

Salt Intakes, Knowledge, and Behavior in Samoa: Monitoring Salt-Consumption Patterns Through the World Health Organization's Surveillance of Noncommunicable Disease Risk Factors (STEPS)

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This project measured population salt intake in Samoa by integrating urinary sodium analysis into the World Health Organization's (WHO's) STEPwise approach to surveillance of noncommunicable disease risk factors (STEPS). A sub-sample of the Samoan Ministry of Health's 2013 STEPS Survey collected 24-hour and spot urine samples and completed questions on salt-related behaviors. Complete urine samples were available for 293 participants. Overall, weighted mean population 24-hour urine excretion of salt was 7.09 g (standard error 0.19) to 7.63 g (standard error 0.27) for men and 6.39 g (standard error 0.14) for women ($P=.0014$). Salt intake increased with body mass index

($P=.0004$), and people who added salt at the table had 1.5 g higher salt intakes than those who did not add salt ($P=.0422$). A total of 70% of the population had urinary excretion values above the 5 g/d cutoff recommended by the WHO. A reduction of 30% (2 g) would reduce average population salt intake to 5 g/d, in line with WHO recommendations. While challenging, integration of salt monitoring into STEPS provides clear logistical and cost benefits and the lessons communicated here can help inform future programs. *J Clin Hypertens (Greenwich)*. 2016;18:884–891. © 2016 The Authors. *The Journal of Clinical Hypertension* Published by Wiley Periodicals, Inc.

Cardiovascular disease is the leading cause of mortality in Pacific Island countries (PICs).¹ Increased blood pressure (BP) has been linked to increased risks of stroke and other adverse health outcomes.² Reducing salt consumption lowers BP, is projected to deliver large health gains,³ and has been identified as a highly cost-effective intervention for the prevention of noncommunicable diseases (NCDs).^{4,5} Accordingly, the World Health Assembly has set targets for NCDs that include a 30% relative reduction in population salt intake by 2025.^{6,7} For most PICs, including Samoa, a key step will be establishing baseline intake so that progress against the target can be measured.⁸ Measuring salt intake can be challenging and costly.⁹ A 2012 review of national approaches to monitoring salt intake highlighted the challenges, particularly for lower-middle- and upper-middle-income countries and the importance of identifying practical approaches without compromising accuracy.⁷ The review included

three examples of lower-middle-income countries (LMICs; China, Philippines, and Thailand) that had monitored salt intake and two examples of research studies from lower-middle-income countries (India and Vietnam). However, only one LMIC (Vietnam) had collected urine samples. Other countries reported ongoing challenges relating to resources, practicalities, and obtaining reasonable response rates. Integrating salt monitoring into other planned surveys, such as the WHO's STEPwise approach to surveillance of noncommunicable disease risk factors (STEPS), should provide efficiencies to help overcome some of these issues.¹⁰

The objective of this study in Samoa was to establish current mean population salt intake and to test the feasibility of integrating urinary sodium analysis into WHO STEPs. The study is the first phase of a before-and-after intervention project investigating the cost-effectiveness of strategies to reduce population salt intake through multisectorial interventions.¹¹

METHODS

Samoa is an LMIC located south of the equator, about halfway between Hawaii and New Zealand in the Polynesian region of the Pacific Ocean. It has a population of almost 200,000 and consists of four inhabited islands.¹² The second Samoan STEPS survey took place between March and May 2013 as a partnership between the Samoan Ministry of Health, the WHO, and The George Institute for Global Health. The objectives were

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to assess and track changes in risk factors for chronic disease and measure baseline salt consumption. A detailed implementation plan outlining roles and responsibilities, budget, and timelines was agreed upon between the project partners. A Ministry of Agriculture agreement was also signed between the Ministry of Health, WHO and George Institute, and other partners to ensure protection of data. Ethics approval was obtained from the Health Research Committee (Samoa), the ethics review committee of the Western Pacific Regional Office of WHO, and the University of Sydney's human ethics research committee (protocol number: 15359).

Sampling Frame

The STEPs survey framework used a three-stage (enumeration area [EA], household, and individual) cluster sampling procedure to select a representative sample of the adult population.¹³ Samoan permanent residents aged 18 to 64 years were included in the sampling frame based on a household list from 2011.¹² The household list was stratified into four statistical regions, namely Apia Urban Area, North West Upolu, Rest of Upolu, and Savaii. Each region comprised a number of districts, villages, EAs, and the number of households. The Apia Urban Area region represented the urban population and the other three regions represented the rural population.

A survey sample size of 2880 was calculated according to the WHO standard formula for STEPS. EAs were selected from each stratum using probability proportional to size sampling. The 2011 Population Household List was then used to select households using equal probability systematic sampling, and an eligible individual from each household was selected using the Kish method.¹⁴ A systematic random sampling approach, taking every fifth household (starting at the fifth) in administrative order from the main STEPS sample with no replacement, was then used to invite 500 participants into the salt study.

Research Team and Logistics

The data collection framework for the STEPS survey was based on 52 field workers, divided into two teams of 26 people per team, then having two fixed points operating concurrently. Teams were constructed as follows: supervisors (1); recruitment field workers for the Kish selection method (4); field workers for the registration/check-in point (2); interviewers for STEPS questionnaire (5); measurements (2); biochemistry testing (2); final check and feedback (1); salt data collectors (2); and drivers (4).

In addition, the survey manager (1), driver and three technical advisors (1 from WHO, 1 from the Ministry of Health's subsurvey, and 1 from the salt subsurvey) resulted in a total of 57 field workers including drivers.

Data collection training for the survey teams took place from February 18 to February 22, 2013 (3 days), followed by pilot testing (2 days). The data collection took place from March to May (9 weeks), with data cleaning and analysis taking place in September.

Recruitment and Participant Consent

Participants were asked to provide written consent, were given instructions on completing the survey, and were invited to come to the survey site the next morning. Samoan communication protocols were followed to ensure community and individual participation. This was done through the usual collaboration with the Ministry of Women, Community, and Social Development. Participation in the survey was also promoted through the media. Selected participants who agreed to participate in the salt study were provided with additional participant information and consent forms. There was no exclusion based on current illness, use of medications, or any other aspect of demography or personal history.

Data Collection

Interviewer-administered questionnaires were used to obtain demographic and risk factor information, including history of raised BP and current treatment or advice to reduce salt, and salt knowledge and behavior. All data were entered into handheld electronic devices. Physical measurements of body weight and height were taken to the nearest 0.1 kg and 0.1 cm, respectively, and used to calculate body mass index (BMI; kg/m²). Systolic BP (SBP) and diastolic BP (DBP) were measured in triplicate according to standard WHO procedures using Omron Premium HEM 7211 sphygmomanometers (Omron Healthcare, Kyoto, Japan).

Participants in the salt study were then provided with written and oral instructions on how to collect spot and 24-hour urine samples based on established protocols.¹⁵ The urine collection was performed in the 24 hours following the STEPS survey to avoid bias introduced by the need for an overnight fast (required for assessing blood glucose). The spot urine samples were collected as part of the 24-hour urine collection. Participants were provided with the two containers: a 5 L bottle for the specimen sample and a 1 L jug to collect the urine to put into the 5 L bottle. They were also provided with a cooler bag to store and carry the containers and were instructed to start urine collection at any time before noon that day, recording the time on the container provided.

A salt data collector then travelled around the next day (after 12 PM on day 3) to collect the urine samples and hand out the healthy compensation package (eg, Masima project T-shirt, and healthy food vouchers) valued at 30 Samoan Tala (\$11.62 US). A salt collection and tracking form was used by the salt data collectors to record all details. The urine samples were transported to a central laboratory where the volumes were measured and aliquots of both the spot and 24-hour samples were analyzed for sodium, potassium, and creatinine.¹⁶

Data Entry and Analysis. Descriptive statistics for demographic and health status and consumer knowledge and behavior were recorded for both the salt and the non-salt participants of the STEPS survey. Urine samples were excluded from the analysis if urine volume was <500 mL

or creatinine was <4 mmol (women) or <6 mmol (men). Mean population intake estimates were obtained by sample weighting to the sex and age distribution of the population to provide overall and sex-, age-, and BMI-specific estimates. Differences between subgroups were assessed using *t* tests. The proportion of the population above the WHO-recommended guideline of 5 g/d of salt and sodium to potassium ratio were also calculated. Analysis of the consumer knowledge and behavior questions was undertaken and associations with salt intake levels were assessed.

The association between salt intake and participant characteristics were explored using regressions for region, age, sex, BMI, education, income, and employment.

Differences in the characteristics of the salt study participants and the non-salt study STEPS participants were explored. Data analyses were undertaken using Proc Surveymeans and Proc Surveyfreq in SAS 9.3 (SAS Institute, Cary, NC) and incorporated the study design (strata, cluster, and weights) into the estimates. We included any variable with indications of association with salt consumption ($P < .20$) in adjusted models. Statistical significance was accepted at $P < .05$. All confidence interval estimations and tests were conducted using a two-sided error rate of 5%. No missing data were imputed.

Lastly, measured 24-hour sodium intake was compared with 24-hour sodium intake estimated from spot urine samples using Bland-Altman plots.

RESULTS

Response Rate

From the 500 participants selected to participate in the salt study, 421 (84%) consented and completed the survey. Sixty-three participants subsequently had to be excluded for lack of unique identifying numbers, 16 for missing urine volumes, and six for missing sex or age data, leaving 336 samples for urine analysis. A further 43 were then excluded for suspected incomplete 24-hour urine collection, leaving a total of 293 participants (58.5% participation rate) for analysis of salt intake.

Descriptive Statistics

The majority (90%) of the participants from the salt subsample were from rural areas. The mean age was 36.4 years, mean BMI 31.92 kg/m², and average SBP 126.5 mm Hg (Table I). About 18.7% of the population were assessed as having hypertension (ie, SPB \geq 140 mm Hg and/or DBP \geq 90 mm Hg). Those included in the salt subsample were an average of 2 years younger ($P = .0166$) and less likely to be from urban areas (8.9% vs 22.1%, $P < .0001$) than the rest of the STEPS sample. Other characteristics were not different (all $P > .05$) (Annex S1).

Results of 24-Hour Urinary Salt Intake

Weighted mean population urinary 24-hour salt excretion for Samoan adults aged 18 to 64 years was 7.09 g

(standard error [SE], 0.19) (Table II). The mean salt excretion in men was 7.63 g/d (SE, 0.27) compared with 6.39 g/d (SE, 0.14) for women ($P = .0014$). This difference remained significant after adjusting for various confounders. A total of 69.3% of the population had a salt intake >5 g with 18.2% consuming more than 10 g of salt per day. The sodium/potassium ratio for the population was 2.48 (SE, 0.13).

Association Between Salt Intake and Other Key Variables

People with low BMI values ate on average 1.34 g less salt than those with higher BMI values ($P = .004$). People in urban areas ate significantly less salt than those in rural areas, although this difference became nonsignificant after adjusting for potential confounders ($P = .0695$). There were no significant associations between salt intake and age, education, employment, or hypertension status (Table III).

Knowledge and Behaviors Related to Salt

More than 80% of the participants (82.8%) knew that salt could cause serious health problems (Table IV) but about half reported behaviors expected to lead to higher salt intake. People who added salt to food or at the table had about 1.5 g higher salt intake than those who did not ($P = .0422$) (Table V). There were no significant associations between any other aspects of behavior to control salt intake and actual salt intake (all $P > .05$).

Estimation of 24-Hour Sodium Intake From Spot Samples

From the four different equations used to estimate 24-hour sodium excretion from spot urine samples at the population level, the INTERSALT method had the closest match in population mean to the 24-hour collection and showed much better agreement in the Bland-Altman plots (Figure) than any of the other existing methods. However, it still overestimated salt intake by more than a gram and a half (8.56 g compared with 6.91 g from 24-hour, Table VI). The methods based on sodium/creatinine ratio (Tanaka, Kawasaki and Mage) overestimated the population levels of salt excretion.

DISCUSSION

In 2013, WHO incorporated the monitoring of salt intake through urine collection into its STEPS protocol. This project was the first time this was done in Samoa and the documenting of the process and the lessons learned will help to inform both national implementation of STEPS surveys to incorporate salt measurements and global policy on monitoring salt intake. Mean population salt intake in Samoa was low compared with average intake levels in many other low- and middle-income countries,¹⁷ although still higher than recommended by WHO and with clear scope to reduce intake to the 5 g/d guideline.¹⁸ The fact that salt levels were higher among men than women is consistent with most

TABLE I. Population Characteristics

Baseline Characteristics	Total	Female	Male
Age, mean (SE), y	36.4 (0.9)	36.4 (0.9)	36.4 (1.2)
Female, %	58.4	—	—
Rural, %	90.0	85.8	93.2
Education, %			
Completed primary school or less	19.7	16.1	22.2
Completed secondary school	61.6	68.9	56.5
Completed tertiary school	18.7	15.0	21.3
Employed, %	61.3	62.2	60.8
Household size, mean (SE), No.	8.6 (0.3)	8.4 (0.5)	8.7 (0.4)
Height, mean (SE), cm	168.26 (0.86)	161.67 (0.53)	173.39 (0.74)
Weight, mean (SE), kg	90.12 (1.21)	88.87 (0.81)	91.09 (1.85)
Body mass index, mean (SE), kg/m ²	31.92 (0.39)	34.04 (0.18)	30.28 (0.57)
Waist circumference, mean (SE), cm	100.26 (1.47)	103.17 (1.55)	98.48 (1.60)
Systolic BP, mean (SE), mm Hg	126.5 (1.1)	123.4 (2.3)	128.6 (0.9)
Diastolic BP, mean (SE), mm Hg	75.4 (1.0)	75.4 (1.4)	75.5 (1.2)
Hypertension, %	18.7	15.6	20.8
Uses BP-lowering medications, %	8.0	11.6	5.6
History of stroke, %	0.0	0.0	0.0
History of heart attacks, %	0.2	0.4	0.0
History of hypertension, %	7.2	7.7	6.8
History of diabetes, %	3.6	7.7	0.6
Urinary volume, mean (SE), mL	1260.7 (27.1)	1167.0 (53.0)	1332.0 (36.9)
Creatinine, mean (SE), mmol	13.1 (0.4)	9.9 (0.2)	15.5 (0.4)

Abbreviations: BP, blood pressure; SE, standard error.

TABLE II. Weighted Results for Salt Intake, Potassium Intake, and Sodium/Potassium Ratio

	Overall (N=293)	Female (n=171)	Male (n=122)
Salt intake, mean (SE), g	7.09 (0.19)	6.39 (0.14)	7.63 (0.27)
Salt intake above the 5 g WHO target, %	69.3	65.2	72.4
Salt intake above the 10 g WHO target, %	18.2	11.7	23.2
Potassium intake, mean (SE), mmol	56.95 (2.47)	45.17 (1.32)	65.93 (3.63)
Sodium intake, mean (SE), mmol	121.37 (3.31)	109.31 (2.34)	130.55 (4.69)
Sodium/potassium ratio, mean (SE)	2.48 (0.13)	2.74 (0.10)	2.29 (0.16)

Abbreviations: SE, standard error; WHO, World Health Organization.

populations.¹⁹ About half of the participants said they were trying to reduce their salt intake and people who said that they sometimes or always added salt to food ate on average 1.5 g more salt than those who rarely or never added salt to foods, which suggests that targeting this behavior could make a difference.

The observation that there was no association between salt intake and most other aspects of consumer behavior is in line with recent studies in Australia²⁰ and confirms current thinking that any approach to reduce population salt intake should have a strong emphasis on changing the food environment, rather than focusing solely on consumer education.²¹ In Samoa, this could include the adoption of existing regional targets for salt levels in foods^{22,23} and working with importers and retailers to ensure that the products that are imported meet these targets. In addition, since a substudy

performed as part of this project showed that iodine consumption in women aged 18 to 45 years was insufficient (median urinary iodine excretion, 88 µg/L; interquartile range, 54–121 µg/L) and 62% of the women had urinary iodine excretion <100 µg/L,²⁴ efforts to reduce salt intake in Samoa should include efforts to achieve universal salt iodization.²⁵

STUDY LIMITATIONS AND STRENGTHS

Several study limitations should be noted when interpreting these results. First, low response rates and the relatively high proportion of nonusable urine samples meant the participants in the final salt subsample were nonrepresentative (mean age differed by 2 years) and more likely to be from rural areas. The participation rate of 58.5% was, however, higher than for many other salt surveys,^{26–28} and most characteristics of the salt

TABLE III. Association Between Levels of Salt Intake, Patient Characteristics, and BP

Sociodemographic Characteristics	Crude			Adjusted	
	No.	Mean (95% CI)	P Value	Mean (95% CI)	P Value
Region					
Urban	26	5.97 (4.73–7.20)	.0293	5.83 (4.29–7.37)	.0695
Rural	267	7.22 (6.82–7.62)		7.12 (6.73–7.52)	
Sex					
Men	122	7.63 (6.96–8.30)	.0014	7.02 (5.93–8.11)	.0122
Women	171	6.39 (6.05–6.72)		5.93 (5.17–6.70)	
Age, y					
18–44	203	7.38 (6.59–8.18)	.0986	6.43 (5.28–7.57)	.0654
45–64	90	6.33 (5.67–6.99)		5.21 (3.98–6.43)	
Age continuous (/5 y)		–0.04 (–0.10 to 0.01)	.1012	–0.05 (–0.10 to 0.00)	.0567
Education					
Primary school or less completed	51	7.46 (5.26–9.66)	.9385		
Secondary school completed	151	7.07 (5.90–8.24)			
Post-secondary/university	37	7.40 (5.18–9.63)			
Employment status					
Employed/domestic duties	133	7.09 (6.22–7.96)	.3016		
Unemployed/student	104	7.37 (6.68–8.06)			
BMI, kg/m²					
Underweight/normal	34	6.40 (5.36–7.44)	.0222	5.15 (4.00–6.30)	.0004
Overweight/obese	251	7.25 (6.82–7.68)		6.49 (5.64–7.33)	
BMI continuous		–0.06 (–0.10 to –0.02)	.0108	–0.02 (–0.05 to 0.01)	.1663
BP, mm Hg					
Systolic BP <140 and diastolic BP <90	205	7.35 (6.46–8.23)	.2080		
Systolic BP ≥140 or diastolic BP ≥90	50	6.40 (5.56–7.24)			
Systolic BP continuous (/10 mm)		–0.02 (–0.06 to 0.02)	.2057		

Abbreviation: CI, confidence interval. The multivariate (adjusted) regression includes variables with a *P* value <.2 in the unadjusted analysis. This version includes the continuous forms for age, body mass index (BMI), and blood pressure (BP). The coefficients for these variables represent a change in salt excretion according to the units on the table.

TABLE IV. Salt Knowledge and Behavior

Knowledge and Behavior Toward Salt	Percentage
Always/often add salt to food	46.4
Always/often add salt while cooking	50.1
Always/often consume processed food high in salt	54.8
Agreed that too much salt could pose serious health problems	82.8
Perceived salt consumption	
Too much	18.9
Just the right amount	52.2
Too little	21.9
Perceived healthy salt consumption	
<10 g or 2 teaspoons	3.1
<5 g or 1 teaspoon	24.5
<2 g or 1/2 teaspoon	52.0
Salt intake control	
Avoid processed food	58.7
Look at sodium labels on food	42.6
Do not add salt on the table	43.8
Buy low-salt alternatives	54.9
Do not add salt when cooking	49.0
Use spices other than salt when cooking	43.9
Avoid eating out	60.9

participants were comparable to those of the non-salt STEPs participants. Volume and creatinine cutoff values were used to ensure completeness and mean volume and creatinine levels of the participants were in line with other studies.^{29–31} Moreover, inclusion of the participants who could not be matched or had urine samples that did not meet the volume or creatinine levels for completeness in the analysis of salt intake also had no impact on calculated intake levels. Second, while it is always possible that the behavior of participants was affected through participation in the survey, ie, that people knew that their salt consumption was being measured and therefore reduced their consumption of salt during the time of the survey, resulting in a lower estimate of population salt intake,^{32,33} this is unlikely to have affected the results in view of the challenges associated with changing behavior around salt usage.³⁴ While lower than expected, we believe the salt intake levels should be reasonably accurate.

Potential barriers to the effective implementation of the survey included the difficulty in communicating the importance of obtaining complete 24-hour urine samples to the participants and the logistics of transporting urine samples from different parts of the Islands to the laboratory. Specialist training and close supervision of the salt data collectors ensured that data were properly

TABLE V. Association Between Levels of Salt Intake and Salt Knowledge and Behavior

Salt Knowledge, Attitudes, and Behavior Variables	Crude		Adjusted	
	Mean (95% CI)	P Value	Mean (95% CI)	P Value
Add salt to food				
Always/often/sometimes	7.56 (6.70–8.41)	.0240	7.54 (6.36–8.72)	.0422
Rarely/never	6.05 (5.04–7.05)		6.05 (5.11–7.00)	
Add salt while cooking				
Always/often/sometimes	7.39 (6.56–8.22)	.1537	6.81 (5.97–7.66)	.9696
Rarely/never	6.29 (4.90–7.68)		6.78 (5.28–8.29)	
Consume processed food high in salt				
Always/often/sometimes	7.33 (6.42–8.24)	.4584		
Rarely/never	6.39 (4.02–8.76)			
Perceived salt consumption				
Too/far too much	6.08 (4.60–7.55)	.2607		
Just the right amount	7.68 (6.12–9.23)			
Too/far too little	7.09 (5.20–8.98)			
Don't know	6.65 (5.58–7.72)			
Could using too much salt pose serious health problems?				
Yes	7.34 (6.34–8.34)	.4209		
No	6.85 (5.35–8.36)			
Don't know	6.39 (5.56–7.23)			
Perceived healthy salt consumption				
<10/5 g (2/1 teaspoons)	6.73 (6.28–7.19)	.3651		
<2 g (1/2 teaspoon)	7.77 (6.14–9.40)			
Don't know	6.40 (5.45–7.35)			
Take action to control salt intake				
No	6.96 (6.09–7.83)	.6669		
Yes	7.18 (6.49–7.87)			

Abbreviation: CI, confidence interval. The multivariate (adjusted) regression includes variables with a P value <.2 in the unadjusted analysis.

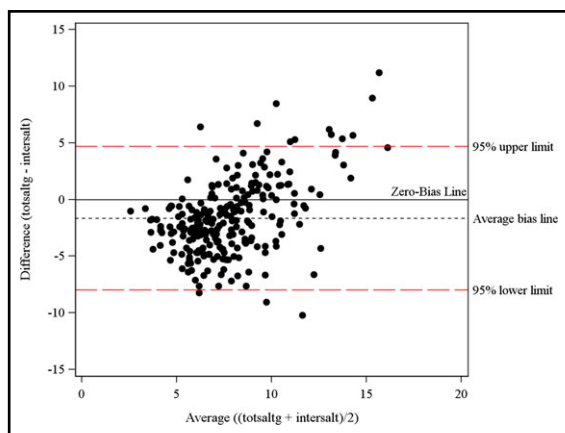


FIGURE. Bland-Altman plot for 24-hour sodium excretion estimated from spot urine using the INTERSALT method.

recorded and the inclusion of laboratory technicians and data analysts in planning ensured a good understanding of what is required and when. It should be noted that some of the challenges faced were in terms of salt monitoring in general and not specific to integration into the STEPS process. Collection of 24-hour urine samples requires a high level of resources and supervi-

TABLE VI. Mean and Intraclass Correlation Coefficients (ICCs) of 24-Hour Salt Excretion Estimated From Spot Urine Samples Using Different Equations

Equation	Mean	ICC
Measured 24-hour	6.91	–
INTERSALT	8.56	0.36
Tanaka	8.99	0.40
Kawasaki	11.86	0.26
Mage	12.09	0.09

sion, which is sometimes difficult to provide as part of large-scale national population surveys. However, survey integration offers clear benefits, particularly in terms of costs associated with the sampling, logistics, and travel.

The relatively high potassium intake levels align with the findings of lower-than-anticipated sodium intake, suggesting that the transition to processed food consumption³⁵ in Samoa is limited, with the diet still including substantial intakes of fresh vegetables.³⁶ Preliminary analysis of the Food and Agriculture’s Household Income and Expenditure Survey confirms that around 55% of total energy intake is derived from vegetables (primarily root vegetables). This is in contrast

to Fiji where salt intake is much higher, partly because of the influence of the Indian diet but likely also because of the greater transition toward high-salt processed foods.³⁷

While other individual studies of salt intake in LMICs or low-income countries have been documented,^{29,31,38–40} few studies focus on the methods used or how they can be applied to other populations. This study has demonstrated that while it is possible to measure salt intake through the integration of 24-hour urinary sodium analysis into STEPS, it is not without its challenges. Undertaking large-scale multifactorial surveys such as STEPS requires large capacity in terms of training, recruitment, and supervision of fieldworkers; use of equipment for biochemical measurement; and transport of people and equipment to sites. The addition of salt monitoring added further logistical complexity in relation to instructions and materials for urine collection, laboratory analysis of urine, transport/storage of urine, and data analysis.

WHO is now considering using spot urine samples to assess population salt intake as part of STEPS in order to monitor progress toward the global targets. Several equations have been developed and tested and proven potentially useful for estimating mean population 24-hour salt intake from spot urine samples.^{41–44} However, they have yet to be tested on a wide range of population groups. The analysis of the spot samples from this survey showed a moderate correlation and the estimations from spot samples were overestimated by about 1.5 g (Annex 3). While the estimation from spot samples effectively demonstrates that salt intakes are well above the WHO recommendations and may provide a basis from which to monitor change, more research will be needed before we are able to confidently use spot urine samples to estimate 24-hour urine excretion for this region.

CONCLUSIONS

This is the first time salt intake has been reported in Samoa and that urinary sodium analysis has been undertaken as part of the WHO STEPS process. As such, it represents a huge step forward in terms of scalability and sustainability of salt reduction programs. The data have already been used to inform a national salt reduction intervention in Samoa. Population-based salt reduction strategies are cost-effective and cost-saving in most settings.⁴⁵ Accurate measurement of salt intake is a fundamental step in the development and monitoring of national programs to reduce population salt intake. Such programs are required to ensure that countries are on track to achieve the global target of a 30% reduction in population salt intake by 2025, which is projected to save around 2 million lives a year as well as millions of dollars in healthcare spending.⁴⁶ These new data and experiences further support the widespread rollout of national monitoring of salt intake to support the increased salt reduction efforts around the world.⁴⁷

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Annex S1. The characteristics of the salt subsample compared with the non-salt participants in the STEPS survey.

Annex S2. Sensitivity analysis comparing knowledge and attitudes related to salt for the salt subsample compared with the non-salt sample of STEPS participants.

Annex S3. Estimation of 24-hour salt consumption from spot samples.

Table S1. Mean and median of estimated 24-hour salt excretion.

Table S2. The intraclass correlation coefficient between 24-hour salt collection and different SPOT methods.

Figure S1. Distribution and summary information on estimated 24-hour salt excretion.

Figure S2. Bland-Altman plot for 24 hour sodium excretion estimated from spot urine using different estimating equations.