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Effect of exclusive cigarette smoking and in combination with waterpipe smoking on lipoproteins

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ABSTRACT

Objective: A significant increase in total cholesterol and LDL-C is well shown in tobacco users, as compared to non-tobacco users. The additive effects of waterpipe and cigarette smoking on LDL levels have not been studied. The study's objective was to assess the correlation between cigarette smoking and LDL levels in Lebanese cigarette smokers and to check the interaction effect of waterpipe and cigarette smoking on LDL levels.

Methods: This cross-sectional study was conducted between October 2016 and February 2017 in 4 different laboratories, enrolling 308 patients (188 non-smokers, 105 cigarette smokers, 15 previous smokers).

Results: Current cigarette smoking (Beta = 25.57; $p < 0.0001$) was significantly associated with higher LDL levels and higher total cholesterol levels (Beta = 53.29; $p < 0.0001$) in exclusive cigarette smokers. Among current cigarette smokers who were current waterpipe smokers, a significant increase in LDL level was observed relative to current cigarette smokers who were not waterpipe smokers (Beta = 66.64 vs Beta = 37.37; $p < 0.0001$).

Conclusion: Among Lebanese current cigarette smokers, LDL levels increased relative to nonsmokers, consistent with findings in other populations. In addition, among Lebanese current cigarette smokers, current waterpipe smoking might increase adverse lipid profiles associated with adverse coronary effects more than cigarette smoking alone. The direct cause responsible for these observed variations in our study remains unidentified, with the hope that future research will reveal it.

1. Introduction

Coronary heart disease (CHD) is the single largest cause of death in the developed countries and is one of the leading causes of disease burden in developing countries as well [1]. Smoking was responsible for 16.3% of cancer deaths, 17.2% of years of potential life lost and 21% of the cost of productivity in Iran (2012) [2]. Cigarette smoking may be an important factor in potential changes in lipid profile already in young healthy people [3,4]. A significant increase in total cholesterol and LDL-C is well shown in tobacco users, as compared to non-tobacco users [5–7]. Thus, smokers have less favorable lipid profiles, even after accounting for current and lifetime smoking history and other CVD risk factors [8].

There is a significant increase in levels of total cholesterol, triglycerides, low density lipoprotein (LDL), very low density lipoprotein (VLDL) and reduced levels of high density lipoprotein (HDL) among smokers [9]. Maternal smoking during pregnancy is associated with an increased rise in total cholesterol levels and a tendency towards an adverse lipoprotein profile in the offspring

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[10]. Even, maternal environmental tobacco smoking exposure affects milk lipids which are essential for infant growth [11].

In addition, smoking is associated with an increased prevalence of metabolic syndrome, independent of sex and BMI class, mainly related to lower HDL cholesterol, and higher triglycerides and waist circumference [12]. Stress and depression were also significantly correlated with an increase in cholesterol levels [13]. Moreover, smoking was associated with unfavorable changes in apoA1 and apoB, and in lipoprotein particle size [12]. Data suggested a synergistic effect between the apoE allele epsilon4 and smoking on carotid atherosclerosis [14], as well as to insulin resistance phenomenon [15].

Clinical characteristics and outcomes of acute coronary syndrome patients depend on the tobacco modality used [16]. In fact, overall tobacco users (cigarettes and waterpipe) tended to have dyslipidemia compared to previous smokers or non-smokers [16]. In addition, waterpipe and cigarette smoking was significantly associated with dyslipidemia [17]. However, the additive effect of waterpipe and cigarette smoking on LDL levels has not been studied to the best of our knowledge. Furthermore, no studies have assessed the impact of cigarette smoking on the LDL in the Lebanese population. Therefore, our primary objective was to assess the correlation between cigarette smoking and LDL levels in the Lebanese cigarette smokers and to check the interaction effect of waterpipe and cigarette smoking on LDL levels. Secondary objectives were to assess its correlation with other cardiovascular risk factors (total cholesterol), taking into account known comorbidities (high blood pressure and obesity status), food habits, stress and physical activity.

2. Methods

2.1. Study design and included population

A cross-sectional study was conducted between October 2016 and February 2017 in 4 laboratories, chosen from 4 different districts in Lebanon. All patients coming for a regular blood test to the laboratory and who were 18 years old and above, were included in the study. However, patients treated with a statin were excluded since statins are established in the primary and secondary prevention of coronary artery disease [18]. Furthermore, patients having thyroid disorders at the time of the study were also excluded for hyper- and hypothyroidism can affect lipid levels and thus change the risk estimation of coronary heart disease [19]. Exclusion criteria also included individuals with a history of cardiovascular, endocrine, dementia or gastrointestinal disorders.

2.2. Sample size calculation

Using the Gpower 3.1.9.2 program for the calculation of the minimal sample size needed for our study, with a 1-β = 0.95, a proportion p2 = 0.05, according to the study of Neki [20] that showed a mean LDL of 87 ± 17.80 mg/dL in non-smokers versus 103.7 ± 29.16 mg/dL in smokers, and considering a ratio of 1 control for every case, the results showed that we need 47 cases versus 47 controls [21].

2.3. Data collection

The questionnaire was administered in Arabic, the native language in Lebanon. A first part of the data was collected via a face-to-face interview and included the following variables: demographics information (age, gender, geographic region, marital status, occupation, educational level, monthly salary per house divided into three levels (low (<1000 USD), intermediate (1000–2000 USD), high (>2.000 USD) based on the total income of the household, history of medical illness (hypertension, asthma, chronic obstructive pulmonary disease (COPD), diabetes, epilepsy) and the medications intake at the time of the study. The social habits of the participants were assessed; we asked about the frequency of cigarette smoking (number of cigarettes smoked per day), the number of alcoholic glasses drunk per week and the number of coffee cups drunk per day.

In the second part of the questionnaire, participants were asked about the total number of hours of no activity during weekdays and weekends, taking into consideration the average hours of sleep, rest, occupational, and extracurricular activities over a typical 24-h period. Information about the physical activity was also collected. In order to test the effect of each activity on the cardiovascular risk, we categorized separately the activities in a dichotomous variable (yes/no), with a yes answer meaning a daily activity of 30 min or more.

We chose a validated scale in Lebanon, the Beirut Distress Scale 22 (BDS22) [22], to measure the level of stress in these patients. The BDS 22 is an Arabic scale, composed of 22 questions that determine six factors, reflecting: depressive symptoms, demotivation, psychosomatic symptoms, mood deterioration, intellectual inhibition and anxiety in these patients. Participants were asked to rate symptoms of stress by indicating how often they have experienced each symptom during the past week on a Likert-type scale that ranges from 0 (not at all) to 3 (all of the time). Possible scores range from 0 to 66 for the BDS22, with higher scores indicating higher levels of stress.

2.4. Dietary intake assessment

The self-administered questionnaire used in this study included numerous questions related to the socio-demographic background of our participants and a short food frequency questionnaire (FFQ) to assess the usual dietary intake of Lebanese patients. The FFQ was composed of 16 semi-quantitative questions covering different food categories (including the five basic food categories typically consumed by the Lebanese population) [23]. The FFQ used in this study was adapted from the questionnaire earlier administered in a sample of a Lebanese population [23] and the CDC Global School Health Survey [24]; the finally used items were vegetables, fruits, olive oil, fish and sea food, meats (including cooked meats, poultry, ham, and hotdog), pasta, sweets (cake, ice cream, chocolate), carbonated beverages, fruit, vegetables, fast food (hamburger, pizza, Lebanese pizza (known as Mankouche with thyme or cheese or yogurt based kechek), fried potatoes and chips. We omitted to ask questions about eggs and dairy products as separate items because they would have been confusing to the participants to record in the FFQ given that these food items are frequently consumed in Lebanon within composite dishes (eggs, cheese, and yogurt within cooked dishes), and fast food meals. The FFQ asked how often each food item, group, or beverage was usually consumed with five possible answers for each of the food categories: (1) never, (2) two times or less per week, (3) three to six times per week, (4) at least one time per day, and (5) at all meals. These five response categories were later merged into four categories for analysis purposes, namely: (1) never, (2) once or twice per week (3) three to six times per week, and (4) consumption on daily basis. We also asked the patient if he eats more when stressed, with the answers dichotomized as yes/no.

2.5. Laboratory analysis

Blood samples were drawn from the antecubital vein between 6:00 am and 7:00 am after an overnight fasting (12 hours fasting) in order to screen for dyslipidemia and check the fasting blood glu-

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