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Abstract

Background Acute lower respiratory infections (ALRI) are an important cause of death in young children in low-income countries. High concentrations of fine particulate matter (PM_{2.5}) indoors caused by open burning of biomass are associated with risk of ALRI. However, improved biomass stoves reduce emissions and might reduce the incidence of lower respiratory illness. A cluster-randomised, step-wedge, community-based trial was conducted to estimate the effect that a change from open burning of biomass to improved biomass stoves could have on rates of ALRI in children younger than 36 months in a rural area of southern Nepal.

Methods Households were enrolled in Sarlahi district that had at least one child aged younger than 36 months or a married woman aged 15–30 years. Respiratory morbidity data were collected for 6 months prior to the introduction of improved biomass stoves between March, 2010, and December, 2010. Mothers were asked about respiratory signs and symptoms (cough, difficult or rapid breathing, wheeze, ear discharge, fever) in their participating children in the past 7 days during weekly visits from local study staff. A 12-month stepped-wedge introduction of an improved biomass stove with chimney to participating households followed the 6-month run-in period (Envirofit Corp. Colorado Springs, CO, USA). Weekly morbidity assessments continued during the step-wedge period (from January, 2011, to February, 2012) and for 6 months after stove introduction (from March, 2012, to December, 2012). Children were discharged at age 36 months. The primary outcome was ALRI, defined as a maternal report of 2 or more consecutive days of fast or difficult breathing accompanied by fever. Episodes were separated by a minimum of 7 symptom-free days. An environmental assessment was done in households once before and once after the improved stove was installed. The trial is registered at clinicaltrials.gov (NCT00786877).

Findings 5254 children from 3376 households were enrolled either at baseline or during the trial period. Mean 20-h kitchen concentration of PM_{2.5} was reduced from 1386 µg/m³ to 930 µg/m³. There was a strong secular decline in the incidence of ALRI over the period of the study. The intervention was associated with a 13% decline in the incidence of ALRI but the strength of evidence was weak (0·87, 95% CI 0·67–1·13). There were statistically significant reductions in persistent cough (0·91, 0·85–0·97), wheeze (0·87, 0·78–0·97) and burn injury (0·68, 0·48–0·95) but not for fever, severe ALRI, or ear discharge.

Interpretation There was weak evidence for a modest decline in the incidence of ALRI. Post-installation PM_{2.5} concentrations remained well above current indoor air standards of 25 µg/m³. Better performing biomass stoves or cleaner fuels such as liquid petroleum gas or ethanol are needed to reduce concentrations enough to estimate the impact on ALRI incidence.

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Declaration of interest

We declare no competing interests.

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