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## Sodium Consumption Among Hypertensive Adults Advised to Reduce Their Intake: National Health and Nutrition Examination Survey, 1999–2004

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### Abstract

The authors estimated the prevalence of taking action to reduce intake related to actual sodium consumption among 2970 nonpregnant US adults 18 years and older with self-reported hypertension by using data from the National Health and Nutrition Examination Survey 1999–2004. Adjusted multiple linear regression assessed differences in mean sodium intake by action status. A total of 60.5% of hypertensive adults received advice to reduce sodium intake. Of this group, 83.7% took action to reduce sodium. Action to reduce sodium intake differed significantly by age, race/ethnicity, and use of an antihypertensive. The mean ( $\pm$ standard error) sodium intake among hypertensive adults was  $3341 \pm 37$  mg and differed by sex, age, race/ethnicity, education, and body mass index ( $P < .05$ ), with the lowest intake among adults aged 65 years and older ( $2780 \pm 48$  mg). Mean intake did not differ significantly by action status either overall or by subgroup except for one age category: among patients 65 years and older, mean intake was significantly lower among those who took action ( $2715 \pm 63$  mg) than among those who did not ( $3401 \pm 206$  mg;  $P = .0124$ ). Regardless of action, mean intake was well above 1999–2004 recommendations for daily sodium intake and about twice as high as the current recommendation for hypertensive adults (1500 mg).

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An estimated 31% of US adults 18 years or older have hypertension, and 46% of this population has controlled hypertension.<sup>1</sup> Hypertension is a major risk factor for heart disease and stroke, end-stage renal disease, and peripheral vascular disease, and it is a chief contributor to adult disability.<sup>2</sup> It is well-known that reducing sodium intake can lower blood pressure (BP)<sup>2–7</sup> and thus the subsequent risk of cardiovascular disease (CVD) and stroke. In the United States, one of the objectives of *Healthy People 2010* was to increase the percentage of persons 2 years or older who consumed  $<2400$  mg/d of sodium to 65%.<sup>8</sup> In 2005 and again in 2010 the *Dietary Guidelines for Americans* recommended a target of 1500 mg of sodium per day for hypertensive adults.<sup>9–11</sup> Despite these recommendations, mean

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sodium intake from foods and beverages in the United States has changed little since 1999, and in 2007 to 2008 was about 2900 mg/d among women and 4000 mg/d among men 20 years and older.<sup>11,12</sup>

Perhaps surprisingly, there have been few reports on sodium intake among hypertensive adults in the United States. One such report, which was based on data from the 1999–2000 National Health and Nutrition Examination Survey (NHANES), estimated that sodium intake was lower among US adults with self-reported high BP than among normotensive adults, but intake in both groups was above 2400 mg/d.<sup>13</sup> Reports have been rare as well on the prevalence of actions to reduce sodium intake among hypertensive adults.<sup>14–16</sup> A 2008 health panel survey found that 57% of hypertensive adults reported being told by a doctor or other health professional to cut down on salt or sodium and then following this advice,<sup>14</sup> but, to our knowledge, it is not known whether US hypertensive adults who receive advice and/or take actions to reduce intake of sodium actually have lower intakes. In 1999 to 2004, but not thereafter, the NHANES included questions on being advised to reduce sodium intake and taking action to do so. In addition, NHANES 1999–2004 included (and it continues to include) dietary data that allows for the assessment of daily sodium intake. Thus, our objectives were to determine the prevalence of receiving advice and taking action to reduce sodium intake among adults with self-reported hypertension (called simply “hypertension” for the remainder of this report) and the associations between taking action and actual consumption of sodium.

## Methods

NHANES, conducted by the National Center for Health Statistics since 1960, is a nationally representative, complex, multistage survey of the noninstitutionalized civilian population of the United States. Detailed information on NHANES is available on the Web site of the Centers for Disease Control and Prevention (CDC) (<http://www.cdc.gov/nchs/nhanes.htm>).<sup>17,18</sup> Since 1999, NHANES has been conducted on a continuous basis and released in biennial cycles. For this study, we combined 6 years (1999–2004) of data from three cycles.

We considered participants to have hypertension if they had made an affirmative response to the question “Have you ever been told by a doctor or other health professional that you had hypertension, also called high blood pressure?” Hypertensive participants were classified as taking an antihypertensive if they answered “yes” to the question “Are you now taking prescribed medications?” Participants with hypertension were classified as having received advice to reduce their sodium intake if they answered “yes” to the question “Because of your (high blood pressure/hypertension), have you ever been told to cut down on salt or sodium in your diet?” Only those who reported that they received advice were asked whether they took action to reduce their sodium intake. Participants were classified as taking action to reduce their sodium intake if they answered “yes” to the question “Are you now cutting down on salt or sodium in your diet?” These questions were dropped after NHANES 2003–2004.

A 24-hour dietary recall was administered to NHANES participants during the Mobile Examination Center (MEC) examination. Detailed information about the MEC examination and dietary recall protocols can be found at the CDC Web site (<http://www.cdc.gov/nchs/>

[nhanes.htm](#)).<sup>17,18</sup> Total intake of dietary sodium (mg/d) and calories were estimated for each individual based on her/his reported consumption of foods and beverages in the day before the survey (24-hour dietary recall) using the Food and Nutrient Databases for Dietary Studies for the sodium content of foods.<sup>19</sup>

Sociodemographic characteristics used in this investigation included sex, age (18–44 years, 45–64 years, and 65 years and older), race/ethnicity (non-Hispanic white, non-Hispanic black, Mexican American, and other), attained educational level (less than high school, high school graduate [including GED], and more than high school), and poverty: income ratio (ratio of family income to the poverty threshold for a family of that size) with three groups (<1.0 [below poverty], 1–3.74, and ≥3.75). Among the other covariates were participation in any leisure-time activity, current smoking status, and diagnosed diabetes, all based on self-reports. Participants were defined as heavy alcohol drinkers if they reported an average of ≥1 drinks per day (women) or ≥2 drinks per day (men). Body mass index (BMI) was calculated from measured weight and height ( $[\text{weight in kg}]/[\text{height in m}^2]$ ). We used three categories for BMI:<sup>20,21</sup> underweight and normal weight (<25.0), overweight (BMI 25.0–29.9), and obese (≥30). Chronic kidney disease was defined as either (1) a glomerular filtration rate <60 mL/min/1.73 m<sup>2</sup> of body surface area estimated with the Modification of Diet in Renal Disease Study equation using serum creatinine and other variables, or (2) a urinary albumin:creatinine ratio >30 mg/g.<sup>22</sup> Control of hypertension (“hypertension control”) was considered to be an average systolic BP <140 mm Hg and an average diastolic BP <90 mm Hg (average of up to three BP measurements obtained during the physical examination).

There were 15,871 adults 18 years and older examined in NHANES 1999–2004, an examination response rate of 77%. We excluded from the analysis those with a self-reported history of heart disease (n=1652), pregnant women (n=862), and women missing pregnancy status (n=339), yielding 13,018 adult participants. In that group, 3306 had hypertension. Among these 3306 persons, 151 were excluded for missing or incomplete 24-hour dietary recall data. We also excluded participants missing BP measurements or information on use of antihypertensives (n=154), height or weight measurements (n=111), or information on education (n=6), physical activity (n=2), or current smoking (n=3). With some participants excluded based on more than one criterion, the final analytic sample was 2970 adults with hypertension.

## Statistical Analyses

We estimated the prevalence with associated 95% confidence intervals (CIs) of receiving advice to reduce sodium intake and taking action to do so. Satterthwaite adjusted chi-square tests were used to estimate significant differences in the prevalence of receiving advice or taking action by selected characteristics and were adjusted for sex, age, race/ethnicity, and education. We estimated mean dietary sodium intake; multiple linear regression analyses were used to determine significant differences in mean sodium intake and were adjusted for age, sex, and race/ethnicity. We used SUDAAN with a 6-year combined sampling weight (from the 2-year medical examination center sample weights) (Research Triangle Institute, Research Triangle, NC) to account for the complex sample design.

## RESULTS

### Prevalence of Receiving Advice and of Taking Action to Reduce Sodium Intake

Of the 2970 hypertensive adults included in this analysis, based on self-reports, 60.5% received advice to reduce sodium intake (Table I). Of that group, an estimated 83.7% took action to reduce sodium intake. After adjustment for sex, age, race/ethnicity, and education, the prevalence of receiving advice to reduce sodium intake differed significantly by age, race/ethnicity, education, diagnosed diabetes, BMI, use of antihypertensives, and hypertension-control status. Only 44.5% of patients not taking an antihypertensive agent were advised to reduce sodium intake. Overall, among those advised to reduce their sodium intake, taking action was most common among adults who were 65 years and older (90.7%), non-Hispanic blacks (90.6%), and those with diagnosed diabetes (90.4%) and least common among those not taking an antihypertensive agent whose BP was controlled (69.8%). However, the lowest rate for taking action (69.8%, as aforementioned) was not a significant finding. Even though the rate of taking action was 90.4% among hypertensive adults with diabetes, this percentage was not significantly higher than the rate (82.5%) among hypertensive adults who were not diagnosed with diabetes.

### Intake of Sodium

In the study, the mean ( $\pm$ standard error) intake of sodium was  $3341\pm 37$  mg (Table II). Because mean intake differed by sex, age, and race/ethnicity, all statistical tests for differences in mean intake were adjusted for these variables as applicable. Women had a significantly lower sodium intake ( $2853\pm 49$  mg) than men ( $3916\pm 72$  mg) ( $P<.0001$ ). Compared with those who were aged 18 to 44 years (mean intake of  $3893\pm 86$  mg), mean sodium intake (in mg) was significantly lower among those who were 45 to 64 years ( $3334\pm 57$ ) or 65 years or older ( $2780\pm 48$ ) ( $P<.0001$  for all comparisons). Compared with non-Hispanic whites ( $3462\pm 45$ ), all other racial/ethnic groups had a significantly lower mean intake. In addition, compared with those with less than a high school education ( $2889\pm 62$ ), mean sodium intake was significantly greater for those with more than a high school education ( $3495\pm 57$ ;  $P=.0001$ ). Sodium intake did not significantly differ by CVD risk factors except for BMI, where mean intake was significantly higher ( $P=.0101$ ) for obese adults ( $3543\pm 69$ ) than for those of normal weight ( $3181\pm 104$ ). Sodium intake did not significantly differ by hypertension-control characteristics or the receipt of advice or taking action to reduce intake.

### Sodium Intake by Response to Advice (Taking Action, No Action)

On average, sodium intake was 259 mg lower among hypertensive adults who took action to reduce their sodium intake ( $3304\pm 49$ ) than among those who did not take action ( $3563\pm 145$ ), but the difference was not significant ( $P=.5497$ ) (Table III). In addition, among patients advised to reduce sodium intake, mean intake varied significantly within a specific characteristic in only one instance: the intake of those 65 years and older who took action was significantly lower ( $2715\pm 63$ ) than that of their counterparts who did not take action ( $3401\pm 206$ ;  $P=.0124$ ). Although they were not significant findings, differences of  $>500$  mg in intake (takers of action having lower values) were observed among non-Hispanic blacks (811 mg less), those with less than a high school education (500 mg less), those with a

poverty:income ratio <1.0 (524 mg), current smokers (616 mg), heavy drinkers (1046 mg), persons with diabetes (967 mg), those with chronic kidney disease (681 mg), normal-weight adults (1265 mg), persons whose hypertension was not controlled (508 mg), and those taking antihypertensive medication whose BP was not controlled (847 mg).

## DISCUSSION

Our study indicates that in 1999 to 2004, the majority of US hypertensive adults (an estimated 61%) not living in institutions received advice to reduce their sodium intake and that, of those receiving advice, the majority (an estimated 84%) took action. The results suggest that hypertensive adults who are older or are non-Hispanic blacks (both are at relatively greater risk of CVD) are more likely to be advised and to take action to reduce sodium intake than are younger adults (ages 18–44 years) and non-Hispanic whites, respectively. For US adults with hypertension (as determined by self-reports) both overall and in almost all subgroups (adults 65 years and older being the exception), taking action was not associated with significantly lower mean sodium intake. Other lifestyle actions to control BP such as increased physical activity may have been taken but was not part of this analysis. In addition, the mean sodium intake in 1999 to 2004 of 3341 mg did not meet guidelines for the time period and was 2.2 times as high as the 1500 mg specified by the current Dietary Guidelines for Americans for people with hypertension.<sup>1–12,19</sup>

Although our findings are not directly comparable because of differences in the populations surveyed and the wording and order of questions, our estimate of the proportion of US adults with hypertension who received advice to cut down on salt intake was in the range of estimates from two previous surveys from HealthStyles mailed survey and telephone survey Behavioral Risk Factor Surveillance System (48%-86%).<sup>14,15</sup> Our results also confirm previous reports that hypertensive adults who were non-Hispanic black or were in older age groups were more likely to receive advice about reducing sodium intake and to do so. Our finding that hypertensive adults who took antihypertensives were more likely to receive advice and take action to reduce their sodium intake than those who did not take these drugs may be a reflection of the first group's having more severe hypertension, being more motivated, or some other cause. It also suggests that there is a large opportunity in the United States to counsel hypertensive adults who are not taking antihypertensive drugs about reducing their sodium intake to help control their BP. Among people who were not taking antihypertensives, we estimate that <50% were receiving advice to reduce their sodium intake.

We found that mean sodium intake of US adults with hypertension did not differ between those receiving advice or taking action to reduce their sodium intake and those not receiving advice or taking action. This is an important negative finding that should alert clinicians to aggressively follow-up the amount of sodium consumption in their hypertensive patient's diet. In addition, consistent with the mean intake for all US adults during the same period,<sup>9–12,19</sup> we found that mean sodium intakes for all subgroups were more than 2 times above recommended amounts even for those who took action, demonstrating at least two things: (1) Americans in general consume far too much sodium, as on average their intakes are a long way above recommendations, and (2) even those who try to reduce their intake usually

have difficulty in doing so. One is struck by how far above the recommendation hypertensive adults are. Thus, many hypertensive patients who take in huge amounts of salt as their starting point may find it too far from their goal that they have to gradually adapt their diet to achieve slow reductions. To our knowledge, this is the first epidemiologic report of actual sodium intake related to receiving advice and subsequent actions to reduce dietary sodium among US hypertensive adults. Although NHANES did not continue to obtain information on advice and actions to reduce sodium intake after 2004, we know that mean intake has not changed.<sup>10–12</sup>

## STUDY STRENGTHS AND LIMITATION

The strengths of our study include the use of a large, nationally representative sample of US adults; the oversampling of population subgroups by age, race/ethnicity, and socioeconomic strata; and adjustment for potential confounders. Potential limitations include our inability to examine temporal associations because of the cross-sectional design of the survey, and the use of a single 24-hour dietary recall, which does not account for within-individual day-to-day variability in intake. It is reasonable, however, to use such data for estimating population means when there is an adequate distribution of days of the week and seasons as in NHANES.<sup>23–25</sup> On the other hand, 24-hour dietary recall underestimates caloric intake by approximately 11%,<sup>26</sup> and thus it likely also underestimates sodium intake.

Another concern is that our analyses were based on self-reported data for hypertension, receiving advice, and taking action to reduce sodium intake. These responses undoubtedly contain some degree of error, given the tendency to give socially desirable answers and inevitable shortcomings in recall. In addition, because of the skip pattern of the questions, we were unable to examine actions among adults who were not advised to reduce sodium intake. Finally, lack of statistical power since the sample of adults with hypertension who reported being advised to reduce sodium intake but not taking action was small, increased the error around the estimates of mean sodium intake and decreased our ability to detect significant differences, particularly within population subgroups.

Our report provides additional evidence that achieving lower sodium intake is not a simple task, even for adults with hypertension who are advised to reduce their sodium intake and then take action to do so. A key problem is that more than 75% of sodium intake in the United States has been estimated to come from processed and restaurant foods,<sup>27,28</sup> and it has been estimated that 37% of meals are consumed away from home.<sup>28</sup> Given these situations, it is not surprising that cutting down on sodium intake is a daunting proposition for many Americans. This does not mean that physicians should not counsel their patients to reduce their sodium intake; they should certainly do so, but they should also recognize the difficulty in achieving substantial reductions given the current state of the food supply. As indicated in the recent recommendations from the Institute of Medicine,<sup>28</sup> along with the ubiquity of sodium in the food supply, preferences for salty foods may drive the consumption of sodium. Even among highly motivated individuals, substantial decreases in sodium intake may require sustained efforts at gradual reductions to adjust their taste preferences and achieve more control of their sodium intake by either preparing more foods at home or becoming more knowledgeable about the content of foods they eat away from

home. Physicians and other health care providers can help their patients by advocating for nutrition labeling and for reductions in the sodium content of packaged and restaurant foods.

## CONCLUSIONS

Our study indicates that the majority of US hypertensive adults during 1999 to 2004 received advice to reduce their sodium intake and took action to do so. Even so, actual average consumption was more than twice than the current recommended daily sodium intake of 1500 mg for the 1999 to 2004 periods across all demographic subgroups. Thus, health care providers need to actively counsel or refer to dietitian/specialist for in-depth counseling of patients as to how to reduce sodium intake.

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**TABLE I.**  
Prevalence of Receiving Advice and of Taking Action to Reduce Sodium Intake<sup>a</sup> Among Hypertensive<sup>b</sup> Adults by Select Characteristics: National Health and Nutrition Examination Survey 1999–2004, United States

Characteristic	Reduce Sodium Intake					
	Advice			Action		
	No.	%	95% CI <sup>c,d</sup>	No.	%	95% CI <sup>c,d</sup>
Total	2970	60.5	58.2–62.7	1876	83.7	80.5–86.4
Sex						
Male	1349	60.0	56.9–63.0	833	80.5	70.6–84.2
Female	1621	60.9	57.4–64.2	1043	86.4	83.0–89.2
Age, y						
18–44	656	54.6	50.0–59.2) ***	378	74.2	67.9–79.6***
45–64	1134	63.9	60.6–67.2	757	84.7	79.5–88.8
65+	1180	61.1	57.3–64.7	741	90.7	87.1–93.4
Race/ethnicity						
Non-Hispanic white	1469	56.9	54.2–59.6***	841	81.1	76.5–85.0**
Non-Hispanic black	732	72.2	67.5–76.5	531	90.6	86.3–93.7
Mexican American	570	63.2	59.2–67.0	369	83.9	77.4–88.7
Other	199	71.2	63.6–77.8	135	90.1	82.3–94.7
Education						
<High school	989	66.8	62.9–70.6*	673	84.8	79.9–88.7
High school graduate	706	63.0	59.5–66.4	458	85.2	78.9–89.9
>High school	1148	56.6	52.8–60.3	678	83.4	78.6–87.3
Poverty:income ratio <sup>e</sup>						
<1.0	483	64.4	57.2–71.1	321	81.0	73.5–86.8
1.0 to <3.75	1469	61.2	57.5–64.7	933	85.5	81.6–88.6
3.75	783	57.8	52.7–62.6	468	80.7	75.1–85.2
Physical activity						
Any	1650	60.4	57.7–63.0	1036	82.9	79.2–86.1
None	1320	60.6	56.3–64.8	840	84.9	80.9–88.2

Characteristic	Reduce Sodium Intake					
	Advice			Action		
	No.	%	95% CI <sup>c,d</sup>	No.	%	95% CI <sup>c,d</sup>
Smoking status						
Current	508	55.7	49.6–61.6	306	82.6	76.8–87.2
Nonsmoker	2462	61.6	59.3–63.8	1570	83.9	80.5–86.8
Heavy drinking <sup>e,f</sup>						
Yes	380	57.3	51.4–63.0	222	81.0	71.4–87.9
No	2520	61.1	58.5–63.7	1609	84.4	80.8–87.4
Diagnosed diabetes <sup>g</sup>						
Yes	495	73.9	67.9–79.1**	382	90.4	85.1–93.9
No	2475	58.5	56.1–61.0	1494	82.5	79.1–85.4
Chronic kidney disease <sup>h</sup>						
Yes	819	65.0	60.3–69.5	554	86.3	81.2–90.1
No	2019	58.6	55.9–61.2	1236	82.5	78.7–85.7
BMI <sup>i</sup>						
Normal weight (<25.0)	585	50.4	45.3–55.6***	300	82.1	74.1–88.0
Overweight (25.0–29.9)	1077	58.1	55.0–61.2	664	86.0	81.3–89.6
Obese (≥ 30.0)	1308	66.3	62.9–69.5	912	82.6	78.9–85.8
Taking antihypertensive medication <sup>j</sup>						
Yes	1989	69.6	67.0–72.1***	1418	88.5	85.6–90.9***
No	981	44.5	41.1–48.0	458	70.5	64.5–75.8
Hypertension control <sup>k</sup>						
Yes	1693	57.8	55.1–60.5*	1032	83.9	79.4–87.6
No	1277	64.7	61.6–67.8	844	83.4	79.4–86.7
Blood pressure control/treatment Taking medication						
Controlled	1082	68.7	65.6–71.6	764	89.2	85.2–92.3*
Uncontrolled	907	71.1	67.3–74.6	654	87.5	83.1–90.9
Not taking medication						
Controlled	611	40.8	36.3–45.5	268	69.8	61.5–76.9

Characteristic	Reduce Sodium Intake					
	Advice			Action		
	No.	%	95% CI <sup>c,d</sup>	No.	%	95% CI <sup>c,d</sup>
Uncontrolled	370	51.6	45.0-58.2	190	71.5	61.9-79.5

<sup>a</sup> Advice was determined by a 'yes' response to the question "Because of your (high blood pressure/hypertension), have you ever been told to cut down on salt or sodium in your diet?" Action was determined by a "yes" response to the question "Are you now cutting down on salt or sodium in your diet?" asked only among those who answered "yes" to receiving advice to lower salt or sodium in their diet.

<sup>b</sup> Hypertension is based on self-report of hypertension by health care provider.

<sup>c</sup> 95% confidence interval (CI).

<sup>d</sup> Satterthwaite adjusted  $\chi^2$  tests were used to estimate significant differences in the prevalence of advice or action by selected characteristics and were adjusted for sex, age, race/ethnicity, and education, yielding *P* values designated by \* $<.01$ , \*\* $<.001$ , and \*\*\* $<.0001$ .

<sup>e</sup> Missing data in this category included.

<sup>f</sup> Heavy drinking defined as 2 alcoholic beverages per day for men, 1 alcoholic beverages per day for women.

<sup>g</sup> Diabetes is based on self-report of this disease.

<sup>h</sup> Chronic kidney disease is based on estimated glomerular filtration rate  $<60$  mL/min/1.73m<sup>2</sup> of body surface area or albumin/creatinine ratio  $>30$  mg/g.

<sup>i</sup> Body mass index (BMI) is calculated from a person's weight and height,  $BMI = [k/(m^2)]$ .

<sup>j</sup> Taking antihypertensive medication is based on "yes" response to the question "Because of your high blood pressure/hypertension, have you ever been told to take prescribed medicine?" and a "yes" response to "Are you now taking prescribed medicine?"

<sup>k</sup> Hypertension control is based on an average systolic or diastolic blood pressure  $<140/90$  mm Hg from physical examination data among hypertensive adults taking antihypertensive medications.

TABLE II.

Sodium Intake From Foods and Beverages Among Hypertensive<sup>a</sup> Adults: National Health and Nutrition Examination Survey 1999–2004, United States

Characteristic	Sodium Intake, mg/d	
	Mean <sup>b</sup> (Standard Error)	P Value <sup>c</sup>
Total	3341 (37)	
Sex		
Male	3916 (72)	Referent
Female	2853 (49)	<.0001
Age, y		
18–44	3893 (86)	Referent
45–64	3334 (57)	<.0001
65+	2780 (48)	<.0001
Race/ethnicity		
Non-Hispanic white	3462 (45)	Referent
Non-Hispanic black	2989 (77)	<.0001
Mexican American	3094 (113)	<.0001
Other	2986 (150)	.0001
Education		
<High school	2889 (62)	.0001
High school graduate	3332 (92)	.6294
>High school	3495 (57)	Referent
Poverty:income ratio <sup>d</sup>		
<1.0	3227 (125)	.9366
1.0–<3.75	3249 (51)	.6530
3.75	3542 (83)	Referent
Physical activity		
Any	3454 (59)	Referent
None	3164 (55)	.5196
Smoking status		
Current	3388 (83)	.0718
Nonsmoker	3330 (42)	Referent
Heavy drinking <sup>d,e</sup>		
Yes	3482 (113)	.7144
No	3321 (41)	Referent
Diagnosed diabetes <sup>f</sup>		
Yes	3240 (108)	.3776
No	3355 (41)	Referent
Chronic kidney disease <sup>g</sup>		
Yes	3034 (71)	.4141

Characteristic	Sodium Intake, mg/d	
	Mean <sup>b</sup> (Standard Error)	P Value <sup>c</sup>
No	3457 (47)	Referent
BMI <sup>h</sup>		
Normal weight (<25.0)	3181 (104)	Referent
Overweight (25.0–29.9)	3157 (60)	.1902
Obese (≥30.0)	3543 (69)	.0399
Taking antihypertensive medication <sup>i</sup>		
Yes	3252 (51)	.0904
No	3496 (70)	Referent
Hypertension control <sup>j</sup>		
Yes	3399 (56)	Referent
No	3249 (64)	.3308
Blood pressure control/treatment Taking medication		
Controlled	3289 (77)	Referent
Uncontrolled	3199 (78)	.2172
Not taking medication		
Controlled	3571 (79)	Referent
Uncontrolled	3352 (142)	.9325
Advice to reduce sodium intake <sup>k</sup>		
Yes	3346 (47)	.1016
No	3333 (67)	Referent
Took action to reduce sodium intake <sup>l</sup>		
Yes	3304 (49)	.5497
No	3379 (53)	Referent

<sup>a</sup>Hypertension is based on self-report of hypertension by health care provider.

<sup>b</sup>Arithmetic mean for sodium intake.

<sup>c</sup>P value based on multiple linear regression to test for difference in mean sodium intake adjusted for sex, age, race/ethnicity (when applicable).

<sup>d</sup>Missing data in this category included.

<sup>e</sup>Heavy drinking defined as ≥2 alcoholic beverages per day for men, ≥1 alcoholic beverages per day for women.

<sup>f</sup>Diabetes is based on self-report of this disease.

<sup>g</sup>Chronic kidney disease is based on estimated glomerular filtration rate <60 mL/min/1.73m<sup>2</sup> of body surface area or albumin/creatinine ratio >30 mg/g.

<sup>h</sup>Body mass index (BMI) is calculated from a person's weight and height, BMI=[(kg)/(m<sup>2</sup>)].

<sup>i</sup>Taking antihypertensive medication is based on a "yes" response to the question "Because of your high blood pressure/hypertension, have you ever been told to take prescribed medicine?" and a "yes" response to "Are you now taking prescribed medicine?"

<sup>j</sup>Hypertension control is based on an average systolic or diastolic blood pressure <140/90 mm Hg from physical examination data among hypertensive adults taking antihypertensive medications.

<sup>k</sup> Advice determined by a 'yes' response to the question "Because of your (high blood pressure/hypertension), have you ever been told to cut down on salt or sodium in your diet?"

<sup>l</sup> Action determined by a "yes" response to the question, "Are you now cutting down on salt or sodium in your diet?" asked only among those who answered "yes" to receiving advice to lower salt or sodium in their diet.

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TABLE III.

Sodium Intake From Foods and Beverages by Action Status<sup>d</sup> for the Reduction of Sodium Intake, Among Hypertensive Adults:<sup>b</sup> National Health and Nutrition Examination Survey 1999–2004, United States

	Action (-)		Action (+)		P Value <sup>d</sup>
	No.	Mean <sup>c</sup> (Standard Error)	No.	Mean <sup>c</sup> (Standard Error)	
Total	242	3563 (145)	1634	3304 (49)	.5497
Sex					
Male	119	4010 (210)	714	3948 (90)	.2191
Female	123	3026 (152)	920	2801 (73)	.5626
Age, y					
18–44	88	3886 (236)	290	3917 (136)	.3280
45–64	89	3315 (246)	688	3386 (81)	.4626
65+	65	3401 (206)	676	2715 (63)	.0124
Race/ethnicity					
Non-Hispanic white	135	3654 (163)	706	3478 (64)	.4108
Non-Hispanic black	46	3670 (466)	485	2859 (81)	.1396
Mexican American	49	3140 (395)	320	3094 (155)	.9416
Other	12	2533 (668)	123	3039 (192)	.2544
Education					
<High school	85	3303 (237)	588	2803 (76)	.3109
High school graduate	55	3374 (372)	403	3340 (130)	.5513
>High school	79	3784 (215)	599	3500 (92)	.5798
Poverty: income ratio <sup>e</sup>					
<1.0	51	3660 (319)	270	3136 (174)	.8072
1.0– 3.75	111	3653 (253)	822	3184 (73)	.5440
3.75	68	3433 (220)	400	3589 (101)	.0455
Physical activity status					
Any	137	3580 (146)	899	3416 (80)	.1175
None	105	3533 (263)	735	3132 (88)	.5881
Smoking status					

	Action (-)			Action (+)			P Value <sup>d</sup>
	No.	Mean <sup>c</sup> (Standard Error)	No.	Mean <sup>c</sup> (Standard Error)	No.	Mean <sup>c</sup> (Standard Error)	
Current	49	3934 (369)	257	3318 (95)			.3375
Nonsmoker	193	3479 (161)	1377	3301 (57)			.1765
Heavy drinking <sup>e,f</sup>							
Yes	35	4521 (523)	187	3475 (168)			.2936
No	200	3361 (125)	1409	3284 (60)			.1058
Diagnosed diabetes <sup>g</sup>							
Yes	34	4036 (430)	348	3069 (121)			.2112
No	208	3516 (152)	1286	3350 (57)			.3580
Chronic kidney disease <sup>e,h</sup>							
Yes	68	3723 (305)	486	3042 (89)			.1210
No	167	3511 (166)	1069	3423 (66)			.2126
BMI <sup>i</sup>							
Normal weight (<25.0)	42	4254 (393)	258	2989 (150)			.0626
Overweight (25.0–29.9)	73	3232 (274)	591	3208 (83)			.7711
Obese (≥30.0)	127	3467 (153)	785	3465 (95)			.0688
Taking antihypertensive medication <sup>j</sup>							
Yes	133	3696 (206)	1285	3244 (63)			.6724
No	109	3422 (205)	349	3510 (130)			.4411
Hypertension control <sup>k</sup>							
Yes	140	3451 (173)	892	3369 (83)			.5246
No	102	3718 (196)	742	3210 (93)			.6984
Hypertension treatment/control Taking medication							
Controlled	70	3462 (241)	594	3323 (96)			.7719
Uncontrolled	63	3978 (295)	591	3131 (118)			.5175
Not taking medication							
Controlled	70	3440 (288)	198	3526 (155)			.9307
Uncontrolled	39	3394 (276)	151	3488 (260)			.2100



- <sup>a</sup>Action (+) determined by a “yes” response to the question “Are you now cutting down on salt or sodium in your diet?” asked only among those who answered “yes” to receiving advice to lower salt or sodium in their diet. Action (–) means a response of “no” to the question about cutting down on salt or sodium.
- <sup>b</sup>Hypertension is based on self-report of hypertension by health care provider.
- <sup>c</sup>Arithmetic mean of total sodium intake based on a 24-hour food recall diary.
- <sup>d</sup>*P*-value based on multiple linear regression to test for difference in mean sodium intake between “action” and “no action” groups, adjusted for sex, age, and race/ethnicity (when applicable). All relative standard errors were <0.40 even when a cell size for one group of that category was <50.
- <sup>e</sup>Missing data in this category.
- <sup>f</sup>Heavy drinking defined as 2 alcoholic beverages per day for men, 1 alcoholic beverages per day for women.
- <sup>g</sup>Diabetes is based on self-report of that disease by a health care professional at any time.
- <sup>h</sup>Chronic kidney disease is based on estimated glomerular filtration rate <60mL/min/1.73m<sup>2</sup> of body surface area or albumin/creatinine ratio >30 mg/g.
- <sup>i</sup>Body mass index (BMI) is calculated from a person’s weight and height,  $BMI = [(kg)/(m^2)]$ .
- <sup>j</sup>Taking antihypertensive medications as prescribed by physician is based on self-reported data among hypertensive adults.
- <sup>k</sup>Hypertension control is based on a mean systolic or diastolic blood pressure <140/90 mm Hg from physical examination data among hypertensive adults taking antihypertensive medications.