Use of Sodium Information on the Nutrition Facts Label in New York City Adults with Hypertension

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ARTICLE INFORMATION

Article history:
Accepted 31 July 2014
Available online 25 October 2014

Keywords:
Sodium reduction
Sodium
24-hour urine collection
Nutrition Facts label
Hypertension

http://dx.doi.org/10.1016/j.jand.2014.08.027

ABSTRACT

The Nutrition Facts (NF) label was established to help individuals monitor their nutrient intake and select healthier foods. This tool is particularly useful for individuals for whom dietary improvements are recommended, such as those with hypertension. Study objectives were to examine the independent association between hypertension and frequency of use of the NF label for sodium information and determine whether frequent use in individuals with hypertension was associated with differences in mean sodium intake assessed through 24-hour urine samples. Data came from the New York City Community Health Survey Heart Follow-Up Study, a cross-sectional study conducted in 2010 in a representative sample of New York City adults (n=1,656). Participants were asked questions regarding frequency of checking the NF label and also had 24-hour urine samples collected to assess actual sodium intake. Results indicated that hypertension was associated with frequent use of the NF label for sodium information (adjusted odds ratio 1.71, 95% CI 1.07 to 2.73). In individuals with hypertension, sodium intake did not differ between frequent vs non-frequent use of the NF label for sodium information (3,084 mg/day vs 3,059 mg/day; P=0.92). Although individuals with hypertension compared to those with no hypertension had 71% higher odds of frequently using the NF label for sodium information, suggesting they may be interested in decreasing sodium intake, sodium intake did not differ by frequency of NF label use among those with hypertension. Future research should explore strategies to ensure that when nutrition information is used, it is translated into meaningful results, especially in individuals with health concerns such as hypertension.
J Acad Nutr Diet. 2015;115:278-283.

CARDIOVASCULAR DISEASE (CVD) CONDITIONS THAT can be modified by diet, such as hypertension, have reached epidemic levels[1] and contribute to CVD being the leading cause of death in the United States and New York City.[2,3] Lifestyle modification, especially improving diet by consuming less sodium and increasing fruit and vegetable intake, has been shown to be effective in inhibiting the progression of hypertension and in preventing, or even reversing, CVD morbidity.[4-6]

To help consumers make better food choices, the US Congress passed the Nutrition Labeling and Education Act in 1990, which required all food manufacturers to display standardized nutrition labels.[7] Nutrients that were associated with priority health concerns, such as sodium, were emphasized on the Nutrition Facts (NF) label.[8] The expectation was that in making such information available, consumers would more readily be able to follow dietary recommendations.[8]

The demographic characteristics of individuals using the NF label are well documented, with higher use in women and those with higher education levels.[9] Research in those with hypertension show that these individuals are more likely to use the NF label for sodium information than those without hypertension.[10-13] Similarly, individuals with hypertension are also more likely to report engaging in sodium reduction behaviors than individuals without hypertension.[14] Less is known about whether using the NF label for information on sodium is associated with lower sodium intake in people with hypertension. A study using a 24-hour dietary recall to assess sodium intake found that, in subjects with hypertension, increased use of the NF label did not translate into healthier eating patterns.[11] Otherwise, the association between NF label use for sodium information and actual sodium intake in those with hypertension has not previously been characterized using the gold-standard of 24-hour urine collection.

Our objectives were to assess the independent association of hypertension with frequency of NF label use for sodium information, and determine whether there is an association between self-reported frequency of NF label use for sodium information and 24-hour urinary sodium excretion as a biomarker of dietary sodium intake for individuals with hypertension.

SUBJECTS AND METHODS

Study Design

Data for this analysis came from the New York City Community Health Survey (CHS) Heart Follow-Up Study (HFUS), a cross-sectional study conducted in 2010 to assess population-based sodium intake from a representative sample of New York City adults. Details of the study can be found in the comprehensive methodology report.[15] Study participants were recruited from the CHS, an annual telephone survey conducted by the New York City Health Department that includes 8,000 to 10,000 adult New Yorkers.[16] To obtain a representative sample of noninstitutionalized adult New Yorkers, the CHS uses a dual frame sample design consisting of random-digit-dial landline telephone exchanges and a second frame of cellular telephone exchanges that cover New York City. The CHS also incorporates a disproportionate stratified random sample design to allow for analysis at the city, borough, and neighborhood levels. Upon completion of the CHS interview, respondents were asked three questions to determine eligibility for HFUS participation: whether they were pregnant (if female), whether they were breastfeeding or lactating (if female), and whether they were currently receiving or had received kidney dialysis during the past 12 months. Any respondents who answered "yes" to any of the three questions were ineligible for HFUS participation. Eligible CHS survey respondents were given detailed explanations of the HFUS and invited to participate. Study participants answered survey questions, collected urine for a 24-hour period, and had a home visit scheduled. During the home visit, a medical technician was required to follow a welcome script.[17] The protocol included checking the identification of the person to verify he or she was the intended study participant and asking for the informed consent form. The visit did not continue if consent forms were not signed. The technician then took anthropometric measurements (height and weight), and seated blood pressure according to a standardized study protocol,[15] aliquotted the urine, and sent it directly to the research laboratory. Sodium measures were linked to participant survey responses. The Institutional Review Board of the NYC Health Department approved this study.

Participation

The 2010 CHS response rates were 17% and 28% for landline and cellular telephone exchanges, respectively. Cooperation rates among those who were reached were 77% among landline contacts and 94% among cellular contacts. Of the 2010 CHS participants screened for HFUS participation, 5,830 were found to be eligible. A total of 2,305 agreed to provide a 24-hour urine sample; of these 1,775 (or 30.4% of the 5,830 eligible CHS participants) provided a sample that could be analyzed by the laboratory. HFUS participants were statistically significantly more likely than CHS participants not recruited into HFUS to be Hispanic, to be younger than age 65 years, to have lower income, and to be obese. However, no significant differences in self-reported high blood pressure or general health status were observed.[15] Incomplete urine samples were defined as those provided by participants who reported missing a collection and samples with a total urine volume $<$500 mL or urinary creatinine $<$6.05 mmol in men and $<$3.78 mmol in women (both being biologically implausible).[15] The final analytic sample size was 1,656 because 119 urine samples were deemed incomplete.

Measurement and Definitions

In addition to using validated questions, extensive cognitive testing was conducted to establish face validity of survey questions. Hypertension was defined as a "yes" answer to the validated[18] question, "Have you ever been told by a doctor or other health professional that you have hypertension (also known as high blood pressure)?" Prior research has shown that consumers are unlikely to pay attention to nutrients on the NF label that they do not deem to be personally relevant.[10,19] Therefore, although measured blood pressure was available in this dataset, the study definition for hypertension was derived via self-report of diagnosed hypertension to best capture individuals in whom sodium information would have perceived relevance (ie, those who aware of their hypertension status).

Based on questionnaires from the National Health and Nutrition Examination Survey,[20] NF label use was first assessed with the question, "The Nutrition Facts panel on a food package is the printed box that includes calories and nutrient information. It is typically on the back or side of the package. How often do you use the Nutrition Facts panel when deciding whether or not to buy a food product?" Response choices were: always, most of the time, sometimes, rarely, or never.

Only individuals who reported using the NF label (rarely or more often) were asked follow-up questions about how often they used serving size and sodium information on the NF label, also based on the National Health and Nutrition Examination Survey questionnaires.[20] The serving size information on the NF label is cited as the first place to start when using the NF label.[21] As such, in our analysis it was used as a tool to help characterize how the NF label was used by the study population. NF label use for serving size and sodium information were assessed with the questions: "When you look at the Nutrition Facts panel to decide about a food product, how often do you look for information about… [serving size, sodium]?" (two separate questions). The answer choices for both questions were: always, most of the time, sometimes, rarely, or never. As in previous studies on NF label use,[13,22] responses were dichotomized to capture frequent (always or most of the time) or nonfrequent use (sometimes, rarely, or never) for serving size and sodium.

All demographic characteristics were derived via self-report through the survey component. Obesity was defined by having a body mass index $\geq$30 calculated by measured height and weight. Twenty-four–hour urine samples were analyzed for sodium using the ion-selective electrode potentiometric method and the Jaffe kinetic colorimetric method for creatinine on a modular analyzer (DPP Modular Analyzer, Hoffman-La Roche). Lab values were normalized to a 24-hour period before analysis.

Statistical Methods

All analyses were performed using weights to account for survey design and nonresponse so that results were representative of New York City adults as a whole. The prevalence of hypertension was assessed and age-adjusted to the US 2000 standard population. Demographic characteristics

(ie, age, sex, race/ethnicity, household poverty, education, nativity, smoking status, family history of CVD, obesity status, self-reported diabetes, self-reported high cholesterol, and self-reported diet quality) in New York City adults were assessed overall and by hypertension status; differences between those with or without hypertension were evaluated using χ^2 tests.

To address the first goal of characterizing NF label use in those with hypertension, the prevalence of NF label use and NF label use for serving size and sodium information was determined overall and by hypertension status. Differences in NF label use between those with and without hypertension were evaluated using χ^2 tests. Next, a multiple logistic regression model was used to assess the crude and independent association of hypertension (yes vs no) on use of sodium information on the NF label after adjustment for age, sex, race/ethnicity, poverty, education, nativity, body mass index, diabetes, and high cholesterol.

To address the second goal of linking frequency of NF label use for sodium information with measured sodium intake (mg per day) in those with hypertension, mean sodium intake was compared within those with hypertension who report frequent vs nonfrequent use of the NF label for sodium information using *t* tests. We expected that mean sodium intake would be lower in those who use the NF label for sodium information frequently.

Subjects with missing data were excluded from analysis. Exclusion of subjects was minimal because survey responses tended to be complete with the exception of the poverty indicator. As a result, crude analyses consisted of the full or close to the full analytic sample size. However, the adjusted logistic regression model omitted 78 observations, largely due to individuals with missing household income data. Data were analyzed using SUDAAN software version 10.0 (2008, Research Triangle Institute).

RESULTS AND DISCUSSION

The age-adjusted prevalence of self-reported hypertension in the New York City adult population was 29.2%. Those with hypertension tended to be older, women, black, have lower incomes, have lower levels of educational attainment, report a less-healthful diet, and report having other CVD comorbidities compared with those without hypertension (Table 1).

Use of the NF label did not differ by hypertension status: 78.7% of individuals with and 82.3% of those without hypertension reported use of the NF label at least rarely when deciding whether to buy a food product (P=0.267) (Table 2). Although there was no association between hypertension and general use of the NF label, individuals with hypertension were more likely to report frequent use of the NF label for sodium information compared with those without hypertension (66.1% vs 43.8%, P<0.001; crude odds ratio 2.50, 95% CI 1.72 to 3.65). This relationship persisted after adjustment for covariates (adjusted odds ratio 1.71, 95% CI 1.07 to 2.73). These results suggest that individuals with hypertension may be interested in sodium information in their food items because these individuals had 71% greater odds of reporting frequent use of the NF label for information on sodium compared with those without hypertension.

However, daily sodium intake was well above the recommended limit of 1,500 mg/day among individuals with hypertension.[23] Further, daily sodium intake was not lower in those who reported frequent vs nonfrequent use of the NF label for sodium information (3,084 mg vs 3,059 mg; P=0.924), a finding consistent with studies utilizing dietary recall to assess nutrient intake.[11] The lack of association between self-reported use of sodium information on the NF label and actual sodium intake may be attributed to individuals having difficulty interpreting sodium content information on the NF label.[10]

Difficulty interpreting NF label information is not restricted to sodium. Studies have found that, in general, the NF label is confusing to users.[24] Poor label comprehension is highly correlated with low literacy and numeracy, but even those with higher literacy skills show signs of difficulty when interpreting the NF label values.[25] Common sources of confusion include calculations of total nutrients per package, interpretation of the meaning of percent daily value, and applications of serving size.[25,26] The serving size on the NF label, which shows how many servings are in a given package and the size of those servings, has been described by the Food and Drug Administration as the "key to the rest of the information" on the NF label.[27] In our New York City population, although those with hypertension were more likely to report frequent use of the NF label for serving size information compared with those without hypertension (50.2% vs 40.5%; P=0.037), use of the NF label for serving size was low overall. These data suggest many New York City adults, including those with hypertension, may not be using information on the NF label correctly. Recently, the Food and Drug Administration has proposed changes to the NF label, in part to bring more attention to the serving size information.[28]

Current results are also corroborated by previous research which found that sodium reduction is difficult even among motivated individuals who report engaging in behaviors to reduce sodium.[14] A randomized controlled trial among people with diabetes found that those who were educated to use the NF label to choose lower-sodium products failed to reduce sodium intake post-intervention and had sodium intakes comparable to the control group (no education).[29] This discrepancy between patient knowledge and patient action is not unique to the field of nutrition as it relates to CVD.[30,31] Although knowledge is necessary for behavior change, that alone may not be sufficient,[31] warranting research to find novel ways of translating knowledge into meaningful action.

In addition to difficulties faced when interpreting NF label information or actually taking action, sodium reduction is particularly challenging given the sheer amount of sodium in the food supply. With approximately 80% of the sodium consumed derived from packaged and restaurant foods[32] and 37% of meals consumed away from the home,[33] meaningful sodium reduction presents individuals with a real challenge. For example, it is estimated that roughly 25% of sodium in the American diet comes from restaurant sources.[34] The lack of sodium information in many restaurants may contribute to difficulties faced by individuals interested in monitoring their sodium intake, potentially influencing the current findings.

The HFUS was the first local population-based study in the United States that used 24-hour urine collection to assess sodium intake. Measured sodium values made it possible to more accurately assess whether mean sodium intake was

Table 1. Demographic characteristics of participants in a representative sample of 1,656 New York City adult residents overall and by hypertension status

Characteristic	Total Population	Hypertension	No hypertension	*P* value[a]
	←——————%±*standard deviation*——————→			
Age group, y				<0.001[c]
18-24	13.2±1.6	2.0±1.6[b]	17.9±2.2	
25-44	43.4±2.0	23.0±3.4	51.9±2.4	
45-64	28.0±1.6	40.8±3.2	22.7±1.7	
65+	15.5±1.2	34.3±3.1	7.4±0.9	
Male	46.2±2.0	36.8±3.2	50.0±2.5	0.001[c]
Race/ethnicity				0.011[c]
Non-Hispanic white	38.7±1.8	32.2±2.8	41.5±2.3	
Non-Hispanic black	23.0±1.6	31.9±3.2	19.2±1.8	
Hispanic	24.7±1.7	23.5±2.8	25.1±2.1	
Non-Hispanic Asian	10.1±1.4	8.5±2.6	10.8±1.7	
Other	3.6±0.8	3.9±1.6[b]	3.5±1.0	
Household poverty[d]				0.004[c]
<200%	48.0±2.0	56.0±3.4	44.9±2.5	
200%-399%	15.0±1.3	16.8±2.3	14.4±1.7	
>400%	28.3±1.7	20.4±2.4	31.6±2.2	
Education				0.001[c]
Less than high school	20.9±1.7	28.3±3.2	17.5±2.1	
Grade 12 or general equivalency diploma	26.4±1.8	29.6±3.3	25.2±2.2	
Some college	21.9±1.6	19.7±2.6	22.8±2.0	
College graduate	30.8±1.7	22.4±2.4	34.5±2.3	
US born	53.4±2.0	51.8±3.4	54.1±2.4	0.589
Smoking				0.367
Never	59.5±1.9	56.2±3.3	61.1±2.4	
Current	17.7±1.5	18.1±2.6	17.5±1.8	
Former	22.8±1.6	25.7±2.7	21.3±2.0	
Family history of cardiovascular disease	37.3±1.9	59.5±3.5	21.3±2.0	<0.001[c]
Obese	30.3±1.8	49.6±3.4	22.4±2.1	<0.001[c]
Self-reported diabetes	10.5±1.1	24.6±2.6	4.4±2.9	<0.001[c]
Self-reported high cholesterol	31.1±1.8	58.0±3.4	20.0±1.8	<0.001[c]
Self-rated diet quality				0.018[c]
Excellent	11.9±1.3	8.7±2.1	13.3±1.6	
Very good	26.8±1.8	20.9±2.9	29.2±2.3	
Good	33.0±1.9	35.7±3.3	31.9±2.3	
Fair	24.2±1.7	28.8±3.1	22.2±2.1	
Poor	4.1±0.6	5.8±1.3	3.3±0.7	

[a]Indicates whether demographic category is significantly different at $P<0.05$ based on hypertension status (yes vs no) using χ^2 tests.
[b]Estimate should be interpreted with caution. Estimate's relative standard error (a measure of estimate precision) is >30% or the sample size is too small, making the estimate potentially unreliable.
[c]Significant differences between hypertension vs no hypertension.
[d]Based on household income as a percentage of the federal poverty threshold. Numbers do not add up to 100% due to missing data.

Table 2. Frequency at which the Nutrition Facts (NF) label is used in a representative sample of 1,656 New York City adult residents overall and by hypertension status

NF label use	Total population	Hypertension	No hypertension	*P* value[a]
	←——————%±*standard error*——————→			
NF label use frequency				0.267
Always	22.9±1.6	25.4±2.9	22.0±2.0	
Most of the time	20.7±1.6	18.5±2.4	21.8±2.0	
Sometimes	27.1±1.8	27.3±3.3	27.0±2.2	
Rarely	10.4±1.3	7.6±1.4	11.5±1.7	
Never	18.8±1.7	21.3±3.0	17.7±2.0	
When using the NF label, look at serving size frequently[b]	43.2±2.2	50.2±3.8	40.5±2.6	0.037[c]
When using the NF label, look at sodium frequently[b]	50.0±2.2	66.1±3.6	43.8±2.6	<0.001[c]

[a]Indicates whether NF label use category is significantly different at $P<0.05$ based on hypertension status (yes vs no) using χ^2 tests.
[b]Only asked in those who reported using the NF label at least rarely. Frequent use was defined as reporting using the NF label always or most of the time.
[c]Significant differences between hypertension vs no hypertension.

associated with frequency of NF label use for sodium information. Although the 24-hour urine collection is the gold standard of sodium assessment,[35] it only reflects sodium consumption on 1 day and may not be indicative of an individual's typical or habitual daily sodium intake. Further, although mean daily sodium intake in the national population is comparable to overall estimates in New York City (3,424 mg and 3,239 mg, respectively),[36,37] results from this study of New York City participants may not be generalizable to the US population. In addition, although completeness criteria were applied to each urine sample (119 of the 1,775 or 6.7% of the urine samples were not included), it is still possible that incomplete samples were included in the analysis. Inclusion of incomplete samples could potentially result in an underestimation of mean daily sodium excretion; however, differential inclusion of incomplete urine samples by frequency of NF label use is unlikely.

Another limitation of our analysis is its focus on NF label use in those with hypertension irrespective of whether blood pressure was controlled. Individuals with hypertension that is controlled vs uncontrolled may have different NF label use and sodium consumption patterns that warrant further investigation. Finally, due to our study's cross-sectional design, it was not possible to establish temporality; that is, that frequent use of the NF label for sodium information was a result of having hypertension.

CONCLUSIONS

Hypertension, a major risk factor for CVD, was associated with frequent use of the NF label for sodium information, suggesting that individuals with hypertension report engaging in behaviors to improve their health. However, among those with hypertension, frequent use of the NF label for sodium information was not associated with lower mean sodium intake using measured biomarker data. Therefore, although the NF label provides valuable information to consumers, additional research is needed to ensure that when the information is used, it translates into lower sodium consumption, particularly for those who are advised to reduce sodium intake, such as those with hypertension.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

FUNDING/SUPPORT

The Heart Follow-Up Study was made possible by funding from the Robert Wood Johnson Foundation, the New York State Health Foundation, the National Association of County & City Health Officials, the Centers for Disease Control and Prevention (grant no. 5U38HM000449-02), the W.K. Kellogg Foundation, and the US Department of Health and Human Services. This funding is administered by the Fund for Public Health in New York, a private nonprofit organization that supports innovative initiatives of the New York City Department of Health and Mental Hygiene. The contents of this article are solely the responsibility of the authors and do not necessarily represent the official view of the funders. The New York City Department of Health and Mental Hygiene staff were involved in the study design; collection, analysis, and interpretation of the data; writing of the manuscript; and the decision to submit the manuscript for publication. Outside funders were not involved.