Cooking with Natural Gas: Just the Facts, Please

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A media firestorm about the impacts of gas cooking on indoor air quality was ignited after comments by a member of the Consumer Product Safety Commission (CPSC) about a potential national ban on new gas stoves (1). The CPSC later clarified that such a ban is not coming in the immediate future. We are writing to share the key facts on gas cooking and its relationship to climate change and adverse health effects.

Do Gas Stoves Contribute to Climate Change?

Natural gas is the primary residential fuel type for heating and cooking in the United States, with 15% of all natural gas use attributed to residential consumers (2). Methane, the primary constituent of natural gas, is a potent greenhouse gas that is 86 times more potent than CO_2 (3). As a result, government policies have been directed at reducing methane emissions, including banning natural gas hookups in new residential construction in some municipal jurisdictions. Recently, government officials have also focused attention on the potential health cobenefits of eliminating natural gas cooking as a source of indoor air pollution.

What Are the Adverse Health Effects of Gas Stoves?

Cooking-related emissions vary with the type of energy used. Some pollutants, such as fine particulate matter with an aerodynamic diameter $\leq$2.5 μm ($PM_{2.5}$), are released during cooking, regardless of fuel type. The primary pollutant of health concern emitted uniquely by gas (and not electric) cooking is nitrogen dioxide (NO_2), but products of incomplete natural gas combustion include polycyclic aromatic hydrocarbons, formaldehyde, carbon monoxide, and ultrafine particles (4). Nitrogen oxides are irritant gases that can cause bronchoconstriction, airway hyperresponsiveness, and airway inflammation with increased risk of asthma exacerbations, bronchitis, and wheezing (2).

Outdoor NO_2 is regulated by the U.S. Environmental Protection Agency with a 1-hour National Ambient Air Quality Standard (NAAQS) of 100 ppb, primarily because of epidemiologic studies that have demonstrated associations between exposure and worsening of asthma in children and adults as well as controlled human exposure studies that have demonstrated increases in airway responsiveness in adults with asthma (5). Peak indoor NO_2 concentrations generated by gas cooking often exceed this health-based NAAQS that has been set for outdoor air quality (2). This is especially true for kitchens with poor ventilation or where range hoods are not used or working properly. Even at levels below the current NAAQS, NO_2 exposures may impact allergic asthma through enhancement of the airway responses to specific aeroallergens, though this is less well described (5).

A 2013 systematic review and meta-analysis of gas cooking and current asthma (n = 10 studies in North America and Europe) reported a pooled odds ratio of 1.34 with a 95% confidence interval of 1.12–1.57 (6). A recent publication used this effect to estimate that 13% of childhood asthma could be prevented by eliminating gas cooking (7), but that does not mean that eliminating gas cooking is the only way to prevent those asthma cases. That article helped spur the CPSC and media to focus on the potential health hazards. Although the observational epidemiology studies used for that effect estimate suggest a strong association between gas cooking and asthma, this topic would benefit from a randomized controlled trial (RCT) to minimize confounding and support causal inferences.

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To our knowledge, there has not been an RCT of the efficacy of the transition from gas to electric cooking on childhood asthma outcomes. Two of the authors (J.R.B. and S.R.H.) have secured California Energy Commission funding to conduct such a study.

How Can Exposure to Cooking-related Pollutants Be Reduced?

An RCT coauthored by two of us (M.C.M. and N.N.H.) demonstrated that electrification of cooking can decrease NO_2 levels in the kitchen and bedroom (8). This key RCT also showed that air filtration devices can reduce NO_2 levels, and there is additional evidence that the use of stove range hoods can reduce concentrations of both NO_2 and $PM_{2.5}$ (9). The use of a high-efficiency particulate absolute air filtration device will primarily reduce $PM_{2.5}$; the inclusion of an activated charcoal filter can effectively reduce NO_2. Because emissions of $PM_{2.5}$ occur with both electric and gas cooking, the regular use of a properly working and vented stove range hood is recommended for all cooking (using either kind of fuel), especially when frying foods at high temperature.

What Are Evidence-based Recommendations for Clinicians?

Both the latest National Asthma Education and Prevention Program guidelines and the Global Initiative for Asthma strategy report call for people with asthma to avoid exposure to respiratory tract irritants because of the potential for exacerbations (10, 11). As noted above, NO_2 is a respiratory tract irritant at concentrations that may occur in some homes during gas cooking.

What Should Policymakers Consider?

There is a strong rationale to electrify home appliances to mitigate climate change. Using a 20-year time frame for methane's climate forcing, annual methane emissions from all gas stoves in U.S. homes have a climate impact comparable to the annual carbon dioxide emissions of 500,000 cars (3). Considering the climate change emergency, eliminating natural gas hookups for new residential construction is justified.

Given the potential health cobenefits of electrification of cooking, households that include individuals with asthma, chronic obstructive pulmonary disease, or other respiratory diseases should make the transition if feasible, and all households could consider it. All households should use good ventilation while cooking to reduce $PM_{2.5}$ concentrations (e.g., a stove range hood vented to the outside) and/or a portable high-efficiency particulate air filtration device that includes an activated charcoal filter. We hope that decreasing exposure to cooking emissions will improve the health of people with respiratory disease. Decreasing production of those emissions in the first place could also benefit the planet. ■

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