

Self-Reported Taste Preference Can Be a Proxy for Daily Sodium Intake in Middle-Aged Japanese Adults

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ABSTRACT

Reducing dietary salt intake remains a challenging issue in the management of chronic disease. Taste preference is suspected to be an important proxy index of daily sodium consumption. This study examined the difference in daily sodium intake according to self-reported taste preference for miso soup as representative of homemade cooking in middle-aged urban Japanese adults. Among 896 candidates randomly selected from examinees of cancer screening provided by the National Cancer Center, Japan, 143 men and women participated in this cross-sectional study. During the period from May 2007 through April 2008, participants provided a food frequency questionnaire, which included information on taste preference and dietary behaviors, a weighed food record over 4 consecutive days, a simultaneous 24-hour urine collection, and a sample of miso soup as it is usually prepared in the home. Mean 24-hour urinary sodium excretion and daily sodium intake were compared according to the self-reported taste preference for miso soup. Taste preference was significantly associated with both 24-hour urinary sodium excretion (trend $P < 0.01$) and daily sodium intake (trend $P = 0.01$), with a corresponding regression coefficient per 1 rank preference increment of 403 mg and 315 mg/day, respectively. The observed association between preference and urinary excretion was attenuated by further adjustment for discretionary salt-related behaviors. These findings suggest that self-reported taste preference for homemade cooking is a defining feature of daily sodium intake through discretionary salt-related dietary behaviors. A reduction in daily sodium consumption per 1 rank light preference was estimated to equate to approximately 1 g salt/day.

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ACHIEVEMENT OF A REDUCED-SALT DIET REMAINS a challenging issue¹ worldwide in the primary prevention of chronic diseases, such as cardiovascular disease, including hypertension²⁻⁴ and gastric cancer.⁵ To reduce salt intake, regulations requiring a stepwise decrease in the amount of salt added to processed foods as a food additive have been proposed,^{4,6} given that the major sources of salt are processed foods, including those prepared by restaurants.^{7,8} However, efforts to reduce dietary salt by reducing salt concentrations in purchased foods are likely to be partially undermined due to the addition of salt at the table by the consumer.^{9,10}

Dietary salt reductions can also be realized by reducing other major contributors to sodium intake, such as discretionary salt or salty seasonings added during food preparation from basic ingredients in the home or at the table. These account for at least 45% of total sodium consumption among Japanese adults and >75% among Chinese adults.⁷ In fact, consumption of sodium chloride in traditional Asian diets is characterized by a relatively large contribution from soup or stew (16.4% of total sodium among Japanese adults and 21.8% among Korean adults) prepared in the home and a wide variety of salty seasonings, such as soy sauce and miso (ie, fermented soybean paste).^{7,11} This discretionary component

of sodium intake (eg, table or cooking salt use) is thought to depend on taste preference and/or gustatory threshold,^{12,13} both of which appear somewhat influenced by oral sensory phenotype.¹⁴ However, quantitative information on the degree to which taste preference is a defining feature of daily sodium intake is lacking.¹⁴⁻¹⁷ Taste preference for miso soup as representative of homemade cooking is suspected to be an important proxy index of daily sodium consumption.

In this study, taste preference for miso soup as a proxy for daily sodium intake was examined among middle-aged urban Japanese adults. Sodium intake was assessed by a 4-day weighed food record, 24-hour urinary sodium excretion, and sodium-related dietary behaviors. Taste preference was based on self-reporting.

METHODS

Study Setting and Participants

Study participants were selected from among participants of a cancer screening program at the National Cancer Center, Japan, from 2004 through 2006. The current study was conducted under a cross-sectional design, and the study protocol has been described in detail elsewhere.¹⁸ Briefly, eligibility criteria were age 40 to 69 years; residence in

metropolitan Tokyo; and no previous or present diagnosis of cancer, cardiovascular disease, or diabetes mellitus. Among the 896 randomly recruited candidates, 187 men and women (response rate, 20.9%) agreed to participate in the study. After excluding those who could not attend the study orientation, 144 men and women participated in all measurements in this study. The study was approved by the Institutional Review Board of the National Cancer Center, Tokyo, Japan. All participants provided written informed consent to participate.

Data Collection and Time Window

During the period from May 2007 through April 2008, participants completed a validated food frequency questionnaire (FFQ)¹⁸⁻²¹ that included information on taste preference for miso soup and dietary behaviors, weighed food records²² over 4 consecutive days,¹⁸ and a 24-hour urine collection. They also provided a sample of miso soup prepared in the manner usually used at home. The 4-day weighed food record and 24-hour urine collection procedures were explained by dietary staff at a study orientation conducted on the day before the start of the 4-day weighed food record data collection. The self-administered FFQ and a sample of miso soup (prepared 1 or 2 days before the orientation) were also obtained at this session. The 24-hour urine collection was self-administered on day 4 of the 4-day weighed food record.

Measurements

The 4-day weighed food record²² included 3 continuous weekdays and 1 weekend day.¹⁸ Food portions were measured by each participant during meal preparation using supplied digital scales and measuring spoons and cups. Trained registered dietitians reviewed and checked the record with the participants and coded the foods and weights. Intakes of energy and sodium or salt equivalent were calculated using the *Standardized Tables of Food Composition*, fifth revised edition.²³

The urinary specimen was collected using the Precise Urine Measurement device (Sumitomo Bakelite Co, Ltd), which obtains a 1/50 portion of all collected urine. On the collection day, the specimen obtained with the device was kept in a cold, dark place and sent to a laboratory the next day. Urinary sodium concentration (mEq/L) was analyzed by SRL Inc using electrode potentiometry. Quality-control testing was done using two sample sets, each containing three samples from one specimen, with each analysis repeated twice. Intra-assay coefficients of variation were 0.51% and 0.60%, respectively, and inter-assay coefficients of variation were 0.75% and 0.49%, respectively, at mean levels of 113.2 mEq/L and 152.3 mEq/L, respectively. After exclusion of individuals who reported two or more urine collection errors (eg, forgetting to conduct sampling and spillage out of the container), the remaining subjects were eligible for analysis of 24-hour urine excretion of sodium. A single urine collection error was assigned the mean value of the individual's recorded urine volumes, and 24-hour urinary excretion of sodium was calculated by the formula: 24-hour urinary excretion of sodium (mg/day)=obtained excretion (mL)×50×urine sodium concentration (mEq/L)×23.

Miso soup prepared in the home in the usual way, including any nonmiso ingredients routinely added, was collected at the study orientation. Salt concentration of the soup was analyzed by atomic absorption spectrophotometry after homogenization of the soup stock together with any added ingredients by SRL Inc.

The validated FFQ asked about the usual consumption of 138 foods and beverages in standard portions/units and nine frequency categories, as well as taste preference for miso soup (very mild, mild, common, strong, and very strong taste) and the following four dietary behaviors during the previous year¹⁸⁻²¹: frequency of salt and soy sauce use at the table (none, rarely, occasionally, almost always, always); frequency of instant food (ready to eat, such as retort pouches) consumption (less than once a month, one to three times a month, one to two times a week, three to four times a week, five to six times a week, or every day); frequency of dining out (less than once a month, one to three times a month, one to two times a week, three to four times a week, five to six times a week, or every day); and amount of soup stock consumed in noodle bowl dishes (almost none, one third of the bowl, half of the bowl, two thirds of the bowl, or almost all). The FFQ included the following salted foods: noodles (three items: udon, soba, and ramen [Chinese noodles]); processed meat (three items: ham, sausage or weiner sausage, and bacon); dried and salted fish (three items: salted fish: salted codfish or atka mackerel or salmon; himono: dried and salted Japanese horse mackerel;shirasuboshi: dried young sardines); and pickled vegetables (six items: Chinese radishes, green leafy vegetables, plums, Chinese cabbage, cucumbers, and eggplant).

Statistical Analysis

Sodium intake based on the 4-day weighed food record was adjusted for total energy intake by the residual method²² to control for potential under-reporting. Adjusted mean 24-hour urinary sodium excretion (mg) and daily sodium intake based on the 4-day weighed food record (mg/day) were calculated using a multivariable linear regression model with adjustment for sex, age (continuous), and body weight (continuous) according to taste preference for miso soup, as well as the number of bowls. Values for the salt concentration of miso soup (percent) were also calculated using the model with adjustment for sex and age. A linear trend for mean levels and regression coefficient was calculated in the multivariable linear regression model using categories of taste preference or number of bowls of miso soup as ordinal variables. In addition, the distribution of dietary behaviors, including food choices or discretionary salt-related behaviors, was compared by taste preference. For the consumption frequency of the salted food groups, the mid-frequency value of intake of each food item (1.5 was assigned as the value if an item was consumed as once or twice a week) was summed for each food group as the frequency of sodium-related food. Trend tests across categories were calculated by analysis of the Cochran-Mantel-Haenszel test for sex- and age-adjusted proportions.

All analyses were performed using SAS software (version 9.1.3, 2006, SAS Institute Inc). Throughout this article, all *P* values are two-sided, and statistical significance was determined at the *P*<0.05 level.

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