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Original Article

A cross-sectional analysis of the association between marijuana and cigarette smoking with metabolic syndrome among adults in the United States

Barbara N.A. Yankey MSc. Pharm, MPA, MPH[a,*], Sheryl Strasser PhD, MPH[b], Ike S. Okosun PhD, MPH[a]

[a] Georgia State University, School of Public Health, Division of Epidemiology and Biostatistics, 140 Decatur Street, Suite 848, Atlanta, GA 30303, USA
[b] Georgia State University, School of Public Health, Division of Health Promotion and Behavior, 140 Decatur Street, Suite 848, Atlanta, GA 30303, USA

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ABSTRACT

Aim: To assess the relationship between marijuana use, cigarette smoking and metabolic syndrome among adults in the United States who reported they use marijuana or cigarettes in comparison to non-marijuana and non-cigarette users.
Method: We conducted multiple logistic regression analyses using data from the 2011–2012 United States National Health and Nutrition Examination Survey to estimate relationships between cardio-metabolic risk factors and increasing years of smoking cigarette or marijuana use. Statistical adjustments were made for both demographic and endogenous factors related to recreational substance use.
Results: Each year increase in marijuana use was significantly associated with increased odds of metabolic syndrome (OR = 1.05; 95% CI: 1.01, 1.09), and hypertension (OR = 1.04; 95% CI: 1.01, 1.07) adjusting for both demographic and endogenous factors related to recreational substance use. Each year increase in cigarette smoking was significantly associated with increased odds of hypertension (OR = 1.03; 95% CI: 1.00, 1.06) and hyperglycemia (OR = 1.03; 95% CI: 1.01, 1.05) after adjusting for confounders.
Conclusion: The results of this investigation suggest that increased years of marijuana or cigarette use are important factors in metabolic health; and consequently calls for the need to consider the potential negative effects of marijuana or cigarette for metabolic syndrome and its associated cardio-metabolic risk components.

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1. Introduction

Cigarette smoking and marijuana (cannabis) use are two common recreational drug behaviors in many societies including the United States (US). While cigarette smoking is a modifiable risk behavior that is often linked to several chronic diseases [1], little is known about the true relationship between marijuana use and chronic disease conditions [2]. In the US, public opinion for marijuana seems to be changing to legalization with respect to its use for recreational purposes [3,4]. The use of marijuana for medical reasons [5–7] has elevated public support for its decriminalization. It is of importance to public health that the burgeoning support for marijuana legalization as a recreational substance be supported by evidence and research. Indeed, the increase in support for recreational use of marijuana in the US calls for an understanding and proper documentation of the nature of the association between marijuana use and conditions associated with diseases that have high rates of morbidity and mortality, including metabolic syndrome (MetS).

Metabolic syndrome is a complex disorder defined by a cluster of interrelated factors that increase the risk of cardiovascular, atherosclerotic diseases and type 2 diabetes. Described originally by Hanefeld and Leonhardt [8] and popularized by Reaven [9], MetS remains a subject of considerable curiosity because of the complexity of the pathophysiology. The main components of MetS are abdominal obesity, elevated arterial blood pressure, dysregulated glucose homeostasis, and dyslipidemia [10].

In this study we examined the relationship of recreational substance use, specifically cigarette and marijuana with MetS.

* Corresponding author.
E-mail addresses: byankey1@student.gsu.edu, byankey1@outlook.com (Barbara N.A. Yankey).

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While some research exist on the effect of cigarette use on MetS [11,12], very little exist on the relationship between marijuana use and MetS, including its components. An underlying reason for investigating the connection between marijuana and metabolic syndrome is that cannabinoid receptors (the cell membrane receptor for active constituent of marijuana) and endocannabinoids (endogenous ligands) are present in the peripheral tissues that are involved in energy regulation and homeostasis [13–15]. Importantly, Delta-9-tetrahydrocannabinol (THC), the main active constituent of marijuana, acts on these cannabinoid receptors [16]. If an important relationship between cannabis and metabolic syndrome exists, its explication may help to lessen the future burden of cardiovascular diseases.

2. Data and method

2.1. Data source

This study used data from the National Health and Nutrition Examination Survey (NHANES). The NHANES is a major program of the National Center for Health Statistics (NCHS), under the Centers for Disease Control and Prevention (CDC) that assesses the health and nutritional status of the US population. Since 1999, NHANES enrolls approximately 5000 persons from 15 counties across the US yearly for interview and examination. The enrollment is based on a continuous nationally representative and complex sampling method.

2.2. Inclusion criteria

This study was restricted to participants of 2011–2012 NHANES. Only subjects aged 20 years and above who responded to the question on our main independent variable, "Have you ever even once used marijuana or hashish?" were eligible for this study.

2.3. Dependent variables

Our main dependent variable is metabolic syndrome (MetS). We also analyzed each of the individual components of MetS separately. We classified MetS using definitions by the National Cholesterol Education Program, Adult Treatment Panel III (NCEP, ATP III) 2004 modification, which adapts the International Diabetes Federation (IDF) definition for hypertension and diabetes. Participants considered as having hypertension had an average blood pressure above 130/85 mmHg or were on antihypertensive medication. We used an average of the recorded blood pressure readings as the value of an individual's blood pressure for the purpose of our study. Details on blood pressure measurement are described (http://www.cdc.gov/nchs/nhanes/nhanes2009-2010/current_nhanes_09_10.htm). Participants with fasting plasma glucose of 100 mg/dl or on some antidiabetic treatment including insulin were coded as having diabetes. The NHANES has a detailed description of laboratory and examination procedures listed on (http://www.cdc.gov/nchs/nhanes/nhanes2011-2012/manuals11_12.htm). Abdominal obesity was coded as yes for females with waist circumference of more than 88.0 cm and yes for males with waist circumference of more than 102.0 cm. Females with plasma High Density Lipoprotein Cholesterol (HDL-C) of less than 50 mg/dl and males with less than 40 mg/dl were coded as having low HDL-C. Hypertriglyceridemia was coded yes for all participants with plasma triglycerides of 150 mg/dl and above. Participants with three or more of the components of metabolic syndrome (abdominal obesity, hypertension, hyperglycemia, hypertriglyceridemia and low HDL-C) were coded as having metabolic syndrome.

2.4. Main independent variables

Participants who answered no to the question "have you ever used marijuana?" were categorized as never marijuana users. Those who answered yes (had ever used marijuana), and answered no to the question, "have you smoked marijuana or hashish at least once a month for more than a year?" were categorized as non-regular marijuana users and those who answered yes as regular marijuana users. Other questions on marijuana use include: Age at first use of marijuana ("how old were you the first time you used marijuana or hashish?") and Age at regular use of marijuana ("how old were you when you started smoking marijuana or hashish at least once a month for more than one year?"). We calculated years of marijuana use by subtracting age at regular marijuana use from the current age of participants. Participants who were non-regular or never users had zero for the number of years of marijuana used. For quantity of marijuana smoked, participants answered the question: "during the time that you smoked marijuana or hashish, how many joints or pipes would you usually smoke in a day?" The answers were 1 per day, 2 per day, 3–5 per day, or 6+ per day. We used this as the quantity of marijuana used per day and assigned never users or non-regular users "zero" use per day.

Our other independent variable of interest is cigarette smoking. Participants were asked, "Have you smoked at least 100 cigarettes your entire life?" We coded those who answered no as non-smokers. For current use of cigarettes, participants who said they have smoked at least 100 cigarettes in their entire life, were asked "do you now smoke cigarettes?" We coded those who said not at all as past smokers and those who said every day or some days as current smokers (current smokers are those who have smoked at least 100 cigarettes in their life time and still smoke either every day or some days). To know the age at regular smoking, participants were asked, "How old were you when you first started to smoke cigarettes fairly regularly?" We coded years of smoking cigarettes for those who have never smoked as zero and did the subtraction for current smokers. Those who refused to answer or did not know were not included in the analysis.

2.5. Control variables

For our control variables, we dichotomized age as above 25 years or below and compared with those above 25 years. This is based on the effect of this age transition on metabolic syndrome, specifically, aging and oxygen uptake during physical activity. Research shows that from age 25 years to age 65 years, the maximal intake of oxygen reduces by almost 5 ml per kg per min [17]. In analyzing the effect of our main independent variables on metabolic syndrome and its factors, we found it important to consider this factor. Gender was categorized as male and female. We compared other racial ethnic groups (Non-Hispanic Blacks, Mexican Americans, other Hispanics, Asians and other Races) with non-Hispanic Whites. We included education on an increasing level as laid down by NHANES (Tables 1a and 1b). We dichotomized physical activity as participation in at least moderate physical activity (at least 10 min of continuous daily recreational activity apart from all other activities) or not.

2.6. Control variables endogenous to recreational substance use

Married participants were compared to all other participants in other marital categories listed in NHANES. Poverty to income ratio was classified on an increasing level (Table 1a). Weekly frequency of alcohol intake as reported by participants was estimated and included in the model on an increasing level. Response to the

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