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Exposure to Cooking-Generated Ultrafine Particles and its neurological and Cardiopulmonary outcomes: A Controlled Clinical Study

Indoor ultrafine particles (UFPs) represent a growing concern, as people spend approximately 90% of their time indoors (Klepeis et al., 2001). UFPs, which are particularly prevalent in indoor environments, are produced by a variety of sources, including combustion processes like cooking (Lachowicz et al., 2022, Massey et al., 2012). Given the importance of cooking as a daily activity, it is crucial to understand the potential health effects of UFPs generated during cooking, especially considering the potential for these particles to impact vulnerable populations. UFPs are small enough to penetrate deep into the respiratory system, and research has suggested that they may translocate to the brain, potentially causing neuro inflammation and exacerbating neurological conditions (Kulkarni et al., 2011, Marval and Tronville, 2022, Thomas, 2013). This study aimed to investigate the effects of cooking-generated UFPs on cardiopulmonary and neurological outcomes. More specifically, the study was designed to separate the health outcomes of cooking-generated UFPs from cooking-emitted gases. A crossover controlled clinical trial was conducted with 60 healthy volunteers, who participated in two separate experimental sessions held over 48 consecutive hours. One session served as a baseline condition (24 hour), where participants remained in the apartment without any cooking, while the other involved cooking to generate UFPs. In the exposure (cooking) condition (24 hour), participants were exposed to cooking aerosols produced during frying chicken and fries. The study was divided into two phases: Phase 1 (control), which focused on the effect of cooking-generated aerosols and, phase II (intervention) focused on that of cooking-generated gases. For the Phase II study, P100 respirators (3M™ particulate respirators, model 8293, P100) were employed to mitigate particle exposure. On both the cooking and control days, participants were instructed to wear a P100 respirator from 09:25 until the particle concentration levels returned to background levels, typically around 15:00. Electroencephalography (QEEG) was used to monitor brain electrical activity throughout the experiments. Measurements were taken at 21 different time points over a 48-hour period, starting from one hour after the participants' arrival in the apartment. The study utilized a variety of other health measurements to monitor the participants'cardiovascular and pulmonary responses. These included a portable electrocardiogram (ECG) to measure heart rate, an Omron 10 blood pressure monitor to record systolic and diastolic blood pressure, a pulse oximeter to measure blood oxygen levels, and a Bedfont NObreath FeNO monitor to assess fractional exhaled nitric oxide (FeNO) only in phase I. Peak flow rate was also measured to assess lung function. The cognitive assessment in this study utilized two key tools: the Hopkins Verbal Learning Test-Revised (HVLT-R) and the WAIS-IV processing speed index. HVLT-R is a verbal memory assessment comprising a 12-word list presented over three learning trials. The WAIS-IV's Processing Speed Index is a standard score derived from a participant's performance on coding and symbol search subtests. The HVLT-R and WAIS-IV tests were conducted four times, including the 11:30 control day, 9:00, 10:30 and 9:00 last day.

Our results showed short-term exposure to particles and gases emitted from frying chicken and fries using either gas or electric stoves led to statistically insignificant changes in blood pressure, heart rate, PERF, or oxygen saturation up to 24 hours post-exposure. This observation was confirmed for both control and intervention studies. However, the pulmonary function during phase I, as indicated by FeNO levels, showed significant changes, with a noticeable increase immediately following cooking exposure, which persisted for up to two hours. The differences HVLT-R scores including the immediate recall, delayed recall and Recognition Discrimination Index (RDI) between baseline and exposure days for both intervention and control studies were statistically insignificant. The results of the WAIS Symbol Search and Coding subtests were statistically

significant between 9:00 a.m. cooking day and 9:00 am the third day approximately 24 hours after cooking for intervention study. Statistically significant reductions were observed in the coding test score at 11:30 a.m. during exposure day compared to the baseline day in Phase I. EEG results will be presented during the conference presentation.

The findings underscore the need for further research into the long-term effects of indoor air pollution, especially for individuals with pre-existing health conditions, such as Alzheimer's disease. The transient but significant changes observed in both brain activity and pulmonary responses emphasize the importance of considering indoor air quality, such as homes.

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