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Epidemiological evidence that indoor air pollution from cooking with solid fuels accelerates skin aging in Chinese women

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ABSTRACT

Background: Recently, we showed that outdoor air pollution exposure from traffic and industry is associated with an increased risk of skin aging in Caucasian women. In China, indoor air pollution exposure caused by the use of solid fuels like coal is a major health problem and might also increase the risk of skin aging in Chinese women.
Objective: As cooking with solid fuels is a major source of indoor air pollution exposure in China, we aimed to test if cooking with solid fuels is associated with more pronounced skin aging in Chinese women.
Methods: We conducted two cross-sectional studies in China to assess the association between cooking with solid fuels and signs of skin aging. In Pingding (in northern China) we assessed $N = 405$ and in Taizhou (in southern China) $N = 857$ women between 30 and 90 years of age. Skin aging was evaluated by the SCINEXA™ score. Indoor air pollution exposure, sun exposure, smoking and other confounders were assessed by questionnaires. Associations were then tested by linear and logistic regression analyses adjusted for further confounders.
Results: The analysis showed that cooking with solid fuels was significantly associated with a 5–8% more severe wrinkle appearance on face and an 74% increased risk of having fine wrinkles on back of hands in both studies combined, independent of age and other influences on skin aging.
Conclusion: The present studies thus corroborate our previous finding that air pollution is associated with skin aging and extend it by showing that indoor air pollution might be another risk factor for skin aging.

Abbreviations: AhR, arylhydrocarbon receptor; AM, arithmetic mean; AMR, arithmetic mean ratio; BMI, Body mass index; CI, confidence interval; GM, geometric mean; GMR, geometric mean ratio; MMP, matrixmetalloproteinase; OR, odds ratio; PAH, polycyclic aromatic hydrocarbon; PM, particulate matter; SCINEXA™, Score for intrinsic and extrinsic skin aging; TGF-ß, transforming growth factor ß.

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1. Introduction

Indoor air pollution caused by the combustion of solid fuels (coal or biomass) for cooking or heating is a major public health challenge in China [1]. In China, more than 70% of the households use solid fuels for cooking or heating [2]. The combustion of coal and biomass indoors emits a substantial amount of toxic pollutants including particulate matter (PM), polycyclic aromatic hydrocarbons (PAHs), carbon monoxide, nitrogen oxides and sulfur dioxide [3]. Various studies have been conducted to investigate the impact of indoor air pollution on health effects including respiratory illnesses, lung cancer, chronic obstructive pulmonary disease, weakening of the immune system, and reduction in lung function [4]. Exposure to indoor air pollution might also lead to more pronounced skin aging.

Clinical hallmarks of the environmentally-induced (extrinsic) skin aging process are coarse wrinkles, solar elastosis and pigment irregularities [5]. Superimposed on chronological (intrinsic) skin aging signs at chronically exposed areas of the body, these skin aging signs contribute to the appearance of looking old. Important environmental factors able to induce extrinsic skin aging include sun exposure and smoking [6,7]. Additionally, Vierkötter et al. [8] showed that exposure to outdoor air pollution from traffic and industry is associated with an increased risk for extrinsic skin aging manifestation in Caucasian women.

The current study specifically investigated the association between cooking with solid fuels and the manifestation of different skin aging signs in two independent study populations of Chinese women. Cooking with solid fuels is a major source of indoor air pollution exposure in China. In contrast to heating with solid fuels, which is used seasonally, cooking with solid fuels causes a constant, daily exposure. Furthermore, women might be especially affected by this indoor air pollution exposure as they spend a larger proportion of their time indoors.

2. Material and methods

2.1. Study design and study populations

For our study, we made use of two independent Chinese study populations, which were recruited in the years 2012 and 2013. In both studies, we applied the same instrument for skin aging evaluation and also used validated questionnaires to assess cooking with solid fuels and further covariates of skin aging like sun exposure and smoking behaviors.

One study population was located north of Shanghai at Taizhou in Jiangsu province (Fig. 1). These study participants were recruited out of an existing large prospective study, the Taizhou Longitudinal Study. The Taizhou Longitudinal Study aims to investigate environmental and genetic risk factors for common chronic diseases in China. The detailed description of the Taizhou longitudinal study was described elsewhere by Wang et al. [9]. Between August and September 2012, we investigated 857 healthy Chinese women ranging in age from 28 to 90 years out of the

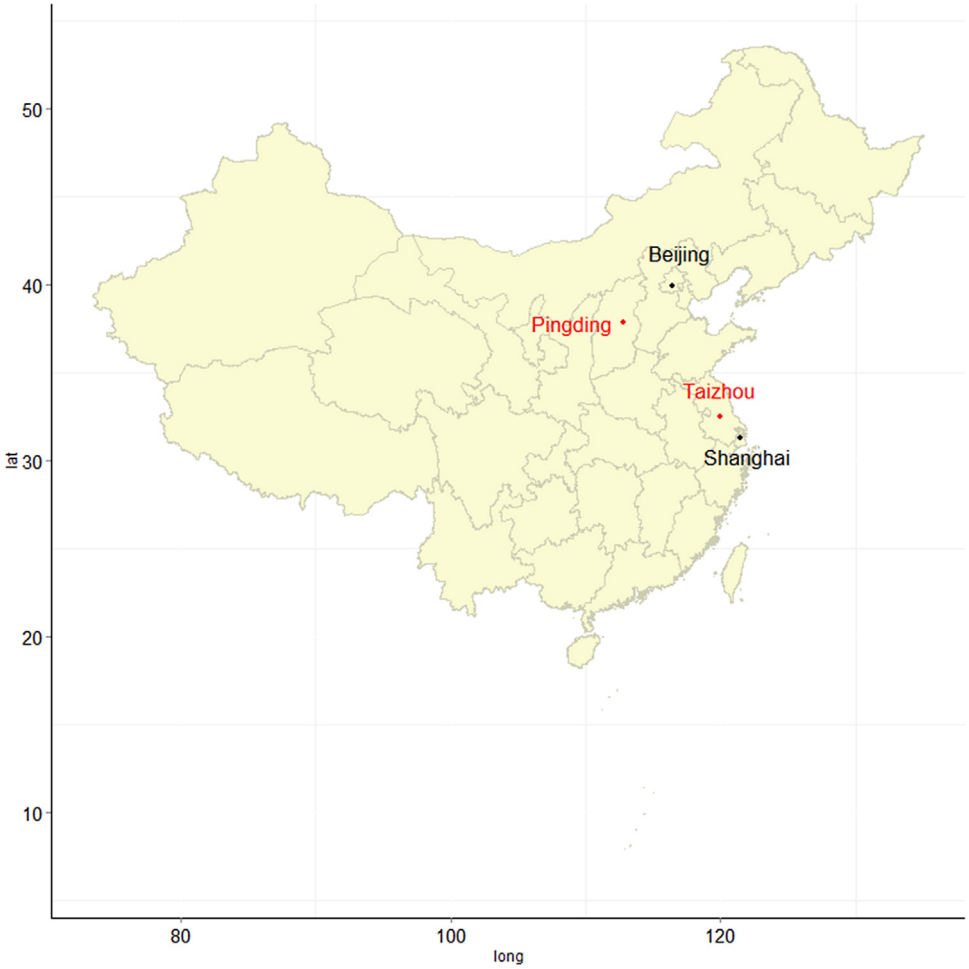

Fig. 1. Map of China with study center locations. The Pingding study population was collected at Pingding County Hospital in Shanxi Province near Beijing and the Taizhou study population was collected in Jiangsu Province near Shanghai.