The Impact of Air Pollution on Child Growth in Myanmar: Insights from the 2015-2016 DHS and Satellite Data

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1. Introduction

Myanmar, a country undergoing rapid urbanization and industrialization, has been facing a silent crisis: "Air Pollution" – characterized by high concentrations of PM 2.5 and other toxic pollutants. In major cities, individuals often experience air pollution levels that exceed the safety threshold set by the World Health Organization. Many studies suggest that air pollution, especially PM2.5, is a major concern as it has been associated with various adverse health outcomes in children in India (Balietti et al., 2022) and Bangladesh (Kurata et al., 2020). However, little attention has been paid to Myanmar. Contrary to many other countries, a traditional land-clearing practice known as "slash-and-burn" (crop burning) is still common in Myanmar. Hence, the air pollution concentration can be more widespread and as severe as in urban cities. Investigating this aspect must be based on nationwide geospatial data instead of those collected from air quality stations, which are in limited numbers and only available in major cities. Our contributions to literature are three-fold. First, although various studies have shown the effects of PM 2.5 on child mortality, there is still little evidence of more subtle effects of air pollution, such as stunting and child development under age 5. By filling this gap, we believe it is an important contribution to literature since child development is an important factor in human capital accumulation. Our second contribution is the use of geospatial data on Burmese municipalities. By utilizing the data from the 2015-2016 Demographic and Health Survey matched with spatial data points for air pollution estimates and various other satellite data, our paper can provide a clearer picture of air pollution. Finally, previous literature has focused mainly on the mean PM 2.5 or chronic PM 2.5 exposure. We argue that the accumulated PM 2.5 is also important since the high concentration of PM 2.5 is correlated with the academic year of Burmese children. Hence, our novel contribution is to examine the consequences of accumulated postnatal PM2.5 exposure on child development.

2. Methodology and Data

This study utilizes data from the 2015-2016 Demographic and Health Survey (DHS) and NASA's satellite data from MERRA-2. We estimate the following models to analyze the effects of accumulated and average PM2.5 exposure on child health.

Model 1: Yic =β1Pre-AccPM2.5ic+β2Post-AccPM2.5ic+ β3(AGE x Post-AccPM2.5ic) + β4(GENDER x Post-AccPM2.5ic)+Xic′+γg+εic

Model 2: Yic =β1Pre-AccPM2.5ic+β2Post-MeanPM2.5ic+ β3(AGE x Post-MeanPM2.5ic) + β4(GENDER x Post-MeanPM2.5ic)+Xic′+γg +εic

Model 3: Yic =β1Pre-AccPM2.5ic+β2Post-AccPM2.5ic+ β3Post-MeanPM2.5ic+ β4(AGE x Post-AccPM2.5ic) + β5(AGE x Post-MeanPM2.5ic) + β5(GENDER x Post-AccPM2.5ic) + β5(GENDER x Post-MeanPM2.5ic)+Xic+γg +εic,

where Yic can be height-for-age (HAZ) score of child i in region c. Pre-AccPM2.5, Post-AccPM2.5 and Post-MeanPM2.5 (μg/m3) are the accumulated PM2.5 from conception until the birth date, the lifetime accumulated PM2.5 from birth until the survey date, the annual average PM2.5 exposure to from birth until the survey date, respectively. Even if the lifetime exposure is the same, the impact of PM2.5 on the health may be different between the younger children and the older children, since younger children are exposed to the PM2.5 for the shorter period. We consider the annual average PM2.5 can capture the exposure in the shorter period (yealy) rather than the lifetime exposure. AGE is defined as the age of the child in months, while GENDER is a dummy

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variable which is equal to 1, if the individual is female. Xic' is a vector of control variables including the other air pollutants, characteristics of children, households and maternal qualities. Finally, γg are fixed effects for geographical regions; εic is the error term. To explore the heterogeneous impacts across various age groups, children under age 5 are divided into the following categories: 0-11 months, 12-23 months, 24-35 months, 36-47 months, and 48-59 months. We employ OLS to estimate the impacts of air pollution on HAZ. AGE and GENDER interaction terms are also included to further quantify the differential effects.

3. Results and Conclusion

Table1 presents the main estimated results from three models. Post-accumulated PM2.5 exposure consistently shows significant negative impacts on the HAZ scores across all models. Specifically, the results show that prenatal accumulation of PM2.5 does not affect the health but postnatal accumulation of PM2.5 has negative impact on HAZ. . Furthermore, the impacts are different among age groups and gender. The positive interaction between post-accumulated PM2.5 and age implies that air pollution effect on the HAZ decreases as a child gets older. It is possible that older children are more resilient and there exists a dilution effect of lifetime exposure. On the other hand, gender interactions reveal that the negative impact on females are larger under post-accumulated PM2.5 exposure. It could mean that females are more vulnerable to lifetime air pollution exposure due to differences in biological mechanisms. However, Post-Mean PM2.5 X GENDER is significantly positive. This indicate that the impact of PM2.5 for the shorter period (yealy) on females is smaller.

Table1. Regression results on the effect of PM2.5 and interaction terms on child growth outcomes

	Model 1	Model 2	Model 3
Pre-Acc PM2.5	-0.0000159	0.0000482	-0.0000026
Post-Acc PM2.5	-0.000102***	-	-0.000105***
Post-Mean PM2.5	-	0.0139804	0.0195517**
Post-Acc PM2.5 X AGE	0.0000018***	-	0.0000017***
Post-Mean PM2.5 X AGE	-	-0.003303***	0.0004941
Post-AccPM2.5 X GENDER	-0.000007	-	-0.0000125**
Post-Mean PM2.5 X GENDER	-	0.0428187***	0.0471840***
Adjusted R^2	0.398	0.377	0.413
F Value	16.22***	15.20***	15.82***
Obs.	2,104	2,083	2,083

Notes: ***, ** and * indicate 1%, 5% and 10% significant level.

In conclusion, our study highlights the significant negative impact of post-accumulated PM2.5 exposure on child development, HAZ scores, in Myanmar. We show that younger children and females are more vulnerable to air pollution in the lifetime exposure.

Reference:

1. Balietti, A., Datta, S., and Veljanoska, S. (2022). Air pollution and child development in India. Journal of Environmental Economics and Management, 113:102624.
2. Kurata, M., Takahashi, K., and Hibiki, A. (2020). Gender differences in associations of household and ambient air pollution with child health: evidence from household and satellite-based data in Bangladesh. World Development, 128:104779.