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Metabolism

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Clinical Science

Soft drink consumption is positively associated with metabolic syndrome risk factors only in Korean women: Data from the 2007–2011 Korea National Health and Nutrition Examination Survey



Sangwon Chung^a, Kyungho Ha^a, Haeng-Shin Lee^b, Cho-il Kim^c, Hyojee Joung^a, Hee-Young Paik^d, YoonJu Song^{e,*}

^a Department of Public Health Nutrition, Graduate School of Public Health, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 151-742, Republic of Korea

^b Nutrition Policy and Promotion Team, Korea Health Industry Development Institute, 187 Osongsaengmyeong2(i)-ro, Gangoe-myeon, Cheongwon-gun, Chungcheongbuk-do 363-951, Republic of Korea

^c Bureau of Health Industry Promotion, Korea Health Industry Development Institute, 187 Osongsaengmyeong2(i)-ro, Gangoe-myeon, Cheongwon-gun, Chungcheongbuk-do 363-951, Republic of Korea

^d Department of Food and Nutrition, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 151-742, Republic of Korea

^e Major of Food and Nutrition, School of Human Ecology, The Catholic University of Korea, 43 Jibong-ro, Wonmi-gu, Bucheon-si, Gyeonggi-do 420-743, Republic of Korea

ARTICLE INFO

Article history:

Received 11 April 2015

Accepted 13 July 2015

Keywords:

Soft drinks

Sugar intake

Metabolic syndrome

Korean population

ABSTRACT

Objective. To examine the association between sugar-sweetened beverage consumption and metabolic syndrome risk factors in Korean adults.

Methods. We used data from 13,972 participants (5432 men and 8540 women) aged ≥ 30 years, from the 2007–2011 Korea National Health and Nutrition Examination Survey. The subjects were divided into six groups based on their soft drink consumption levels from a food frequency questionnaire. Dietary sugar intake was compared among groups using 24-hour dietary recall data.

Results. The highest soft drink consumption frequency category was ≥ 4 times per week, observed in 4.6% of men and 1.7% of women. The percentage of energy from total sugar and sugar in processed foods increased with increased soft drink consumption in both men and women. In the highest consumption group, the percentage of energy from sugar in processed foods was 8.9% in men and 11.0% in women. After adjusting for potential confounding variables, greater consumption of soft drinks was positively associated with all of the components of metabolic syndrome, except the high density lipoprotein (HDL) cholesterol level, in women only. Women who consumed soft drinks ≥ 4 times per week had a 74% higher risk of metabolic syndrome compared to those who consumed soft drinks infrequently (OR: 1.74; 95% CI: 1.00–3.03; P for trend <0.0001).

Abbreviations: SSB, sugar-sweetened beverage; SBP, systolic blood pressure; DBP, diastolic blood pressure; HDL, high density lipoprotein; BMI, body mass index; GI, glycemic index; GL, glycemic load; KNHANES, Korea National Health and Nutrition Examination Survey.

* Corresponding author. Tel.: +82 2 2164 4681; fax: +82 2 2164 6583.

E-mail address: yjsong@catholic.ac.kr (Y. Song).

<http://dx.doi.org/10.1016/j.metabol.2015.07.012>

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Conclusion. High levels of soft drink consumption might constitute an important determinant of metabolic syndrome and its components only in Korean adult women.

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1. Introduction

Several recent large-scale cohort studies have found that sugar-sweetened beverages (SSBs), which generally include soft drinks, fruit drinks, and sports drinks, are positively associated with an increased risk of metabolic dysfunctions such as type 2 diabetes and cardiovascular disease [1]. American adult men in the top quartile of SSB intake have been found to have a 24% higher risk of type 2 diabetes [2] and a 20% higher risk of coronary heart disease [3] relative to those in the bottom quartile. Furthermore, compared with individuals who did not consume SSBs, those who consumed one or more servings per day had a 16% higher risk of any stroke [4]. In European adults, one 12-ounce daily increment in SSB intake was associated with a 22% increase in the risk of type 2 diabetes [5].

A meta-analysis of the association between SSBs and metabolic syndrome that included three studies found that individuals in the highest quartile of SSB intake had a 20% higher relative risk of developing metabolic syndrome than those in the lowest quartile [6].

Although most epidemiological investigations of the link between SSBs and metabolic diseases have been conducted in Western populations, a few have considered Asian populations. A study of Japanese men found that those who consumed one or more servings of SSB per day had a 35% higher risk of developing type 2 diabetes than those who rarely or never consumed SSBs; however, the difference was not statistically significant [7]. A study in Taiwanese boys and girls found that high SSB consumption was associated with a 1.9 and 2.7 times, respectively, higher risk of metabolic syndrome [8].

SSB consumption has been steadily increasing worldwide. In the United States, the energy intake from SSBs increased almost threefold from 3.9% of total calories in the late 1970s to 9.2% in 2001 [9,10]. A similar trend has been documented in Mexico [9]. Furthermore, 25% of Americans consume approximately 200 kcal a day from SSBs, which corresponds to more than one 12-ounce can of soft drink, and 5% of the population consumes more than 567 kcal a day, which is the equivalent of four 12-ounce cans of soft drink [11].

SSB consumption is on the rise among Asians, although it remains lower than that in Western populations. As Asian populations adapt to the Western lifestyle, the traditional dietary practice consisting primarily of rice or grains as staples and plenty of vegetables has gradually come to include meat and sweet foods such as desserts and beverages.

A recent Korean study found that all beverages, including SSBs, coffee, and tea, were a major source of sugar intake from processed foods [12] and that beverage consumption has increased over the past decade. The average energy intake from SSBs in adolescents and young adults has increased from 22.3 and 20.0 kcal a day in 1998 to 35.1 and 29.4 kcal a day in 2009, respectively [13]. Furthermore, sugar intake from soft drinks is the highest among all types of beverages [12].

Although SSB consumption and the prevalence of metabolic syndrome in Korean adults are increasing [14], no study has investigated the associations between SSB consumption and metabolic syndrome in a large sample of Korean adults. Thus, we examined the associations of soft drink consumption with the components of metabolic syndrome in Korean adults using data from the 2007–2011 Korea National Health and Nutrition Examination Survey (KNHANES).

2. Methods

2.1. Study Subjects

The KNHANES is an ongoing nationwide survey conducted by the Korea Centers for Disease Control and Prevention to collect data on the health and nutritional status of the Korean population. This survey uses a complex multistage, probability-sampling design to select nationally representative non-institutionalized Korean participants aged 1 year or older [15].

Of the 37,836 2007–2011 KNHANES participants, we excluded those who were <30 years old ($n = 13,196$), were pregnant or lactating women ($n = 224$), reported implausible energy intake (<500 or >5000 kcal/day, $n = 349$), diagnosed with or receiving medication for hypertension, dyslipidemia, stroke, myocardial infarction, angina, or diabetes ($n = 7920$), and those who were missing information for our target variables ($n = 2175$). Our final study sample consisted of 13,972 participants.

The survey protocols were approved by the Korea Centers for Disease Control and Prevention Institutional Review Board, and written informed consent was obtained from each participant.

2.2. Dietary Assessment

The KNHANES included a dietary questionnaire and a single 24-hour dietary recall method. The dietary questionnaire assessed general dietary behaviors and the intake of 63 food items on the food frequency questionnaire. The 24-hour dietary recall method was administered in a face-to-face interview conducted by a trained staff member [15].

Soft drink consumption was estimated by the question “How often do you consume soft drinks (carbonated beverages, e.g., Cola and Sprite)?” on the food frequency questionnaire. The initial response options were “rarely,” “6–11 times/year,” “once a month,” “2–3 times/month,” “once a week,” “2–3 times/week,” “4–6 times/week,” “once a day,” “2 times/day,” and “3 times/day.” However, we found that few individuals were in the high-consumption group; thus, the categories were revised to “rarely,” “ ≤ 1 time/month,” “2–3 times/month,” “1 time/week,” “2–3 times/week,” and “ ≥ 4 times/week.”

The 24-hour dietary recall method was used to assess nutrient intake. The KNHANES dietary survey did not specifically assess sugar intake; thus, we developed a sugar

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