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Original Research

The association of fruit and vegetable consumption with changes in weight and body mass index in Chinese adults: a cohort study

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ABSTRACT

Objectives: Findings regarding the benefits of fruit and vegetables (FV) on weight control are inconsistent and little is known among Chinese populations. Therefore, we examined the relationship between change in FV consumption, weight, and change in body mass index (BMI) among Chinese adults, participants of the China Health and Nutrition Survey (CHNS).
Study design: A prospective cohort study.
Methods: Two waves of CHNS conducted in 2006 and 2011 were used. Continuous FV consumption increase was considered as the exposure and changes in weight and BMI as outcomes. Change in FV consumption was categorized into quintiles. Analysis of covariance and multiple linear regression models, after controlling for potential confounders such as energy intake, physical activity, and smoking, were used to describe the relationship between change in FV consumption and change in weight and BMI.
Results: A total of 4357 participants aged 18–65 years were included in this study. The respective weight and BMI gains in male individuals were 1.81 kg and 0.73 kg/m^2 in the fifth quintile of FV change relative to individuals in the first quintile (3.67 kg for weight gain and 1.48 kg/m^2 for BMI gain). An increase in FV consumption by 100 g was associated with a 211 g weight loss (B = −2.11; 95% confidence interval [CI], −3.34, −0.89, $P < 0.001$) and a decrease in BMI by 0.94 kg/m^2 (B = −0.94; 95% CI, −1.36, −0.46, $P < 0.001$) in men; and a 140 g weight loss (B = −0.14; 95% CI, −0.97, 0.69, $P = 0.74$) and a decrease in BMI by 0.29 kg/m^2 BMI (B = −0.29; 95% CI, −0.63, 0.06, $P = 0.11$) in women.
Conclusions: Increase in FV consumption was associated with statistically significant weight loss and decrease in BMI among Chinese men, and, although suggested, weight loss among women was not significant. Considering the protective effect of FV on human health, increasing FV consumption in the Chinese population is recommended.

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Introduction

The prevalence of overweight and obesity has increased substantially in the past few decades worldwide.[1,2] It was estimated that the proportion of overweight adults increased from 28.8% in 1980 to 36.9% in 2013, which exacted a substantial burden on people's health globally.[3] Obesity has been linked to an increased risk for cardiovascular diseases (CVDs), diabetes, some types of cancers, and osteoarthritis.[4] Considering the challenges in treating obesity and achieving weight maintenance, there is an urgent need for obesity prevention approaches across populations.

Obesity is a multi-factorial, complex condition, and no single intervention will be sufficient to prevent it. Multiple strategies are needed and one of such identified strategies includes an increase in fruit and vegetable (FV) consumption.[5] It has been observed that increased FV consumption may reduce the risk of CVD, diabetes, and certain cancers.[6] However, findings regarding the benefits of FV on weight control were inconsistent. Although some studies reported that increased FV consumption reduced weight or body mass index (BMI),[7–9] others noted no such relationship.[10,11]

With rapid economic growth and industrialization,[12] a dramatic rise in the prevalence of overweight and obesity was observed among Chinese adults posing a major threat to their health.[13] Simultaneously, data suggest a reduction of vegetable consumption among this population. According to a recent study in China, vegetable consumption of Chinese citizens decreased from 363.4 g/day in 1993 to 321.6 g/day in 2011, whereas it was reported that Chinese people ate only 90.1 g fruit daily in 2011.[14] Although some cross-sectional studies have explored the effects of dietary pattern on obesity among Chinese adults,[15,16] the longitudinal association between FV consumption and obesity has not been investigated. Therefore, we assessed the relationship of the change in FV intake with changes in body weight and BMI over a 4.6-year period in a large cohort of Chinese adults.

Methods

Study design and participants

The China Health and Nutrition Survey (CHNS) is an ongoing prospective cohort study with data from 1989 to 2011 available for public use. The CHNS was designed to provide representation of rural, urban, and suburban areas varying substantially in geography, economic development, public resources, and health indicators. A multistage random-cluster sampling method was employed to recruit subjects. The original survey sites included eight provinces: Liaoning, Jiangsu, Shandong, Henan, Hubei, Hunan, Guangxi, and Guizhou; a 9th province, Heilongjiang, was added in 1997. Counties in the nine provinces were stratified by income (low, middle, and high), and a weighted sampling scheme was used to randomly select four counties in each province. Two cities (the provincial capital and a lower income city) and four economically striated counties were selected in each province. Within cities, two urban and two suburban communities were selected; and within counties, one community in the capital city and three rural villages were chosen. Details of the study design and recruitment methods have been described elsewhere.[17] The present study was based on 2006 and 2011 waves of the CHNS. Written informed consent was provided by each participant. The study protocol for this study was approved by institutional review boards of University of North Carolina at Chapel Hill, and National Institute for Nutrition and Health, Chinese Center for Disease Control and Prevention.

Outcomes

The outcomes of the study include changes in weight and BMI between years 2006 and 2011. Participants' height and weight at baseline and follow-up were measured by trained technicians using standard methods. Weight was measured with participants in light clothing to the nearest 0.1 kg. Individual's height was measured to the nearest 0.1 cm with participants being barefoot. BMI was defined as body weight in kilograms divided by the square of height in meters.

Exposure

The exposure was defined as change in FV consumption (g/day) between years 2006 and 2011. FV consumption was assessed by three consecutive 24-h dietary recalls, which included two week days and one weekend day.[18] Individuals were asked about the exact type and weight of food they consumed by trained interviewers including food consumed away from home. A food system was specifically developed for CHNS and Chinese Food Composition Tables, which included 162 fruit items and 256 vegetable items.[19] The average daily FV intake was derived from participant responses.

Confounders

Information on gender, age, education, province, and lifestyle were collected from self-administered questionnaires. Education level was defined as the highest education the participants received. Lifestyle measures included physical activity (PA), energy intake (EI), smoking status, and alcohol and soft drink consumption. PA level was calculated by multiplying the weekly time spent in each activity by metabolic equivalent (MET) score, an indicator of average intensity of each PA.[20] In this study, we defined PA as the leisure PA domain according to the Sleep, leisure, occupation, transportation and home (SLOTH) model,[21] containing 13 items of active and sedentary leisure. EI was measured by aggregating the energy contained in each food consumed daily based on Chinese Food Composition Tables. The information of smoking status, alcohol and soft drink consumption were collected through a self-reported questionnaire. Current smoking was assessed by two questions. Participants were first asked to report whether they ever smoked. If yes, they were asked if they still smoked. Individuals who reported ever smoking and still smoked were considered as 'current smoking'. Alcohol consumption was assessed by the question 'Did you ever drink alcohol (beer, white wine or other spirits) in the last year?' If yes, they were defined as 'current alcohol consumption'. Soft beverage