

# The effect of chimney fitted improved stove on kitchen fine particulate matter (PM2.5) concentrations in rural Ethiopia

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## Background

Millions of Ethiopian people cook with biomass fuels using traditional stoves, releasing harmful pollutants and contributing to a significant public health crisis. Improved stoves offer a potential escape route, but their effectiveness needs close scrutiny. This study delves into the impact of chimney-fitted stoves on kitchen PM2.5 concentrations in rural Ethiopian households.

## Method

We conducted a randomized controlled trial with 86 households equally divided (1:1 ratio) between intervention and control groups. The 24-h average kitchen PM2.5 concentrations was measured using Particle and Temperature Sensor (PATS+) at baseline and after intervention. All relevant sociodemographic and cooking related characteristics were collected at baseline and dynamic characteristics were updated during air monitoring visits. Three distinct statistical models, including independent sample t-tests, paired sample t-tests and one-way analysis of variance were used to analyze the data using Statistical Package for the Social Sciences (SPSS) software for Windows (v 24.0).

## Result

At baseline, the average 24-h kitchen PM2.5 concentrations were 482 µg/m3 (95% CI: 408, 557) for the control and 405 µg/m3 (95% CI: 318, 492) for the intervention groups. Despite remaining elevated at 449 µg/m3 (95% CI: 401, 496) in the control group, PM2.5 concentrations reduced to 104 µg/m3 (95% CI: 90,118) in the intervention group, indicating a statistically significant difference ( $t = 6.97$ ,  $p < 0.001$ ). All three statistical analyses delivered remarkably consistent results, estimating a PM2.5 reductions of 74% with the before-and-after approach, 76% when comparing groups, and 74% for difference in difference analysis. Beyond the overall reduction, homes with primary school completed women, larger kitchens, smaller family size, and those specifically baking Injera (the traditional energy-intensive staple food), witnessed even greater drops in PM2.5 levels.

## Conclusion

Pregnant women in our study encountered dangerously high PM2.5 exposures in their kitchens. While the intervention achieved a significant PM2.5 reductions, unfortunately remained above the WHO's safe limit, highlighting the need for further interventions.

**Author:** DEMELASH, Habtamu (Debre Tabor University)

**Co-authors:** Dr BEYENE, Abebe; Prof. TIKU, Seid

**Presenter:** DEMELASH, Habtamu (Debre Tabor University)

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