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Indoor Particulate Matter Levels in School Classrooms and its Association with Asthma in Adolescents from Anuradhapura, Sri Lanka

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Background: Indoor particulate matter (PM) is a key determinant of respiratory health.

Objective: To determine indoor PM levels in classrooms and their association with asthma among adolescents.

Methods: A descriptive cross-sectional study was conducted in January 2023 among Grade 8 students across six randomly selected government secondary schools in the Anuradhapura Municipal Council Area, Sri Lanka. Using a video particle counter (VPC-300-EXTECH™), that quantifies airborne PM (0.3 µm to 10 µm) was positioned centrally within each classroom while students were present. Respiratory symptoms were assessed using validated, self-administered International Study of Asthma and Allergies in Childhood questionnaires in Sinhala and Tamil. The minimal sample size was 932, based on a 10.7% asthma prevalence, 2% precision, and a 10% dropout rate. Associations between PM exposure and respiratory symptoms were analysed using the χ^2 -test. Informed written consent from parents(s) and/or guardian(s) and assent from adolescents was obtained.

Results: All 32 classrooms exceeded the maximum acceptable temperature, while 84.4% surpassed recommended relative humidity. Among 1,029 adolescents aged 13-14 years, prevalence of current wheeze was 23.7% (n=244; 95% CI: 21.1–26.4) and severe asthma 15.3% (n=157; 95% CI: 13.1–17.6). Indoor PM concentrations of PM_{0.3}, PM_{0.5}, PM_{1.0}, PM_{2.5}, PM_{5.0} and PM₁₀ exceeded recommended levels in 93.8%, 87.5%, 81.3%, 100%, 93.8% and 93.8% respectively. The highest mean fine particulate matter level was more than 28 times the approved range. Maximum counts exceeded approved ranges for PM_{1.0} (176,048), PM_{2.5} (56,237), and PM₁₀ (2,025), 20-times, 103-times, and 29-times, respectively. Minimum PM_{2.5} levels exceeded hazardous limits in 30 classrooms. A significant positive correlation was observed between minimum PM_{0.3} levels and severe asthma (Spearman $r=0.46$; $p=0.01$).

Conclusion: Indoor air quality in classrooms was suboptimal, with PM levels exceeding safety limits and significantly associated with severe asthma. This indicates the necessity of developing school-based environmental interventions aimed at improving indoor air quality.

Keywords: Asthma, Indoor air pollution, Particulate matter