Wood stove interventions and child respiratory infections in rural communities

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Wood stoves

Across the US, ~11 million homes report the use of wood as either a primary or secondary heating fuel.

Over 80% of these woodstoves are old and inefficient.
PM$_{2.5}$ health effects

- PM$_{2.5}$ exposure is associated with many adverse health outcomes, including a greater than three-fold increased risk of lower respiratory tract infections (LRTIs) in children.

- Acute LRTIs account for more than 27% of all hospitalizations among US children <5 years of age.

- Poor indoor air quality may be related to risk of lower respiratory tract infections (LRTI) among children.
Indoor wood smoke exposures
Indoor residential PM$_{2.5}$ sampling programs

- Northern Rockies / Fairbanks, AK intervention study (97 homes).
- Avg (sd) indoor PM$_{2.5}$ across all homes was 34.8 ± 56.5 µg/m$^3$.

- Indoor PM$_{2.5}$ concentrations often exceed health based standards such as WHO and EPA NAAQS.
Residential PM$_{2.5}$ Program
PM$_{2.5}$ Mass - Home 4A

Before Changeout

Start Sampling:
10/25/06 @ 14:00

End Sampling:
10/26/06 @ 14:00

Avg = 131.8 μg/m$^3$
Interventions – indoor air

Our team has evaluated:

• wood stove changeouts
• use of filtration units
Wood stove changeout

Old stove
40-60 g smoke/hr

EPA-certified stove
2-5 g smoke/hr
Wood Stove Changeouts

- Promoted by EPA to reduce wood smoke.
- Expensive (~$1500 - $4500).
- Effective in reducing ambient PM$_{2.5}$.
- Results can be variable for indoor air.
- Learning curve.
Indoor intervention
- air filtration units -

Monitor compliance (KiloWatt meter).
Filtration units

- ~60% improvement in air quality.
- Expenses: costs of the unit (~$200), yearly filter replacement (~$100), and energy usage (~$100-$200/year).
- Noise, filter replacement, etc.
- Compliance issues.
What about education on best-burn practices?

• Can education be used as an effective, economical, and sustainable intervention to improve indoor air quality and health effects?

• Education coupled with the use of inexpensive tools.
Education intervention

- Videos on Best Burn Practices.
- Training on simple tools:
  - moisture meter
  - stove thermometer
  - firestarter
“KidsAIR”

- Wood Stove Interventions and Child Respiratory Infections in Rural Communities.

- Curtis Noonan and Tony Ward (co-PIs).

- 5-year R01 funded by the NIEHS.

- Project Period: 06/19/2014 – 03/31/2019.

- Study areas include western MT, Alaska Native Villages (Univ Alaska Fairbanks, CANHR), and the Navajo Reservation (Univ New Mexico).
Overview of KidsAir

• Hypothesis: a low-cost, educational intervention targeting indoor wood smoke (PM$_{2.5}$) exposures will be an efficacious, sustainable strategy for reducing children’s risk of LRTI in underserved Native and rural communities.

• Interventions:
  • Household-level strategies, including 1) filtration units, 2) placebo filtration, and 3) education (randomized trial).

• Participants 324 homes with an anticipated 486 children <5 years (108 homes at Navajo Nation, 162 children in total).
Health Outcomes

• The primary health outcome will be occurrence of LRTI among children.

• Identification of LRTI episodes will occur through a three step process:
  • (1) parent reporting of symptoms
  • (2) Collection of confirmatory and severity data
  • (3) physician classification of case status (medical records).
Health Measures

• Identification of symptoms consistent with LRTI (wheeze and cough, fever/temperature, elevated respiratory rate, saturated oxygen, and evaluate the child for presence of chest indrawing (retractions)).

• Parents asked to contact their Community Coordinator when such symptoms are present in household children <five years.

• Home visits will occur within 48 hours of parent notification of signs and symptoms of LRTI.

• Continue to track this child’s symptoms.
Exposure Outcomes

• Indoor PM2.5 Monitoring. A stationary DustTrak (TSI) is used to continuously measure PM2.5 mass with 60-second time intervals for 6 day periods.

• Stove temperature. We monitor stove use throughout the winter using a LogTag.
• Activity logs.
Results

- Enrolled through winter three of grant:
  - 49 homes, 74 kids.

- Target Winter 4 (2017/18 winter)
  - 33 homes, 50 kids.

- Data analysis is in progress.
Recruiting and other challenges
Conclusions

- Residential wood combustion is a large source of PM$_{2.5}$ within the indoor environment during the winter months.

- Education on best-burn practices shows promise in reducing ambient and indoor air pollution, but needs to be comprehensively evaluated.

- **Benefits of research:** A low-cost, educational intervention targeting indoor wood smoke PM$_{2.5}$ exposures will be sustainable, and can reduce children’s risk of LRTI in underserved Native and rural communities.
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