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Association between Chinese cooking oil fumes and sleep quality among a middle-aged Chinese population☆

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ABSTRACT

Poor sleep quality is an important symptom of many medical or psychiatric disorders. However, the impact of cooking oil fumes (COFs) on sleep quality has not been studied. This population-based cross-sectional study was conducted to examine the association between COFs of Chinese household cooking and sleep quality. Individual sleep quality assessment was completed in 2197 participants with an average age of 37.52 years, through Pittsburgh Sleep Quality Index (PSQI). Information about their cooking practice were also collected by self-reported questionnaire. As an internal biomarker of COFs, urinary 1-hydroxypyrene (1-HOP) (n = 562) was further measured using high-performance liquid chromatography. Binary logistic regression models were performed to evaluate the association between exposure to COFs and individual sleep quality. We found that, subjective poor kitchen ventilation, pre-heating oil to smoking, and cooking for over 30 minutes were positively associated with overall poor sleep quality (global PSQI score >5) [odds ratio (OR) = 1.75, 95% confidence interval (CI) = 1.43–2.16; 1.25, (1.03–1.52); 1.42, (1.15–1.76), respectively]. After adjusting for potential confounders, subjective poor kitchen ventilation still tend to increase the risk of long sleep latency, sleep disturbances, and daytime dysfunction [OR = 1.37, 95% CI = 1.09–1.73; 1.91, (1.39–2.61); 1.54, (1.23–1.93), respectively]. Similar results were observed in participants who preheated oil to smoking [OR = 1.36, 95% CI = 1.08–1.72; 1.55, (1.14–2.14); 1.25, (1.02–1.55), respectively] and cooked for over 30 minutes [OR = 1.34, 95% CI = 1.05–1.72; 1.46, (1.03–2.06); 1.36, (1.08–1.72), respectively]. Furthermore, high urinary 1-HOP level was also positively associated with overall poor sleep quality (OR = 2.30, 95% CI = 1.31–4.05). The results indicated that exposure to COFs from Chinese household cooking may be a risk factor for poor sleep quality among middle-aged Chinese population.

1. Introduction

Sleep quality has attracted increasing attention for two major reasons. First, sleep quality complaints are common in the general population across different age groups and countries (Blackwell et al., 2014; Lu et al., 2015; Wu et al., 2015). Second, poor sleep quality is an important symptom of many medical or psychiatric disorder (Lu et al., 2015; Vecsey et al., 2009). Previous studies have

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reported that sleep quality can be affected by various factors, such as smoking and nighttime traffic noise (Halonen et al., 2012; Sabanayagam and Shankar, 2011). Few studies have linked outdoor air pollution and indoor solid fuel heating to poor sleep quality (Accinelli et al., 2014; Castaneda et al., 2013; Fang et al., 2015; Zanobetti et al., 2010). However, the association between cooking oil fumes released from household cooking, and individual sleep quality has not been studied.

Indoor air pollution from household cooking is a noticeable environmental issue (Straif et al., 2006). In the past decade, most studies paid more attention to the hazards related to biomass fuels. However, with the widespread use of clean energy and the generalization of improved cook stoves in recent year, attributable disability-adjusted life-years (DALYs) was declined for household air pollutant from solid fuels in 2015 compared with 2005, while indoor air pollution reminded major environmental causes of DALYs (Forouzanfar et al., 2016). Therefore, cooking oil fumes (COFs), as another main emission of household cooking practice, is also a key environmental risk that shouldn't be overlooked.

In China, frying (e.g., stir-frying, frying, and deep frying) ingredients in a wok within a confined space is the most common cooking method. Besides, high quantities of oil and seasoning are used in those methods to impart complex flavors. Hence, high levels of COFs containing high concentration of health-damaging aerosol are likely to be released because of decomposition or oxidation of fatty acids during Chinese cooking practices (Abdullahi et al., 2013). Thereamong, particulate matter (PM) and polycyclic aromatic hydrocarbons (PAH) have received extensive attention for its adverse health effects such as cardiovascular diseases and lung cancer (Lin et al., 2016; Xia et al., 2013). A study compared PAH emission from different cooking-type restaurants and reported that the annual emission rate of total PAH for Chinese restaurants at 2038 kg/year is nearly 8 times higher than western restaurants and approximately 400 times higher than Japanese restaurants (Li et al., 2003a). Another study undertaken in a typical Chinese food stall in Singapore found that the average mass concentrations of fine particles (PM 2.5) increased from 26.7 μgm^{-3} during non-cooking hours to 312.4 μgm^{-3} during cooking hours (See and Balasubramanian, 2006). Previous studies have reported that inhaled PM and PAH can increase systemic or brain-base inflammation responses (Arlt et al., 2015; Campbell et al., 2005; Chen et al., 2017). In addition, epidemiological and experimental data have shown that PM and PAH are neurotoxic compounds for both humans and animals (Gillespie et al., 2013; Niu et al., 2010), and furthermore, several studies have linked PM and PAH exposure to the decline of memory abilities and symptoms of depression (Power et al., 2015; Xia et al., 2011). Thus, we hypothesized that COFs may impact on central nervous system and thereby influence sleep-wake cycle.

China is the most populous country in the world, where household cooking is an important daily activity in Chinese family. This population-based cross-sectional study were conducted to examine the association between exposure to the COFs of Chinese household cooking and sleep quality. To further estimate this impact, we also evaluated the level of urinary 1-hydroxypyrene (1-HOP), which has been recommended as a useful biomarker of internal dose to assess recent COFs exposure (Chen et al., 2007), and its relationship with sleep quality.

2. Method

2.1. Study population

The study population consisted of participants in the workers health study, an ongoing prospective study for employees working in a Machinery Company in Liuzhou. This study, which started in August 2014, aimed to assess the living and working conditions of workers, and to determine the prevalence of the physiological dysfunction (e.g., sleep) and chronic diseases (e.g., hypertension). A total of 2382 participants were recruited for the baseline survey. Most participants lived in company residential areas, far away from the urban areas, therefore that they might be less affected by traffic noise. All participants were asked to finish a questionnaire, including sleep quality assessment, hourshold cooking practice, personal mental health, family function, and individual-level characteristics (e.g., sex). The questionnaires were reviewed by our on-site investigators, and blank or illogical answers were reconfirmed through face-to-face interviews. A total of 71 answered questionnaires had missing information in some items of the Pittsburgh sleep quality index (PSQI) or questions assessing COFs exposure, and thus, these were excluded for the analysis. After acquiring data on occupational history and medical examination, we further excluded 114 subjects who met any one of the following criterias: used coal or wood for cooking, exposed to coke oven emissions during work, and medically afflicted with a disorder that may intervene with the study (e.g., serious nervous system diseases). Thus, the final sample size of participants for the analysis was 2197.

2.2. Ethical statement

This study involving human participants were approved by the ethics committee of Guangxi Medical University [Reference Number/ID: (2014)LUNSHEN [KE]DI(125)HAO], in accordance with the guidelines for the protection of human subjects. Participants provided written informed consent after being briefly informed about the aims of the study and their rights to keep information confidential. Written consent was obtained from all study participants.

2.3. Measure of sleep quality

The Pittsburgh sleep quality index (PSQI) (Buysse et al., 1989) is the most commonly used self-rating questionnaire assessing personal sleep quality in clinical and research fields. This measure can discriminate the poor from good sleepers well. This validated scale is composed of 18 items, gathering information in 7 components, including sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, subjective sleep quality, use of sleeping medication, and daytime dysfunction during the previous month. These domains generate 7 component scores, ranging from 0 to 3, with higher scores indicating worse sleep impairment. The sum of the 7 components constitute a global sleep quality score ranging from 0 as no impairment to 21 as serious sleep disturbance. A global score of above 5 represents overall poor sleep quality. Single-item scores of more than 2 were considered as impairment of the respective component, including the sleep latency and duration of more than 30 minutes and less than 6 hours, respectively.

2.4. Assessment of COFs exposure

All subjects provided information about their household cooking practices, including major and second cooking method (frying, stir-frying, roast, poach, steam); usage of cooking oil (peanut oil or others); preheating oil to smoking (yes or no); frequency of personal household cooking ($\leq$5 or >5 times per week); total cooking years ($\leq$10 or > 10 years), and duration of each cooking (<30 or $\geq$ 30 min). To evaluate the cooking condition, we also collected information about the kitchen area ($\leq$5 or >5 m^2), cooking energy (natural or liquid petroleum gas, electricity, coal briquette, or wood), usage of mechanical ventilation including rang hood or