil, ash, smoke, and fluid droplets emitted into the air and they are little enough to be suspended in the environment. Airborne particulates may be a complex mixture of natural and inorganic substances. They might be portrayed by their physical properties, which impact their transport and testimony, and their synthetic organization, which impacts their impact on wellbeing. The physical properties of airborne particulates incorporate mass focus and size dissemination. Ambient levels of mass concentration are measured in micrograms per cubicmeter (µg/m3); size attributes are usually measured in aerodynamic diameter. Particulate matter (PM) exceeding 2.5 microns (µm) in aerodynamic diameter is generally defined as coarse particles (($PM_{2.5}$), while particlessmaller than 2.5 microns ($PM_{2.5}$) are called fine particles.We have selected to work on particulate matter pollution in the railway road from the Sholoshahar railway junction to Chittagong University railway station. We worked with two types of particulate matter depending on size, 2.5 micrometers and 10 micrometers. Particulate matter is a major concern in this road as because of theNasirabad industrial area is situated beside this route.The main objective of the study was to estimate the concentration of particulate matters in the railroad of the Chittagong university shuttle.

2. MATERIALS & METHODS

Chittagong University is the only public university in Bangladesh with a shuttle train based student transportation. The study was conducted at the shuttle train of Chittagong University as because of it has been plying from the Sholashahar station to

Chittagong university rail station.Theareas under samplings were Sholashahar,Muradpur, Oxygen crossing, Baluchora, CTGcantonment, Chowdhuryr hat, Noyapara and Foteyabad. The distance between Amin Jute Mill to Oxygen is a part of Nasirabad industrial area,andthere are several brickfields nearby Noyapara and Foteyabad, which might've contributed to SPM inhaled by CU students.Ambient Air particulate matter samples(PM_{10} and $PM_{2.5}$) were collected uniformly using a high volume air sampler at an average flow rate of 2 L/min and each sampling was run for 15 minutes. To qunatify the amount of PM, we made our observation as the mass of analyte. For that, we classified the analyte (PM of air) in two groups based on their diameter. Trap the PM of diameter equal to, or more than 10 microns, we used Whatman filter paper (41). Then the air free of macro particles was drawn through Whatman filter paper (42) to trap the remaining micro particles. The filter papers were kept in empty air tight zip lock plastic bags till the beginning & soon after finishing the sampling, to prevent further exposure to air. The packets with the matrix were flattened & weighted once before and after the sampling. The difference between the two weights gave the amount of macro & micro particles.The samples were collected time to time between Apr 5, 2014 and Jun 17, 2014. All information gathered from different sources and after sorting only the necessary and required information was set aside for compilation and analysis to avoid unnecessary bulk of paper. Intensive care was taken regarding the applicability, reliability and validity of information. After sorting and compilation, the data were analyzed statistically and graphically using MS office and SPSS software.

3. FINDINGS

Variations of particulate exposure due to time of the day

We can see from the error bars (Mean±1SE) in (Fig.1) the concentration of $PM_{2.5}$ varies widely on different days in the morning while the concentrations in the early afternoon and late afternoon has lower variability. On the other hand, the concentration of PM_{10} varies widely on different days in the late afternoon while the concentrations in the morning and early afternoon showed lower variability (Fig. 2). We are unsure of the causes of such variability but we hypothesize that the variation may be linked to the differences inherent to the landscape and the disturbance pattern on the land through which the train route passes leading to particulate production.

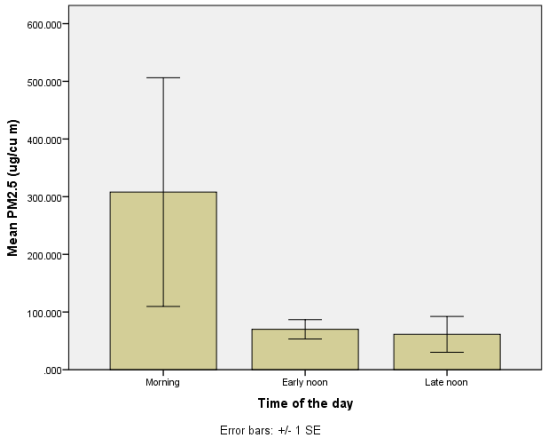

Fig.1: Relative concentrations of $PM_{2.5}$ and the distribution of concentrations in the air of shuttle train of Chittagong University among different times of the day.

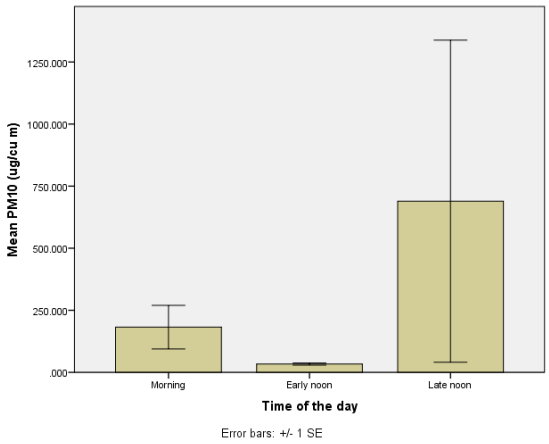

Fig.2: Relative concentrations of PM_{10} and the distribution of concentrations in the air of shuttle train of Chittagong University among different times of the day.

Fig. 3 and 4 depicts that, boxplots for $PM_{2.5}$ and PM_{10}, the interquartile ranges are different though the median value indicates the similarity in concentrations of these in different times of the day. These results do not indicate statistically significant variations, may be due to lower sample size. Therefore, we need further investigation to confirm the variation in concentrations at different times of the day in shuttle train and also to elucidate the causes of such variations.

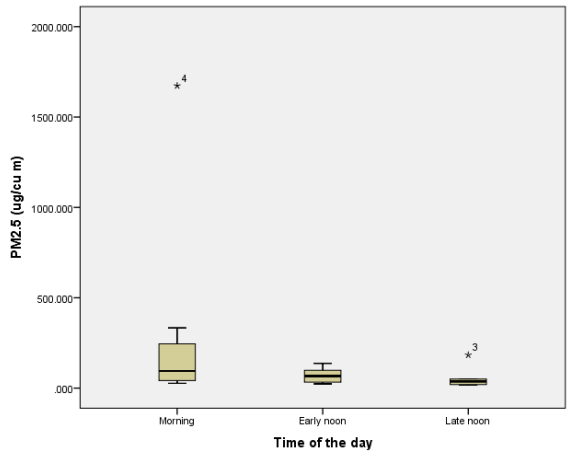

Fig.3: Box plot of $PM_{2.5}$ concentrations in the air of shuttle train of Chittagong University among different times of the day.

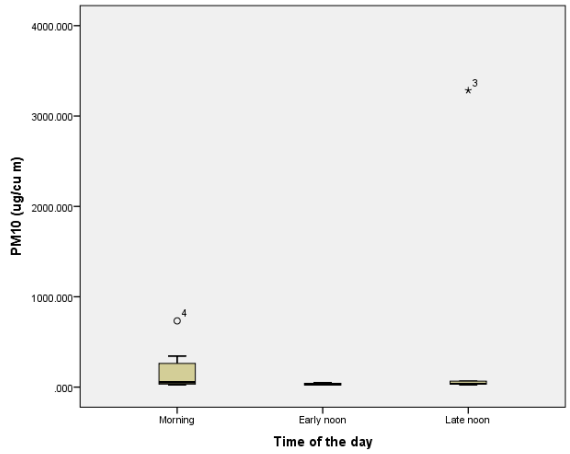

Fig.4: Box plot of PM_{10} concentrations in the air of shuttle train of Chittagong University among different times of the day.

As we can see from the error bars (Mean±1SE) in (Fig.5) the concentration of $PM_{2.5}$ varies widely on different sides. While on the right side of the shuttle the concentration of $PM_{2.5}$ was higher than that on the left side. In our observation, we can say that the increased number of industries, particularly in the Nasirabad industrial area, along the right side of the shuttle train route may add an excess amount of $PM_{2.5}$ during the morning of the day. On the other hand, the concentration of PM_{10} varies widely on different sides (Fig.6). While on the left side the concentrations have higher variability, the right shows lower variability. We assume that emissions of smokes from the all kinds of buses, trucks, motorbikes are the main contributors to increase the concentration of the PM_{10} in the left side of the shuttle train route.The boxplots for $PM_{2.5}$ and PM_{10},we can see that the interquartile ranges are different though the median values indicate the similarity in concentrations of these in different side of the train. These results do not indicate statistically significant variations, may be due to lower sample size (Fig. 7 and 8). Therefore, we need further investigation to confirm the variation in concentrations at different sides in shuttle train and also to elucidate the causes of such variations.

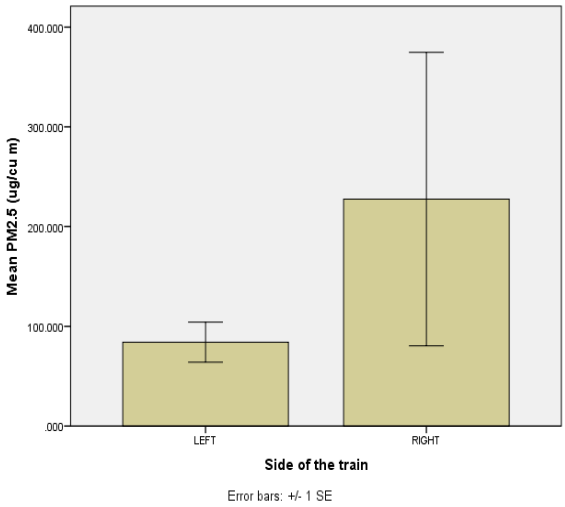

Fig.5: Relative concentrations of $PM_{2.5}$ and the distribution of concentrations in the air of shuttle train of Chittagong University among different side of the train.

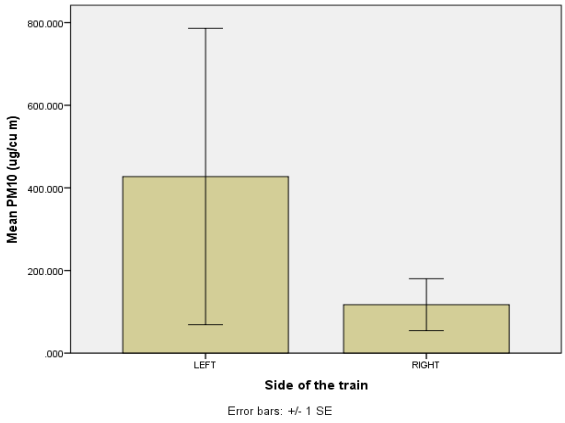

Fig.6: Relative concentrations of PM_{10} and the distribution of concentrations in the air of shuttle train of Chittagong University among different side of the train.

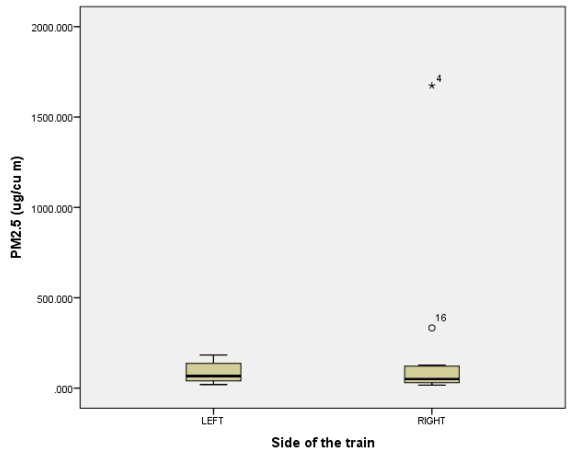

Fig.7: Box plot of $PM_{2.5}$ concentrations in the air of shuttle train of Chittagong University among different side of the train.

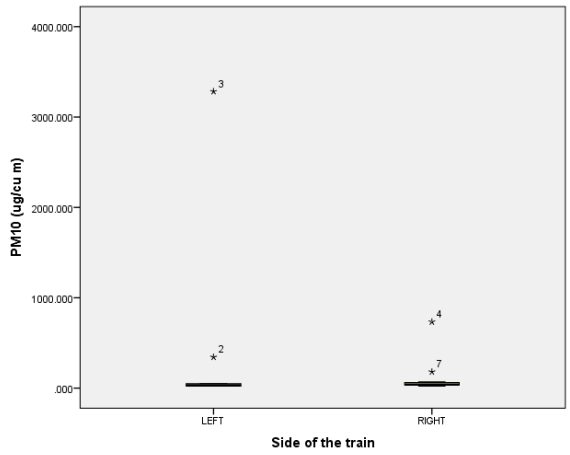

Fig.8: Box plot of PM_{10} concentrations in the air of shuttle train of Chittagong University among differentside of the train.

As we can see from the error bars (Mean±1SE) in (Fig.9) the concentration of $PM_{2.5}$ varies broadly on different direction of the train. While on the up the concentration is higher, in the down it shows lower variability. From our observation, we can say that continuous emitting of pollutants of Nasirabad industrial area and vehicles of the road are responsible for the higher concentration of the PM. On the other hand, the concentration of PM_{10}varies widely on different direction of the train (Fig. 10).In the down, the concentration was higher whereas in the up shows the lower variability.

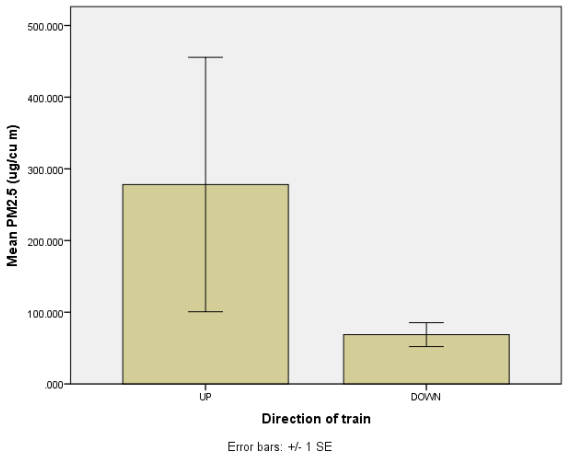

Fig.9: Relative concentration of $PM_{2.5}$ and the distribution of concentrations in the air of shuttle train of Chittagong University among different direction of train.

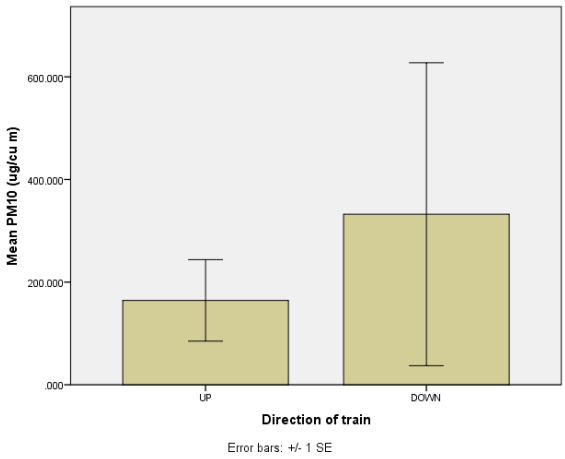

Fig.10: Relative concentration of PM_{10} and the distribution of concentrations in the air of shuttle train of Chittagong University among different direction of train.

The boxplots for $PM_{2.5}$ and PM_{10},we can see that the interquartile ranges are different though the median values indicate the similarity in concentrations of these in different direction of the train (Fig. 11 and 12). These results do not indicate statistically significant variations, may be due to lower sample size. Therefore, we need further investigation to confirm the variation in concentrations at different direction of train in shuttle train and also to elucidate the causes of such variations.

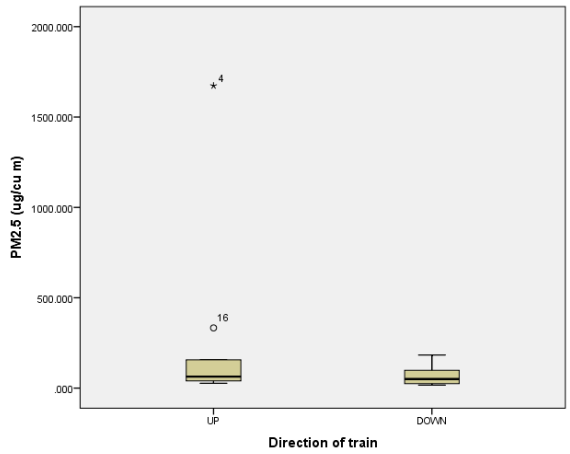

Fig.11: Box plot of $PM_{2.5}$ concentrations in the air of shuttle train of Chittagong University among different direction of train.

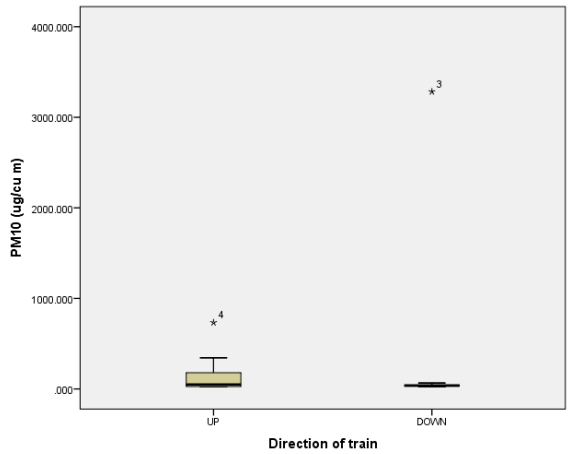

Fig. 12:Box plot of PM_{10} concentrations in the air of shuttle train of Chittagong University among different direction of train.

Fiure 13 shows the concentration of $PM_{2.5}$ which varied widely on different times of the day.In the morning concentration was comparatively lower in the left when going up. In early noon and late noon concentration gets comparatively lower in both sides than morning. On the other hand, in case of going down in the early noon and late noon, concentration gets higher than morning. The study releavedthat therewas a little variation between left and right sides in the early noon. Again in the late noon the concentration was higher in the left side than right.

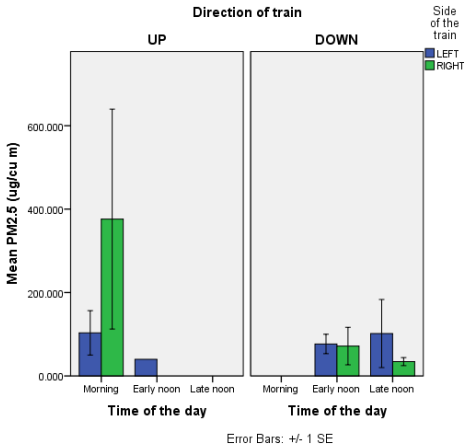

Fig.13: Variation of $PM_{2.5}$ concentrations with different time, directions and sides of Shuttle train of Chittagong University

The concentration of PM_{10} varies widely on different times of the day (Fig 14). When going up there was little variation in the left and right sides in the morning. The concentration gets lower in the early noon and late noon than morning. Again in case of going down the concentration in the late noon on the left side gets higher than morning and early noon.

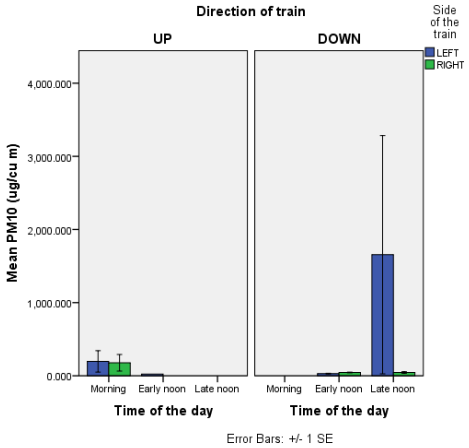

Fig.14: Variation of PM_{10} concentrations with different time, directions and sides of Shuttle train of Chittagong University

4. CONCLUSION

Air pollution is one of the most challenging problems facing by the international community which has widespread impacts on human health and the environment. This research was aimed to examine the concentration of particulate matters (PM) in the railroad of Chittagong university shuttle and the degree of particle pollution among distinctive times

of the day. Surrounding air PM (Pm10 and Pm2.5) was collected consistently using a high volume air sampler at a normal flow rate of 2 L/min and each sample was run for 15 minutes.To trap the PM of distance across equivalent to, or more than 10 microns, we usedWhatman filter paper (41). At that point, the air free of macro particles was drawn through Whatman filter paper (42) to trap the staying micro particles.

The study found that the mean concentration of $PM_{2.5}$ and PM_{10} in the shuttle train air was very high in the morning amounting to 307.91 $\mu g/m^3$ and 689.33 $\mu g/m^3$, respectively. In the early morning trains are very crowded and this high load of particulates in the air inhaled by they are exposing them to both $PM_{2.5}$ and PM_{10} related health hazards.In case of $PM_{2.5}$,on the right side, the concentration of $PM_{2.5}$ was higher than that on the left side.On the other hand, on the left side the concentrations have higher variability, the right shows lower variability and in the down the concentration is higher, in the up shows the lower variability. We can conclude that early morning of the day, the concentration of $PM_{2.5}$ and PM_{10} in the shuttle train air is higher in the right side of the railroad which may have impacts on health of students of Chittagong University.

5. ACKNOWLEDGEMENT

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