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Lifetime cumulative exposure to waterpipe smoking is associated with coronary artery disease

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ABSTRACT

Objective: Globally, waterpipe (WP) smoking is becoming a more prevalent form of tobacco consumption. Whilst research so far has demonstrated a significant link between WP use and a number of health outcomes, little is known of its association with heart disease. We examine in this study the association of WP smoking with angiographically confirmed coronary artery disease (CAD).

Methods: A total of 1210 patients, aged 40 years and over and free from smoking-associated illnesses or history of cardiovascular procedures, admitted for coronary angiography at four major hospitals in Lebanon, were included. The extent of CAD was summarized in two ways, firstly as diseased (≥50% and ≥70% occlusion in at least one main coronary artery) versus non-diseased (entirely normal coronaries), and secondly, as CAD cumulative score based on Duke CAD Prognostic Index. A score of WP-years, capturing intensity and lifetime duration of exposure, was estimated for each individual.

Results: Lifetime exposure exceeding 40 WP-years was associated with a threefold significant increase in the odds of having severe stenosis (≥70%) compared to non-smokers (OR = 2.94, 95% CI 1.04–8.33) as well as with the CAD Index (β = 7.835, p-value = 0.027), net of the effect of socio-demographic characteristics, health behaviors and co-morbidity. A dose–response relationship between WP-years and percent stenosis was also established. WP smoking status (never, past and current) did not associate with CAD.

Conclusions: Cumulative exposure to WP smoking is significantly associated with severe CAD. There is a need to monitor WP use among cardiac patients and include this information in their medical charts in the same manner cigarettes smoking is documented. This is likely to increase awareness of the hazards of WP smoking and prompt physicians to target WP tobacco control by providing advice to their patients on WP smoking cessation.

1. Introduction

More than 3 billion people worldwide currently smoke tobacco in its various forms, and the majority (80%) live in low and middle-income countries. Tobacco use has already been established as the number one modifiable risk factor for cardiovascular diseases, contributing to an annual mortality rate that exceeds six million individuals [1]. Whist smoking tobacco using waterpipe (WP) has been most commonly associated with the Eastern Mediterranean Region, it is increasingly becoming a popular method of tobacco consumption worldwide [2]. Data from several national and regional studies suggest that the epidemic of WP smoking is on the rise reaching a prevalence of 20–30% among adults and increasing significantly among younger cohorts [3]. With the accumulated evidence of the epidemiology of this behavior and its health consequences, the American Lung Association addresses WP smoking as a 'growing threat to public health' and an 'emerging deadly trend' [4].

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Research has so far demonstrated a significant link between WP smoking and a number of diseases including lung, oral and bladder cancers, respiratory illnesses and adverse pregnancy outcomes [5]. Some studies have also shown associations with surrogate markers of coronary disease such as heart rate variability [6], heart rate and systolic blood pressure [7]. Though anticipated to share the coronary disease hazards of cigarettes smoking [8], epidemiological studies addressing the long-term effect of WP smoking on heart disease remains largely lacking [5]. We examine in this study the association of WP smoking with heart disease as manifested by angiographically determined coronary artery disease (CAD).

2. Materials and methods

2.1. Study population

The study sample included consecutive admissions of patients for coronary angiography at four major tertiary hospitals in Beirut, the capital city of Lebanon, and its suburbs, during the period extending from July 2007 until August 2008. Patients were excluded from the study if they: 1) were younger than 40 years old; 2) had undergone a previous coronary angiography, coronary artery bypass surgery, or percutaneous coronary intervention; 3) had a history of heart disease (myocardial infarction, angina, valvular heart disease, congenital heart disease), peripheral vascular disease, or stroke; 4) had chronic or obstructive pulmonary disease; or 5) any type of cancer associated with smoking (lung, gum, mouth, throat, pancreas, bladder and cervix).

During the study period, a total of 2525 consecutive patients were admitted for cardiac catheterization. Of these, 625 were admitted on an out-patient basis and could not be contacted, 632 did not meet the inclusion criteria, 32 refused to participate in the study, and 26 had missing data on the main exposure variables, yielding a total of 1210 study subjects with complete interviews.

2.2. Outcome measure and classification

Extent of CAD, our outcome variable, was based on percent maximal stenosis at any location (ostium, proximal, mid and distal) in the coronary vessels (left main, left anterior descending, first and second diagonals, left circumflex, first, second, and third obtuse marginals, right coronary artery, and posterior descending artery). In vessels that had more than one stenosis, the most severe stenosis was recorded. For this study, the extent of CAD was summarized and examined in two ways: firstly, as diseased versus non-diseased (dichotomous outcome) using the case–control study design and corresponding method of analyses, and secondly, as detailed characterization of the extent of coronary disease severity (continuous outcome) using the cross-section approach and corresponding method of analyses.

In the case–control design, subjects with mild stenosis (1–49%, $n = 247$) were excluded from the analysis. This was made for a precise separation between diseased and non-diseased subjects and for better delineation of risk factors for angiographically defined coronary atherosclerosis [9]. Hence, persons with entirely normal coronaries (0% stenosis, $n = 382$) were considered as controls, and following the American College of Cardiology/American Heart Association guidelines [10], we defined two groups of cases: patients with ≥50% stenosis in any coronary artery (Group I cases, $n = 581$) and patients with ≥70% stenosis in any coronary artery (Group II cases, $n = 327$).

For the second classification of the outcome, the atherosclerotic burden of CAD was summarized for the total sample ($n = 1210$) as a continuous measure based on the Duke Coronary Artery Disease Prognostic Index [11]. This CAD Index takes into consideration not only the percent of coronary lesions but also the number of diseased vessels and the site, thus providing a weight for various combinations. For example, a one vessel disease with 75% stenosis was given a score of 23, while a three-vessel disease with ≥95% in at least one vessel was given a score of 63, and a left main disease of 75% stenosis was given a score of 82. This yielded a stenosis Index for each patient ranging from 0 (completely normal arteries) to 100% (left main ≥95%).

2.3. Interviews and measures of exposure

Interviewers were recruited at each hospital for the face-to-face interviews using a structured questionnaire. In order to avoid reporting bias, patients were interviewed either prior to the performance of the catheterization (37%) or prior to their knowledge of the results of their cardiac catheterization (57%).

The questionnaire items on WP smoking habits were adapted with minor modifications from Maziak and colleagues standardized interview schedule [12] eliciting information on WP smoking status (never, past and current), duration (age at initiation and age at stopping for the past smokers), frequency (number of days of smoking per week) and intensity (average number of WPs consumed on each occasion). Consequently, 'waterpipe-years' (WP-years) were estimated for each individual by multiplying the average number of WPs smoked per day by the number of years they have been smoking. This yielded a continuous score ranging from 0 for the never WP smokers to a maximum of 164 WP-years. Thus, for a person scoring 20 WP-years for example, this meant that the subject had smoked an average of two WPs per day for a total of 10 years or one WP per day for 20 years, and so on. The score, capturing lifetime WP smoking exposure, was then grouped into four categories (0, 1–20, 21–40 and ≥41 WP-years). Information on cigarette smoking was similarly reported and assessed according to status (never, past and current) and cigarette pack-year. The pack-year was grouped into five categories (0, 1–20, 21–40, 41–60, and ≥61 pack-years).

Data on socio-demographic characteristics (gender, age, education, work and marital status) and the classical, behavioral and clinical risk factors for CAD (physical activity, alcohol consumption, diabetes, hypertension, hyperlipidemia, and family history of CAD) were also collected. Physical activity was assessed by including both habitual work and leisure physical activity [13]. Alcohol drinking was categorized as "never/rare" (none or <1 glass per week), "occasional" (1–2 glasses per week), and "frequent" (≥3 glasses per week) [14]. Diabetes, hypertension and hyperlipidemia were considered present if the subject was diagnosed of having any of the conditions or if they were on a diet and/or were taking medications for these conditions. Family history of CAD was restricted to early CAD onset in first degree relatives (<50 years for males and <55 years for females).

The Institutional Review Board of the American University of Beirut approved the study protocol which complies with the Declaration of Helsinki, and participants signed an informed consent prior to the interview. All data were treated in a confidential manner and the anonymity of respondents was maintained.

2.4. Data analysis

Frequencies and means with standard errors (SE) were used to describe the sample, and differences in baseline characteristics and potential confounders across categories of the WP-years were examined using chi-square test and *t*-test, as appropriate. Associations between WP and cigarette smoking with angiographically determined CAD were analyzed in two ways: considering the outcome firstly as a dichotomous variable (cases vs controls) and secondly as continuous (CAD index). Two case control comparisons