Supporting Information

Title: Mixing Factor Analysis For Air Exchange Rates in Village Housing

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-Table 1S: Results of Mixing Factor Analysis

An additional analysis examining mixing factors was conducted to assess if further adjustment was necessary when determining air exchange rates.

Supporting Information

Mixing Factor Assessment Methods. Air exchange rate studies that utilize tracer gas decay techniques typically assume that the air in the space being tested is well-mixed[1]. If the air is not uniformly mixed, a mixing factor, *k*, can be used to obtain more accurate AER estimates[2–5]. The mixing factor is equivalent to 1 when the air is perfectly mixed and is <1 when incomplete mixing is present. To assess the degree of mixing in the test house, we compared the decay measured as described in the Exfiltration Fraction Determination section (Main Paper) to a decay curve measured with artificial mixing.

To assess the degree of mixing, CO decay was measured with and without mixing (using the same modified water boil test in the mock house) post-fire extinguishment as described in the Exfiltration Test Protocol section (Main Paper). For tests with mixing, two pedestal fans (Super Deluxe iii Crompton Greaves Corporation, Mumbai, India) were placed 0.5m from the wall in the northeast and southwest corners. Both fans rotated in 90° intervals and were placed such that their combined oscillation fields covered the entire room. To mix the air, both fans were turned on at their lowest setting after one of the pot's reached boiling point. When the second pot reached boiling point, the fire was extinguished and remnant fuel removed. The fans continued to run for an additional minute post fuel removal. CO concentration decay data was extracted from this point forward and analyzed accordingly to determine the AERs for each condition. Fuel type was restricted to wood only and window/door status was set to either all open or all closed (with n=10 for each). Mixing factor, designated as *k*, is defined as

$$k = \frac{\mathrm{MA}}{\mathrm{NAM}} \qquad (1\mathrm{S})$$

where MA is the average air exchange rate (h^{-1}) for the (ideal) artificially, well-mixed tests and NAM is the average air exchange rate (h^{-1}) for the non-mixed condition. If the ratio of the two exchange rates is equal to 1 then the space can be considered well-mixed[5].

Mixing Factor Assessment Data Analysis.

For the mixing factor analysis, a Mann-Whitney-Wilcoxon test was applied to see if the ratio of the two AER means were different from 1 (perfect mixing). These values were assessed in order to determine whether or not perfect mixing could be assumed and if a mixing factor must be applied to AER measurements. All statistical analyses were performed in the R Statistical Computing Environment (version 3.0.2; R Project for Statistical Computing, Vienna, Austria).

Mixing Factor Analysis Results. Results for the mixing factor analysis are reported in Table 1S. The mean (95% CI) AER for non-mixed tests was 9.9 h^{-1} (4.7, 15.1), with artificially mixed tests yielding 7.5 h^{-1} (4.5, 10.5). These means are not statistically different (p-value = 0.63) suggesting that the well-mixed model assumption (k = 1) is not unreasonable, thus allowing the assumption of perfect mixing. The homes in this region are small and typical occupant movement creates air movement within the house that contributes to the overall mixing. To our knowledge this is the first study to evaluate the well-mixed assumption in a village-like home within a developing country.

Table 1S. Results of Mixing Factor Analysis

Mixing Status	N	Average Air Exchange Rate Per Hour (95% CI)	Mixed Artificially to Not Artificially Mixed Ratio (95% CI)
Mixed Artificially (MA)	10	7.5 (4.5, 10.5)	0.76 (0.34, 1.46)*
Not Artificially Mixed (NAM)	10	9.9 (4.7, 15.1)	

*P-value >> 0.05

Mixing Factor Analysis Limitations.

Mixing factor analysis was limited by a small sample size and an assessment conducted in a mock house. Although our findings indicated a mixing factor not statistically different from 1, a larger sample size will provide more confidence in this result. Furthermore, additional tests assessing mixing are needed in occupied homes to assess variability across housing type.

References

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