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BUILDING EVIDENCE FOR HEALTH

HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH

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COOKING EMISSIONS

Contributors: Maia Gokhale, B.A., Harvard T.H. Chan School of Public Health
Parichehr Salimifard, PhD, Harvard T.H. Chan School of Public Health

What are cooking emissions?

The phrase "cooking emissions" is a blanket descriptor referring to the gas and air fumes that are expelled during cooking activities. Cooking Emissions are produced from two main sources; 1) the emissions from the stove used for cooking and 2) the emissions produced by cooking food itself. Characteristics of both stove and the food being cooked influence cooking emissions type and concentration levels. Emissions from the stove can vary significantly depending on the fuel source. National surveys show that 58% of homes in the United States have natural gas burners, and 60-70% of European homes use them. [1,2] For the purposes of this paper, we refer to cooking emissions related to the practice of indoor stovetop cooking activities, which typically rely on electricity or natural gas as a fuel source. Electric coil burners can release both fine (smaller than 2.5 m in diameter) and ultrafine (smaller than 100 nm in diameter) particles (UFPs) from the heated surfaces even without the presence of the food.[3,4] Gas burners, which have been shown to produce higher particle concentrations compared to electric stoves[5], can release UFPs as well, along with formaldehyde (HCHO), carbon monoxide (CO), and nitrogen dioxide (NO2) that are emitted as a result of combustion. [6-9] Electric and natural gas-fired stoves produce significantly fewer emissions compared to the stoves using biomass or solid fuels. While in most developed countries electric and natural gas stoves are used for indoor cooking, in many countries and even some communities within the developed countries, biomass and coal are used for cooking which results in much higher emissions.[10,11] Besides stove and fuel source characteristics, type of food, method of cooking, and cooking temperature can also impact the cooking emissions type and intensity.[12-16] For example, high-heat cooking activities such as broiling and frying can produce acrolein, polycyclic aromatic hydrocarbons (PAHs), and particulates,[14,15] while it has also been demonstrated that the process of charbroiling and the practice of cooking fatty foods (such as high-fat hamburgers) yield higher particle emission concentrations compared to lower-heat cooking and low-fat foods.[14] Another example of cooking method effect was shown by a study that found higher carcinogenic potency of deep-frying than regular frying due to higher oil temperature and volume.[15]

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How do cooking emissions impact health?

Cooking emissions are one of the main sources of indoor air pollution.[13,17] It is notable that even in the outdoor environment, particles emitted from cooking are comparable with highway vehicles. [18] In buildings, pollutants such tend to be diluted less than outdoors, and without adequate ventilation to exhaust them, they can get accumulated indoors, resulting in concentrations higher than outdoors. [19] Elevated indoor NO2 levels have been associated with chest tightness, shortness of breath, asthma attack incidence, wheeze, and daily deaths. [9,20,21] Elevated indoor CO levels have been associated with increased incidences of chronic obstructive pulmonary disease, asthma symptoms, and lower respiratory infections. [12,22] Besides the specific chemical compounds, UFPs are also a health concern. One study observed indoor air concentrations of UFPs increased by a factor of 10 during cooking periods. [23] The small size of these particles allows them to penetrate deep into the respiratory system or even be transferred into the bloodstream through lung alveoli. Such

exposure to particles can cause long-term adverse health effects such as cardiovascular disease, DNA damage, and can exacerbate attacks or wheezing among people with asthma. [24-26] Children are particularly vulnerable to these air pollutants, given their developing bodies' higher absorption rates, and increased breathing volume compared to that of adults. [27] One meta-analysis observed that children living in homes with everyday gas cooking have a 42% increased risk of current asthma, a 24% risk of lifetime asthma, and a 32% increased risk of having both current and lifetime asthma.[20]

What can I do?

Various studies have demonstrated the effectiveness of range hoods with external vents in mitigating cooking fumes, especially with respect to UFPs.[25,28] ASHRAE 62.2 standard requires all new homes to have kitchen ventilation systems capable of exhausting pollutants outdoors through the overhead range hood.[29] Currently, only a few states have adopted 62.2 as part of their building code, and there is no present combination microwave/range model that meets the 62.2 airflow and noise standards.[30,31] Therefore, it is common to see hoods in kitchens that do not actually exhaust anything to the outside; they just suck in the air above the stove and recirculate it back to the kitchen. In order to effectively reduce the cooking emission exposure, it is essential to have a kitchen hood with a direct exhaust path to the outside.[32]

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In addition to the presence of range hoods that "actually" exhaust cooking emissions, cooking emissions and exposure to them can be further mitigated by changes in occupants' behavior and cooking practices. Even in kitchens equipped with range hoods, the majority of people do not use them regularly. Survey data indicate that noise and lack of knowledge about why they should be used contribute to this behavior. [33] Duration of running the exhaust fans and the flow-rate at which fan is running can also reduce the cooking emissions exposure. An experimental study in Ottawa, Canada, found that when it comes to reducing the integrated exposures, running the exhaust fan at a lower flow rate can potentially be compensated with keeping the exhaust fan running after cooking has ended. [34] While the exhaust hood is in operation, using the back burner of the stove is another practice that can reduce exposure. [25,35] Finally, when mechanical exhaust system is not available, using natural ventilation while cooking, particularly when using high emission cooking methods and food types such as frying and fatty foods, can help mitigate the exposure.

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