Clean cooking and heating solutions

1. Pope, D et al. (2021). Are cleaner cooking solutions clean enough? A systematic review and meta-analysis of particulate and carbon monoxide concentrations and exposures. *Environmental Research Letters*, *16*(8), 083002.

2. Boudewijns, E. A. et al. (2022). Facilitators and barriers to the implementation of improved solid fuel cookstoves and clean fuels in low-income and middle-income countries: an umbrella review. *The Lancet Planetary Health*. 6(7): e601-e612.

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Title of evidence summary:
Clean cooking & heating

Who is this summary for?
Adolescents

Focus
Evidence of in-field measurements (personal and kitchen PM2.5 and CO) from four cleaner cooking technologies (with and without venting, complex intervention, advanced combustion) and three clean fuels (ethanol, LPG, and electricity).

Key findings/recommendations
- *For kitchen PM2.5*, all intervention types resulted in statistically significant reductions. Only very clean fuels consistently achieved mean post-intervention levels near/below the WHO AQG IT-1 level.
- *For kitchen CO*, post-intervention kitchen concentrations of CO were significantly reduced for both chimney and non-chimney cleaner biomass stoves, as well as ethanol and LPG clean fuel stove interventions. The majority of all types of interventions achieved CO levels at or below the WHO 24 h guideline.
- *For personal exposure (for cooks and children) to PM2.5*, whilst the data was more sparse, only the interventions involving cooking with advanced combustion cookstoves, LPG or electricity resulted in a statistically significant pollutant reduction and only LPG interventions consistently achieved levels below or near the WHO IT-1 AQG.
- *For personal exposure (for cooks and children) to CO*, chimney stoves, advanced combustion biomass stoves, and LPG interventions resulted in statistically significant reductions. All interventions resulted in levels of personal exposure below the WHO 24 h guideline level.

Implementation considerations
- The path to clean household energy will include transitional steps as the cleanest options may not be feasible in many contexts due to infrastructure, resource, or other constraints.
- The impact of multiple stove use, or stove 'stacking', can have dramatic impacts.
- A holistic approach jointly targeting ambient and HAP should be followed in LMICs.
- No evidence was available for pellet fuelled stoves.
- The Cleaner Cookstove Implementation Tool and the Clean Fuel Implementation Tool provide 15 factors that should be addressed during the development of implementation strategies (2).

Quality of the evidence
Study design: systematic review and meta-analysis. Fifty studies provided 168 estimates synthesized through meta-analysis. This review represents a comprehensive appraisal of the current evidence base. However, there is substantial heterogeneity between included studies. There is a paucity of studies being published on intervention impacts of advanced combustion stoves, alcohol fuels, and electricity. There is also a lack of empirical evidence on the direct effects on personal exposure to PM2.5.

Citation for any linked full evidence review
A list of included studies is included in Pope, D et al. (2021). Are cleaner cooking solutions clean enough? A systematic review and meta-analysis of particulate and carbon monoxide concentrations and exposures. Environmental Research Letters, 16(8), 083002. Also see Boudewijns, E. A. et al. (2022). Facilitators and barriers to the implementation of improved solid fuel cookstoves and clean fuels in low-income and middle-income countries: an umbrella review. The Lancet Planetary Health. 6(7): e601-e612.

Who funded it?
This study was commissioned and paid for by the World Health Organization (WHO).

Languages the review is available in (can use ISO codes)
English

Other sources of information
- Energy Sector Management Assistance Program. The state of access to modern energy cooking services. (2020). World Bank.
- World Health Organization (2022). Tracking SDG7.
- Clean Cooking Alliance (2022). Accelerating clean cooking as a nature-based climate solution.

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E.A. Boudewijns