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Trends and determinants of discretionary salt use: National Health and Nutrition Examination Survey 2003–2012

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Abstract

Objective: To examine temporal trends and determinants of discretionary salt use in the USA.

Design: Multiple logistic regression was used to assess temporal trends in discretionary salt use at the table and during home cooking/preparation, adjusting for demographic characteristics, using data from the National Health and Nutrition Examination Survey 2003–2012. Prevalence and determinants of discretionary salt use in 2009–2012 were also examined.

Setting: Participants answered salt use questions after completing a 24 h dietary recall in a mobile examination centre.

Subjects: Nationally representative sample of non-institutionalized US children and adults, aged ≥2 years.

Results: From 2003 to 2012, the proportion of the population who reported using salt 'very often' declined; from 18 % to 12 % for use at the table ($P < 0{\cdot}01$) and from 42 % to 37 % during home cooking ($P < 0{\cdot}02$). While one-third of the population reported never adding salt at the table, most used it during home cooking/preparation (93 %). Use of discretionary salt was least commonly reported among young children and older adults and demographic and health subgroups at risk of CVD.

Conclusions: While most people reported using salt during home cooking/preparation, a minority reported use at the table. Reported 'very often' discretionary salt use has declined. That discretionary salt use is less common among those at risk of CVD suggests awareness of messages to limit Na intake.

Keywords
Salt
Sodium
Diet
Trends
National

CVD is a leading modifiable cause of death in the USA, accounting for approximately one-third of all deaths annually[1]. High dietary Na intake is associated with hypertension which is a leading risk factor for CVD such as heart disease and stroke[2]. In the USA and other developed countries such as the UK, the majority (approximately 75 %) of population dietary Na intake is estimated to come from commercially processed foods and foods prepared in restaurants, rather than discretionary salt (salt added at the table or during cooking)[3–5]. In 2011–2012, average daily Na intake among persons aged ≥2 years was estimated to be 3478 mg[6] and over 90 % of US adolescents and adults consume Na in excess of current recommendations, excluding salt added at the table[7]. Discretionary salt is estimated to comprise approximately 11 % of dietary Na intake, with 6 % coming from salt added at the table and 5 % from salt added during cooking[2,4,5]. With manufacturer reductions in Na added to foods, some argue that individuals will add salt more frequently at the table or during cooking, decreasing the effectiveness of some Na reduction strategies[8].

In the UK, salt use at the table decreased after initiation of the national salt campaign that aimed to reduce the Na content of processed foods and increase consumer awareness[9]. In the USA, several food companies have committed to reducing the Na content of their products[10,11]; however, limited evidence shows that, to date, changes have been inconsistent[10,12–14]. Research suggests that consumers do not notice small reductions in the Na content of foods and can hedonically acclimatize to lower salt intensity over time[4,15]. As a shift towards lower Na in processed foods occurs in the USA, it is important to

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monitor the use of discretionary salt, to assess if consumers compensate for the Na reduction. The primary objective of the present analysis was to evaluate recent temporal trends in the prevalence of reported discretionary salt use in the USA. Lower socio-economic status and minority race/ethnicity are associated with increased risk of CVD[1] and with the likelihood of cooking at home, although the direction varies between different groups[16,17]. All of this may impact discretionary salt use. Therefore, a secondary objective was to examine demographic and health status determinants of discretionary salt use.

Methods

Data source

The National Health and Nutrition Examination Survey (NHANES) is an ongoing, nationally representative, multistage probability sample of the US non-institutionalized population. Selected participants consent to a household interview followed by a medical examination and an in-person, 24 h dietary recall in the mobile examination centre among other survey components. At the end of the dietary recall, participants are asked questions about discretionary salt use. A proxy respondent such as a mother, father or other person who knows the child's intake reports for children less than 6 years of age. Interviews of children aged 6–8 years are conducted with a proxy and with the child present to assist, and interviews of children aged 9–11 years are conducted with the child and the assistance of a proxy. The questions are:

1. 'What type of salt do you usually add to food at the table? Would you say ordinary salt (includes regular iodized salt, sea salt, and seasoning salts made with regular salt), lite salt, salt substitute, don't use or add salt at the table, other, don't know?'
2. 'How often do you add ordinary salt to food at the table? Would you say rarely, occasionally, very often, refused, don't know?'
3. 'How often is ordinary salt or seasoned salt added in cooking or preparing foods in your household? Is it never, rarely, occasionally, very often, or you don't know?'

Study population

Survey participants aged ≥2 years who had a complete and reliable in-person, 24 h dietary recall from NHANES 2003–2012 were included in the study (n 42 326). Participants were excluded from the analysis if they were missing information on discretionary salt use questions (n 1144) or reported using lite salt or salt substitutes (n 1770); 4 % of participants reported using lite salt or salt substitutes (3·2 % of children aged 2–18 years and 4·3 % of adults aged ≥19 years). Participants were further excluded if they were missing covariates, including BMI, self-reported hypertension and self-reported diabetes (n 516). Overall, exclusions resulted in a final sample size of 38 896, representing a 60 % overall response rate. Our study sample had a slightly lower prevalence of self-reported hypertension, self-reported diabetes, and had fewer overweight and obese participants compared with those who were excluded from the analysis (n 3430).

Demographic and health characteristics

Information on sex, age, race/ethnicity, family income and household size (used to calculate poverty income ratio; PIR), self-reported hypertension and self-reported diabetes were obtained by a trained interviewer during the in-person household interview. Race/ethnicity groups used in the analysis were non-Hispanic white, non-Hispanic black, Mexican-American and other, which included Asian, other Hispanic and multiracial individuals. PIR is calculated by dividing family (or individual) income by the Department of Health and Human Services' poverty guidelines specific to the survey year. The PIR categories used for the analysis were ≤1·3, 1·3–1·85 and >1·85, which correspond to guidelines used for eligibility into federal programmes such as free and reduced-price lunch and are used as a proxy for socio-economic status.

Self-reported hypertension was reported if the participant answered 'yes' to the question 'Have you ever been told by a doctor or other health professional that you had hypertension, also called high blood pressure?' and 'yes' to the question 'Were you told on two or more different visits that you had hypertension, also called high blood pressure?' Self-reported diabetes was determined by an answer of 'yes' to the question 'Other than during pregnancy, have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?' Self-report was used for these measures to account for any potential change in diet based on knowledge of diagnoses; actual measures would not indicate whether participants were aware of having hypertension or diabetes.

Body measurements of weight (in kilograms) and height (in metres) were used to obtain BMI (weight/height^2) and were completed in the mobile examination centre by trained health technicians. For adults aged ≥20 years, BMI < 25·0 kg/m^2 was classified as under- or normal weight, 25·0 kg/m^2 ≤ BMI < 30·0 kg/m^2 as overweight, and BMI ≥ 30·0 kg/m^2 as obese. Among children and adolescents aged 2–19 years, weight status was classified based on sex- and age-specific percentiles of BMI from the Centers for Disease Control and Prevention growth charts. Under- or normal weight is BMI < 85th percentile, overweight is 85th percentile ≤ BMI < 95th percentile, and obese is BMI ≥ 95th percentile[18].

Statistical analysis

Prevalence of 'never', 'rarely', 'occasionally' and 'very often' using discretionary salt from 2003 to 2012 was

determined for the total population, children/adolescents aged 2–18 years and adults aged ≥19 years, and each age group was further stratified by sex. Multiple logistic regression models were used to assess temporal trends from 2003 to 2012 in the reported frequency of ordinary salt added at the table and salt added during home cooking/preparation, adjusting for age, sex and race/ethnicity. For the total sample and each subgroup analysed, two models were used to assess the outcome 'never' *v.* all others and 'very often' *v.* all others, with NHANES cycle as the main predictor in each model. The χ^2 test was used to assess current (2009–2012) differences in discretionary salt use of ordinary or seasoned salt by demographic/health characteristics. All analyses were adjusted for the complex sampling design using SAS-callable SUDAAN and sample weights for the day one 24 h dietary recall.

Results

Demographic and health characteristics of the sample are listed in the online supplementary material, Supplemental Table 1, by cycle and for the total sample. Only race/ethnicity appeared to change significantly over time, with a greater percentage of the population falling in the 'other' race/ethnicity group and a smaller proportion of non-Hispanic whites.

Overall, the reported frequency of never using salt at the table did not change significantly among the US population from 2003 to 2012 (online supplementary material, Supplemental Table 2). However, the proportion of the US population aged ≥2 years who reported using salt at the table 'very often' declined by about one-third from 18 % in 2003–2004 to 12 % in 2011–2012 ($P<0·01$ for trend; Fig. 1). When examined by subgroup, this decline was statistically significant among adults overall (21 % in 2003 to 14 % in 2012, $P<0·0002$ for trend) and among men (25 % to 14 %, $P<0·0001$ for trend; Supplemental Table 2). Among women and children, temporal declines in using table salt 'very often' were more variable and not statistically significant (Supplemental Table 2).

The reported frequency of never using salt during home cooking or preparation did not change significantly from 2003 to 2012 (online supplementary material, Supplemental Table 3). The proportion of the US population aged ≥2 years who reported 'very often' adding salt during cooking or preparation declined by 5 percentage points from 42 % in 2003–2004 to 37 % in 2011–2012 ($P=0·02$ for trend). Similarly, 'very often' adding salt during home cooking or preparation declined by 4–6 percentage points among adults overall (42 % to 37 %, $P=0·02$ for trend), men (39 % to 33 %, $P=0·04$ for trend) and female children (39 % to 35 %, $P=0·04$ for trend; Fig. 2).

In 2009–2012, 33 % of persons aged ≥2 years reported 'never' using salt at the table, while 13 % used it 'very often' (Table 1). Overall, frequency of salt use at the table differed significantly by age, race/ethnicity, BMI, self-reported diabetes status and income, but not sex. Among children aged 2–18 years, frequency of never using salt at the table was highest among children aged 2–3 years (78 %) and lowest among children aged 14–18 years (17 %), with 12 % of children aged 14–18 years reporting they 'very often' used salt at the table. Among adults aged ≥19 years, the frequency of never using salt at the table was highest among those aged ≥71 years (43 %) and lowest among those aged 19–30 years (23 %). By race/ethnicity, frequency of never using salt at the table was highest among non-Hispanic blacks. The pattern of frequency of using salt at the table by BMI varied among children and adults. Among children, those with obesity were most likely to use salt at the table: 10 % of obese children reported using salt at the table 'very often' compared with approximately 6 % of children who were not obese. Among adults, those who were obese were least likely to use salt at the table. Adults with diabetes or hypertension were less likely to use salt at the table. Among adults, those with low income (PIR ≤ 1·3) used salt at the table more frequently than those with higher income (Table 1).

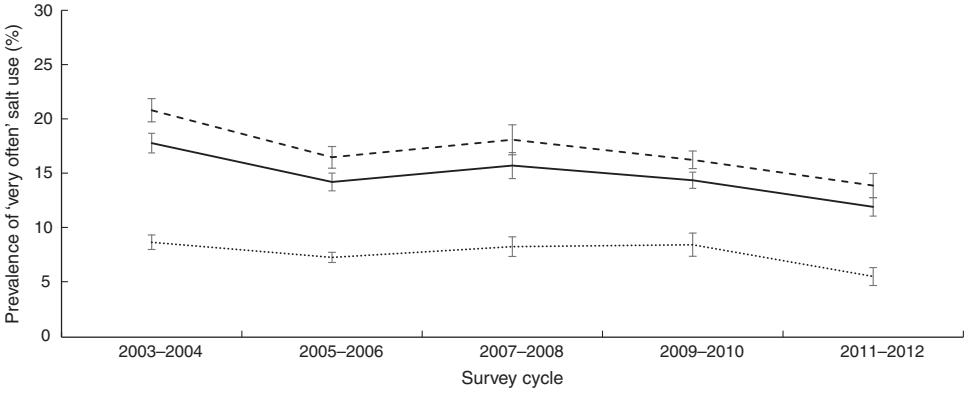

Fig. 1 Trends in prevalence of using salt 'very often' at the table, with standard error represented by vertical bars, among the US population aged ≥2 years (———), children/adolescents aged 2–18 years (· · · · · ·) and adults aged ≥19 years (– – – – –); National Health and Nutrition Examination Survey 2003–2012

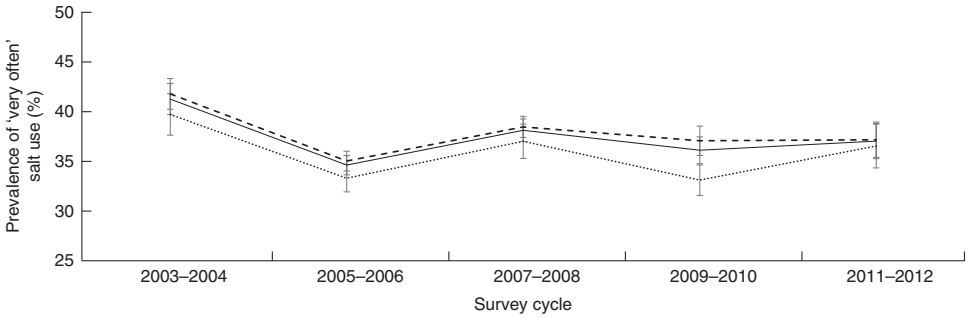

Fig. 2 Trends in prevalence of using salt 'very often' during home cooking or preparation, with standard error represented by vertical bars, among the US population aged ≥2 years (———), children/adolescents aged 2–18 years (· · · · ·) and adults aged ≥19 years (– – – – –); National Health and Nutrition Examination Survey 2003–2012

The 2009–2012 prevalence of reported any salt use during home cooking or preparation was 93 % (7 % reported never adding salt during home cooking or preparation), with 37 % reporting using it 'very often' (Table 2). Across the population aged ≥2 years, frequency of salt use during cooking or preparation differed significantly by sex, race/ethnicity, BMI, self-reported diabetes and PIR. Among children, use differed by race/ethnicity, age and income, but not by sex or BMI. Older children (aged 14–18 years) were the least likely to report 'never' adding salt during cooking/preparation (2·5 %) compared with other age groups, where prevalence was approximately 5 %. Among adults, frequency of salt use during cooking differed significantly by sex, age, race/ethnicity, self-reported hypertension status, self-reported diabetes status and income, but not BMI. About 29 % of adults aged ≥71 years used salt during cooking 'very often', while 37–40 % of adults in other age groups reported using salt 'very often' during home cooking or preparation. Adults with self-reported hypertension were more likely than those without to report 'never' adding salt during cooking or preparation (11 % *v.* 7 %), as were self-reported diabetics compared with those without diabetes (15 % *v.* 7 %). Among children and adults, the prevalence of using salt 'very often' during home cooking/preparation was highest among Mexican-Americans and those of other race/ethnicities and lowest among non-Hispanic whites. Also across all ages, prevalence of using salt 'very often' during home cooking/preparation was highest among those with low incomes (PIR ≤ 1·3) and lowest among those with the highest incomes (PIR ≥ 1·85; Table 2).

Discussion

The proportion of the population who do not use discretionary salt has not changed between 2003 and 2012, but the proportion of the population who use it 'very often' has declined. While two-thirds of the US population reported never adding salt at the table, most used it during home cooking/preparation. There were significant differences in the frequency of discretionary salt use at the table and during cooking by demographic and lifestyle covariates, and self-reported hypertension and diabetes status, which are consistent with previous findings regarding overall Na intake and population characteristics.

Although difficult to compare results due to differences in study methods, questions and time periods, data from the UK suggest a decreased frequency of discretionary salt use in 2003–2007, during which time the UK's national salt reduction campaign was implemented. The UK's campaign included consumer education along with the reductions in processed foods. The focus on salt in processed foods may have influenced discretionary salt use; a finding that may be important for future work on this issue in the USA[9,19]. In the USA, the National Salt Reduction Initiative, started by the New York City Department of Health and Mental Hygiene, developed voluntary salt reduction targets for packaged and restaurant foods. Several companies have committed to reducing the Na content in their foods. Recent analyses of the Na content of packaged and restaurants foods documented some small declines[10,20]; however, reductions can be inconsistent across manufacturers[10,12].

Many reductions in Na go undetected. Even with larger decreases of Na in prepared foods, individuals may not completely offset declines in Na intake through discretionary salt use as these sources do not increase markedly even when Na content is decreased in prepared foods[21,22]. In one study of eleven adults placed on a low-salt diet for 13 weeks, participants added back at the table less than 20 % of Na taken out of their food[21] and results in a subsequent study with sixteen participants were similar[22]. A more recent study found that reducing the Na content of bread by up to 50 % did not lead to compensation by increased Na intake from other foods[23]. Additionally, a 2013 analysis of cross-sectional surveys from 1965 to 2008 noted that while cooking at home has decreased over time, this decrease plateaued in the 1990s and has since changed little[24].

Along with these industry and household changes, the current findings show that the proportion of the US

Table 1 Prevalence of frequency of salt use at the table among the US population aged ≥2 years by demographic characteristics and health factors; National Health and Nutrition Examination Survey 2009–2012

		Ordinary salt use								
		Never		Rarely		Occasionally		Very often		χ^2
Frequency of table salt use	*n**	%	SE	%	SE	%	SE	%	SE	*P* value
Total	15 740	32·8	0·8	31·6	0·6	22·3	0·7	13·2	0·6	
Children/adolescents aged 2–18 years	5726	41·1	1·4	33·1	1·2	18·8	0·9	7·1	0·7	
Sex										0·7239
Male	2931	41·4	1·8	33·8	1·7	18·3	1·1	6·5	0·8	
Female	2795	40·8	1·6	32·3	1·7	19·2	1·5	7·7	0·9	
Age (years)										<0·0001
2–3	885	77·8	2·6	16·3	2·0	5·2	1·3	0·7	0·2	
4–8	1873	57·8	2·3	28·7	1·8	10·3	1·2	3·2	0·6	
9–13	1607	31·4	2·0	34·5	2·5	25·3	2·2	8·9	1·7	
14–18	1361	17·3	1·5	43·5	1·6	27·1	1·6	12·1	1·2	
Race/ethnicity										0·0002
Non-Hispanic white	1604	37·1	2·1	33·0	1·8	22·3	1·6	7·7	1·1	
Non-Hispanic black	1402	51·1	2·0	28·5	1·6	13·7	1·3	6·6	0·9	
Mexican-American	1357	38·7	1·4	37·8	2·1	15·7	1·3	7·7	0·7	
Other	1363	48·6	2·4	33·0	2·1	13·6	1·7	4·8	0·9	
BMI category†										0·0173
Under- or normal weight	3825	42·8	1·5	31·3	1·4	19·4	1·1	6·5	0·6	
Overweight	847	38·5	2·6	35·7	2·9	19·5	2·5	6·3	1·2	
Obese	1054	36·7	2·4	37·7	2·6	15·6	1·6	10·0	2·0	
PIR										0·0333
≤1·3	2450	43·7	1·3	33·5	1·5	14·5	1·1	8·4	1·3	
1·3–1·85	712	43·1	1·8	34·5	3·5	17·1	2·6	5·4	1·4	
>1·85	2080	39·2	2·2	32·6	1·8	21·7	1·6	6·5	0·9	
Adults aged ≥19 years	10 014	30·3	0·8	31·2	0·6	23·4	0·9	15·1	0·7	
Sex										0·3354
Male	4885	28·8	1·2	31·6	1·1	23·9	1·2	15·6	1·0	
Female	5129	31·7	1·1	30·7	0·7	22·9	1·1	14·7	0·8	
Age (years)										<0·0001
19–30	2202	23·0	1·5	37·3	1·4	25·8	1·5	13·9	1·1	
31–50	3411	29·9	1·2	31·8	1·2	22·6	1·3	15·8	1·1	
51–70	3045	32·2	1·5	28·0	1·2	23·2	1·6	16·7	1·1	
≥71	1356	42·6	1·9	24·8	1·1	21·7	1·2	10·9	0·8	
Race/ethnicity										<0·0001
Non-Hispanic white	4374	28·5	1·1	30·0	0·9	25·9	1·1	15·5	1·0	
Non-Hispanic black	2189	38·2	1·7	28·9	1·1	18·7	1·2	14·2	1·2	
Mexican-American	1466	26·4	1·8	37·6	1·8	19·3	1·4	16·7	1·1	
Other	1985	35·0	1·7	35·3	1·6	16·7	1·0	13·0	1·2	
BMI category†										0·0465
Under- or normal weight	3053	28·7	1·3	31·8	1·1	23·9	1·3	15·6	0·9	
Overweight	3254	29·0	1·4	30·8	1·2	24·3	1·1	15·9	1·2	
Obese	3707	32·9	1·0	31·0	1·3	22·1	1·2	14·0	0·7	
Hypertension‡										0·0001
Yes	2739	38·0	1·4	26·9	1·0	20·6	1·6	14·6	1·0	
No	7275	27·9	1·0	32·5	0·8	24·3	0·9	15·3	0·8	
Diabetes§										0·0018
Yes	1136	39·2	2·5	26·9	1·5	20·7	2·0	13·2	1·4	
No	8878	29·5	0·9	31·6	0·7	23·6	0·9	15·3	0·8	
PIR										0·0028
≤1·3	3097	28·1	1·3	32·7	1·3	21·7	1·1	17·5	1·1	
1·3–1·85	1250	31·2	31·6	34·3	1·9	20·6	2·0	14·0	1·3	
>1·85	4741	31·1	1·3	30·3	0·8	24·5	1·2	14·2	1·0	

PIR, poverty income ratio.
*Unweighted sample size.
†BMI = weight/height^2. Among children/adolescents aged 2–19 years, weight status is classified based on sex- and age-specific percentiles of BMI from the Centers for Disease Control and Prevention growth charts: under- or normal weight = BMI <85th percentile; overweight = 85th percentile ≤ BMI <95th percentile; obese = BMI ≥ 95th percentile. Among adults aged ≥20 years: normal weight = BMI <25·0 kg/m^2; overweight = 25·0 kg/m^2 ≤ BMI <30·0 kg/m^2; obese = BMI ≥ 30·0 kg/m^2.
‡Self-reported hypertension: an answer of 'yes' to the question 'Have you ever been told by a doctor or other health professional that you had hypertension, also called high blood pressure?' and an answer of 'yes' to the question 'Were you told on two or more different visits that you had hypertension, also called high blood pressure?'.
§Self-reported diabetes: an answer of 'yes' to the question 'Other than during pregnancy, have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?'.

Table 2 Prevalence of frequency of salt added during cooking or preparation in the household among the US population aged ≥2 years by demographic characteristics and health factors; National Health and Nutrition Examination Survey 2009–2012

		Ordinary salt use								
		Never		Rarely		Occasionally		Very often		χ^2
Frequency of salt added	*n**	%	SE	%	SE	%	SE	%	SE	*P* value
Total	15740	6·8	0·4	18·9	0·6	37·5	0·8	36·8	1·1	
Children/adolescents aged 2–18 years	5726	4·4	0·7	19·1	1·1	41·5	1·1	35·0	1·3	
Sex										0·7362
Male	2931	3·8	0·5	19·1	1·2	41·4	1·6	35·8	1·6	
Female	2795	5·1	1·2	19·1	1·4	41·6	1·5	34·2	1·8	
Age (years)										<0·0001
2–3	885	5·1	1·1	23·3	2·2	38·9	2·3	32·8	2·5	
4–8	1873	5·0	0·8	22·8	2·0	34·8	2·2	37·4	2·1	
9–13	1607	5·5	1·8	17·5	1·9	40·5	1·9	36·4	1·8	
14–18	1361	2·5	0·5	14·8	1·6	50·7	2·3	32·0	1·9	
Race/ethnicity										<0·0001
Non-Hispanic white	1604	5·1	1·1	21·5	1·9	46·2	1·8	27·2	1·9	
Non-Hispanic black	1402	5·2	1·1	18·4	1·1	35·6	2·2	40·8	2·4	
Mexican-American	1357	2·1	0·8	14·9	1·1	35·5	1·7	47·5	2·0	
Other	1363	3·4	0·8	15·2	2·0	35·7	1·9	45·7	2·7	
BMI category†										0·1388
Under- or normal weight	3825	4·6	0·8	20·0	1·3	41·3	1·3	34·1	1·5	
Overweight	847	3·5	1·1	17·9	2·3	45·5	2·2	33·1	2·5	
Obese	1054	4·5	0·9	16·3	1·5	39·1	2·2	40·1	2·9	
PIR										<0·0001
≤1·3	2450	4·4	0·9	19·2	1·3	33·6	1·3	42·9	1·9	
1·3–1·85	713	5·1	1·7	17·9	3·2	44·1	3·3	32·9	3·2	
>1·85	2080	4·5	1·1	19·6	1·9	46·9	1·4	29·0	1·9	
Adults aged ≥19 years	10014	7·6	0·4	18·8	0·6	36·3	0·9	37·3	1·2	
Sex										0·0003
Male	4885	8·5	0·7	20·0	0·9	37·9	1·2	33·7	1·3	
Female	5129	6·7	0·5	17·8	0·9	34·8	1·0	40·7	1·5	
Age (years)										<0·0001
19–30	2202	4·7	0·7	20·0	1·7	38·2	1·5	37·1	1·6	
31–50	3411	6·5	0·6	17·6	0·9	36·2	1·4	39·8	1·6	
51–70	3045	9·3	0·6	19·1	1·1	34·5	1·7	37·1	1·6	
≥71	1356	13·0	1·2	19·8	1·4	38·1	2·0	29·1	1·3	
Race/ethnicity										<0·0001
Non-Hispanic white	4374	8·7	0·5	20·7	0·9	39·6	1·1	31·0	1·4	
Non-Hispanic black	2189	7·2	0·6	15·6	1·1	30·0	1·5	47·2	1·7	
Mexican-American	1466	3·9	0·7	16·1	1·1	28·2	1·7	51·9	2·0	
Other	1985	4·5	0·7	13·4	1·2	29·2	1·2	52·9	1·8	
BMI category†										0·1524
Under- or normal weight	3053	6·6	0·7	20·0	1·2	38·1	1·5	35·2	1·8	
Overweight	3254	6·8	0·7	18·4	0·8	36·4	1·3	38·4	1·3	
Obese	3707	9·2	0·7	18·1	1·0	34·5	1·3	38·2	1·5	
Hypertension‡										0·0007
Yes	2739	10·9	1·0	17·6	1·1	36·9	2·1	34·6	2·0	
No	7275	6·5	0·4	19·2	0·9	36·1	0·9	38·2	1·3	
Diabetes§										0·0001
Yes	1136	14·5	1·3	19·8	1·7	32·0	2·5	33·7	2·8	
No	8878	7·0	0·4	18·7	0·7	36·7	0·9	37·6	1·2	
PIR										0·0018
≤1·3	3097	7·9	0·8	17·4	1·0	32·3	1·2	42·4	2·0	
1·3–1·85	1250	9·1	1·2	17·8	1·6	33·7	2·2	39·4	2·1	
>1·85	4741	7·2	0·6	19·6	0·9	39·0	1·3	34·2	1·3	

PIR, poverty income ratio.
*Unweighted sample size.
†BMI = weight/height^2. Among children/adolescents aged 2–19 years, weight status is classified based on sex- and age-specific percentiles of BMI from the Centers for Disease Control and Prevention growth charts: under- or normal weight = BMI<85th percentile; overweight = 85th percentile ≤ BMI<95th percentile; obese = BMI ≥ 95th percentile. Among adults aged ≥20 years: normal weight = BMI<25·0 kg/m^2; overweight = 25·0 kg/m^2 ≤ BMI<30·0 kg/m^2; obese = BMI ≥ 30·0 kg/m^2.
‡Self-reported hypertension: an answer of 'yes' to the question 'Have you ever been told by a doctor or other health professional that you had hypertension, also called high blood pressure?' and an answer of 'yes' to the question 'Were you told on two or more different visits that you had hypertension, also called high blood pressure?'.
§Self-reported diabetes: an answer of 'yes' to the question 'Other than during pregnancy, have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?'.

population who report frequent discretionary salt use has declined. Consumer research conducted in 2012 of 2000 adults with Internet access found that 60 % of participants reported trying to limit their Na intake, and when asked how, 72 % reported 'cook with less salt' and 64 % reported 'salt my food less,' despite the knowledge that packaged and restaurant foods are the major sources of Na intake[25]. However, while frequent use of discretionary salt has decreased from 2003 to 2012, never using discretionary salt has not changed. Participants may be using salt less frequently (i.e. 'rarely' or 'occasionally') due to several factors including increased diversity of flavours in processed and restaurant foods, increased usage of condiments, cooking sauces and marinades[26–28], or overall attention to the impact of Na on health. Conversely, some may not report frequent salt use due to a bias towards more socially desirable responses. In addition, it is possible that frequent users of ordinary salt may have switched to use of salt substitutes. However, the prevalence of reported lite salt/salt substitute use also declined from 4·3 (95 % CI 3·7, 4·3) % in 2003–2004 to 3·4 (95 % CI 2·8, 4·1) % in 2011–2012 ($P = 0{\cdot}01$, trend test adjusting for sex, age and race/ethnicity).

The findings regarding income and discretionary salt use have been noted before, although previous associations are mixed. No relationship between income and discretionary salt use was reported in an online convenience sample of Australian adults. Almost half of respondents had annual household incomes of $AU 60 000 or above[29]. In Canada, a national health survey conducted in 2004 found no inequities in Na consumption based on socio-economic status; however, the authors found that income was negatively associated with reported use of table salt among men[30]. Frequent home cooking may be associated with a healthier diet[31] and those of lower socio-economic status are reportedly more likely to either always or never cook at home[16,31]. Wolfson and Bleich described that families with lower incomes may be forced to cook either more frequently for financial reasons or less frequently due to lack of time. If the former is true, that may lead to more discretionary salt use, as our findings suggest. Frequency of cooking also may differ by sex, with women more likely to cook meals more often than men[31]. However, while some studies support our findings that women are more likely to report salt added in cooking or preparation in the household[19], others have reported no association between sex and discretionary salt use[17].

Literature on age and discretionary salt use is also mixed. Some studies report that age is inversely related to discretionary salt use[17,29], as was seen in the present analysis. However, others have noted the opposite association[9,19]. Race/ethnicity may play a role in differences of Na intake and home cooking, and was seen in the present analysis. Among adults, non-Hispanic whites have higher Na intake than blacks and Mexican-Americans[2]. However, black households reportedly cook at home the least, while Hispanics cook at home more frequently[16,31]. In contrast to our analysis, one analysis observed whites *v.* other race/ethnic groups were more likely to add salt, but the other ethnicities were not delineated and so comparisons cannot be made[9].

Literature on hypertension and diabetes status and Na intake indicates that those with self-reported hypertension are more likely to report taking action to reduce Na intake compared with those without hypertension, and the same has been shown for those with self-reported diabetes[19,32,33]. Dietary guidelines suggest that adults with prehypertension and hypertension would benefit from a further reduction of Na beyond the 2300 mg/d recommended for the general population[34]. Results from the present analysis are consistent with this and suggest awareness of the evidence to reduce Na among those who are at higher risk of developing CVD.

As the USA moves forward with initiatives to lower the Na content of food products, it is important that the discretionary salt use habits of Americans be monitored. The Institute of Medicine recommends enhanced monitoring of Na intake and salt taste preference; however, limited research exists on the use and trends of discretionary salt use[4]. The present study assessed the use of discretionary salt over the period from 2003 to 2012 and by various demographic and health characteristics. However, some limitations should be addressed. First, data obtained from the NHANES survey questions are self-reported and may not be directly related to the amount of salt consumed, especially since the present analysis is not able to assess the quantity of salt added at the table or during cooking, only the frequency of its use. Second, the questions regarding discretionary salt use have not been validated. Third, error in reporting may be present among children for whom proxies were used and among older children and adults who did not use proxies, but may not know about the use of salt added to cooking. Lastly, institutionalized populations are excluded from this survey and therefore results cannot be generalized to this group. However, the present analysis can help inform further research and policy on Na reduction, and fills a gap in this area of Na research.

Data suggest consumers are exceeding recommended Na limits before salting at the table or during cooking[7]. Additionally our analysis shows that 'very often' use of discretionary salt has declined over recent years. Further, salt use differs by several demographic and health characteristics, which supports prior research. Individuals who are at higher risk of hypertension report using discretionary salt less frequently. As the food supply and dietary habits of the US population evolve, ongoing monitoring of discretionary salt use is warranted. In particular, it will be important to examine trends in selected subgroups of the population as Na reduction strategies are implemented.

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Supplementary material

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/S1368980016000392

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