

Effects of a liquefied petroleum gas stove intervention on gestational blood pressure: intention-to-treat and exposure-response findings from the Household Air Pollution Intervention Network (HAPIN) trial*

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Background. Approximately 3-4 billion people worldwide are exposed to household air pollution (HAP) from burning solid fuels (wood, animal dung, and coal etc.). HAP has been shown to be associated with increased blood pressure (BP) in pregnant women, although the literature is sparse and inconsistent.

Methods. The HAPIN trial is the first multi-center randomized controlled trial (RCT) to assess the efficacy of a liquefied petroleum gas (LPG) stove and fuel intervention on health. We recruited 3195 pregnant women (9 to <20 weeks' gestation) in Guatemala, India, Peru, and Rwanda and randomly assigned half of them to receive the intervention, which consisted of a LPG stove, free fuel supply and behavioral messaging to encourage exclusive LPG use during their entire pregnancy. Those assigned to the control group continued cooking with existing methods (primarily solid fuels). We measured gestational BP and personal exposure to PM_{2.5}, black carbon (BC), and carbon monoxide (CO) three times during gestation: once at baseline and twice after randomization. We conducted an intention-to-treat (ITT) analysis and an exposure-response analysis to determine if the average exposure to HAP during gestation was associated with an increase in BP at final measurement compared to baseline.

Results. In the intervention group, median 24-hour average PM_{2.5} dropped from 84 µg/m³ at baseline to 24 µg/m³ after the intervention; BC and CO decreased similarly. ITT analyses comparing the change of BP from baseline to final measurement showed an increase in systolic BP (SBP) and diastolic BP (DBP) in both groups, as expected, but the increase was greater in the intervention group for both SBP (0.69 mmHg higher, 95% CI 0.03 - 1.35; p = 0.04) and DBP (0.62 mmHg higher, 95% CI 0.05 - 1.19, p = 0.03) than controls. Despite the exposure-response analyses suggested that higher exposures of PM_{2.5}, BC, and CO were associated with moderately higher increases in the changes of SBP and DBP from baseline to final measurement, none of these associations reached statistical significance at the 0.05 level. Analyses of quartiles of exposure showed generally positive but inconsistent trends of increased BP with higher exposures.

Conclusions. We found a greater increase in gestational BP in the intervention group in ITT analyses. This was contrary to what we expected, although the increases were not considered clinically significant. In exposure-response analyses, we found the opposite, a slight increase in BP with higher exposure, although no increases were significant at conventional significance levels, and again are not likely to be clinically important. Overall, an intervention strategy of LPG stove did not markedly affect gestational BP when compared to controls.