Assessing the Impact of Cooking Fuels on Indoor Particle Matter 2.5 ($PM_{2.5}$) Levels in Sri Lankan Households

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Household air pollution resulting from biomass and fossil fuel combustion is a major contributor to indoor $PM_{2.5}$ concentrations, which is linked to respiratory health issues like chronic bronchitis and asthma. Different types of fuel produce varying amounts of $PM_{2.5}$, thereby affecting indoor air quality and potential health risks. This study aims to evaluate the relationship between fuel type, $PM_{2.5}$ levels, and respiratory health outcomes. $PM_{2.5}$ data were collected continuously over three days from 48 selected households in Kandy, Sri Lanka, using portable samplers. The data were analyzed to compare $PM_{2.5}$ concentrations across different household fuel types. In addition, the frequency of probable and confirmed cases of chronic bronchitis and asthma was assessed in relation to $PM_{2.5}$ exposure levels. $PM_{2.5}$ concentrations were categorized based on standard air quality classifications: Good (≤ 12 μg/m³), Moderate (12.1–35.4 μg/m³), Unhealthy for Sensitive Groups (35.5–55.4 μg/m³), Unhealthy (55.5–150.4 μg/m³), Very Unhealthy (150.5–250.4 μg/m³), and Hazardous (> 250.4 μg/m³). Among the households surveyed, LPG (31) was the most commonly used cooking fuel, followed by firewood (12), while kerosene and electricity were each used by one household. Analysis of $PM_{2.5}$ concentrations by fuel type showed that kerosene had the highest mean $PM_{2.5}$ concentrations (57.0 μg/m³.), followed by firewood (n = 12, 34.4 ± 11.7 μg/m³), LPG (n = 31, 31.0 ± 28.4 μg/m³), and electric stoves (n = 1, 21.6 μg/m³). Firewood showed different $PM_{2.5}$ concentrations depending on the stove type, improved Anagi stoves (n = 1, 46.8 μg/m³), traditional clay stoves (n = 4, 42.1 ± 3.51 μg/m³), traditional stoves (n = 7, 29.9 ± 12.6 μg/m³) Based on standard air quality classifications, 5.4% of observations fell into the 'Good' category, 69.6% were 'Moderate', 14.3% were 'Unhealthy for Sensitive Groups', and 10.7% were classified as 'Unhealthy'. The findings indicate fuel type influences indoor $PM_{2.5}$ concentrations, with kerosene and biomass linked to the highest exposure. However, this study does not consider household ventilation, which may affect $PM_{2.5}$ dispersion and exposure. Transitioning to cleaner fuels like LPG and electricity may reduce indoor air pollution and improve respiratory health.

Keywords: Indoor air quality, $PM_{2.5}$, cooking fuels, biomass combustion