Original Research

Solid fuel use is a major risk factor for acute coronary syndromes among rural women: a matched case control study

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ABSTRACT

Objectives: Almost half of the world's population uses solid fuel for cooking, exposing women to high levels of particulate pollution in indoor air. The risk of acute coronary syndrome (ACS) was assessed among rural women, according to their use of solid fuel.

Study design: Matched case control study.

Methods: Data were collected at a public tertiary care hospital in a rural district of Pakistan. Seventy-three women with ACS were compared with controls, individually matched for sex and age (±5 years), who were admitted to hospital for other reasons. Fuels used for cooking and exposures to potentially confounding variables were ascertained through a questionnaire administered at interview and measurement of height and weight. Conditional logistic regression was used to estimate odds ratios (ORs) with 95% confidence intervals (95% CIs).

Results: After adjustment for potential confounding factors, current use of solid fuel was strongly associated with ACS (OR 4.8, 95% CI: 1.5–14.8), and risk was lowest in women who had last used solid fuel more than 15 years earlier. The population attributable fraction for ACS in relation to current use of solid fuel was 49.0% (95% CI: 41.3%–57.4%).

Conclusions: These findings support the hypothesis that indoor air pollution from use of solid fuel is an important cause of ACS. Our study demonstrates the feasibility of case-control studies in rural populations of women to address this question, and is an encouragement to larger and statistically more powerful investigations.

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Introduction

Almost half of the world's population relies on solid fuels such as wood, crop residues, cow dung and coal, for cooking and domestic heating.[1] This combustion of biomass fuel produces particulate matter (PM), and can lead to concentrations in indoor air substantially higher than the standards for outdoor air that currently apply in the United States and European Union. For example, 24-h mean levels of PM_{10} of 300–3000 mg/m^3 have been recorded in living areas, and levels as high as 30,000 mg/m^3 may be reached in kitchens during cooking.[2,3] Indoor air pollution from burning of solid fuel has been linked with increased risk of acute respiratory infections (ARIs), interstitial lung diseases, chronic obstructive pulmonary disease (COPD), asthma, hypertension, cataract and blindness.[4–9] It is is a major cause of morbidity in developing countries, and is responsible for an estimated 1.6 million deaths annually.[10]

There are reasons to expect that indoor air pollution also increases the risk of coronary heart disease. PM in urban ambient air has been linked with elevated risk of cardio-vascular disease, both in time-series and in cohort studies.[11–13] Exposure from solid fuel smoke induces oxidative stress and systemic inflammation, which can lead to high blood pressure and tachycardia.[5] Smoke from solid fuels impairs endothelial and smooth muscle function in blood vessels, increases coagulation tendency and promotes platelet activation,[5,14] thus predisposing to atherosclerosis, which can lead to coronary heart disease and stroke. Furthermore, long-term exposure to smoke from solid fuel has been linked with impaired systolic and diastolic function of the heart.[15] Recent studies have shown higher diastolic blood pressures among Guatemalan women exposed to wood smoke,[16] and a reduction in non-specific ST-segment depression after installation of improved stoves to reduce indoor air pollution.[17] In addition to this indirect evidence, a recent cross-sectional study found that use of solid fuel in homes carried an increased risk, not only of hypertension, but also of coronary heart disease (CHD). However, the assessment of CHD was relatively crude, depending on participants' recall of doctors' diagnoses.[18]

Pakistan offers a good opportunity to address the risk of CHD in relation to indoor air pollution from use of solid fuel. In Pakistan, 67.5% of the population use solid fuel for cooking, and as many as 90% in rural areas,[19] exposure to the resultant pollution being highest in women, who spend more time in the house and undertake most cooking. Furthermore, people of Indo-Asian origin, including those from Pakistan, have among the highest rates of coronary artery disease (CAD) in the world.[20,21] Also, there is evidence that in Pakistan, CHD is more frequent in women than in men.[22]

The authors therefore carried out a pilot, matched case-control study of acute coronary syndrome (ACS) in a rural district of the province of Sindh in Pakistan, to explore its association with the use of solid fuel for cooking. As well as estimating effects on the risk of individuals, potential impacts were also assessed at a population level through calculation of a population attributable fraction (PAF).

Methods

The study population comprised women living within the catchment area of a public sector tertiary care hospital in Mirpurkhas, a rural district of Sindh province, Pakistan, who were lifelong non-smokers and had no self-reported history of chronic obstructive pulmonary disease or diabetes mellitus. The exclusion of smokers extended to women who had used *bidi* (locally made cigarettes without filters that are commonly smoked in South Asia) or a *huqqa* (water pipe) as well as those who had smoked cigarettes.

The hospital, which has a separate cardiac care unit, was chosen for study because it provided care for a mixed population of solid fuel and natural gas users.

Case definition and selection

All members of the study population who were admitted to the hospital's cardiac care unit with ACS during August 2010 to February 2012 were eligible for inclusion in the study as cases. They included women with ST elevation MI (STEMI), non-ST elevation MI (NSTEMI) and unstable angina (UA).

Diagnoses were made by cardiologists working in the unit. All cases with symptoms or signs of ACS were tested for cardiac troponin-T,[23] which was classified as positive or negative using trop T kits at the bedside.[24] STEMI was defined as chest pain with ST elevation of >1 mm in ≥2 contiguous leads, or a new onset left bundle branch block. NSTEMI was defined as chest pain without the ECG changes specified above, but with evidence of myocardial injury as indicated by a positive troponin T. Patients presenting with chest pain, with ST elevation on the ECG and a negative troponin T, were classified as UA.[24,25]

Selection of controls

For each case, a control of the same age to within 5 years was selected, who was a member of the study population admitted to a medical ward at the same hospital for a primary reason other than ACS, on the same day if possible, and otherwise on the following or previous day. If more than one eligible control was available, the patient whose age matched that of the case most closely was chosen.

Data collection

Cases and controls were approached at their bedside after the physician visit timing (usually in the afternoon) by trained interviewers, and those who agreed, answered a structured questionnaire. As well as confirming that women met the criteria for study (e.g. that they were lifelong non-smokers), the questionnaire covered history of presenting complaints, demographic and socio-economic information, dietary habits, physical activity, family history of chronic diseases, use of chewable tobacco, exposure to environmental tobacco smoke, and details about kitchen type and construction of the house. Anthropometric measurements were also recorded.