HOW TO OBTAIN MEASURES OF POPULATION-LEVEL SODIUM INTAKE IN 24-HOUR URINE SAMPLES

PROTOCOL

World Health Organization
REGIONAL OFFICE FOR Europe

KEYWORDS

CARDIOVASCULAR DISEASES – prevention and control

DIET, SODIUM-RESTRICTED – utilization

HYPERTENSION – prevention and control

NUTRITION AND FOOD SAFETY

SODIUM CHLORIDE, DIETARY

NONCOMMUNICABLE DISEASE

Address requests about publications of the WHO Regional Office for Europe to:

Publications
WHO Regional Office for Europe
UN City, Marmorvej 51
DK-2100 Copenhagen Ø, Denmark

Alternatively, complete an online request form for documentation, health information, or for permission to quote or translate, on the Regional Office website (http://www.euro.who.int/pubrequest).

Document number: WHO/EURO:2021-2333-42088-57949
© World Health Organization 2021

Some rights reserved. This work is available under the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 IGO licence (CC BY-NC-SA 3.0 IGO; https://creativecommons.org/licenses/by-nc-sa/3.0/igo).

Under the terms of this licence, you may copy, redistribute and adapt the work for non-commercial purposes, provided the work is appropriately cited, as indicated below. In any use of this work, there should be no suggestion that WHO endorses any specific organization, products or services. The use of the WHO logo is not permitted. If you adapt the work, then you must license your work under the same or equivalent Creative Commons licence. If you create a translation of this work, you should add the following disclaimer along with the suggested citation: "This translation was not created by the World Health Organization (WHO). WHO is not responsible for the content or accuracy of this translation. The original English edition shall be the binding and authentic edition: How to obtain measures of population-level sodium intake in 24-hour urine samples: protocol. Copenhagen: WHO Regional Office for Europe; 2021".

Any mediation relating to disputes arising under the licence shall be conducted in accordance with the mediation rules of the World Intellectual Property Organization. (http://www.wipo.int/amc/en/mediation/rules/)

Suggested citation. How to obtain measures of population-level sodium intake in 24-hour urine samples: protocol. Copenhagen: WHO Regional Office for Europe; 2021. Licence: CC BY-NC-SA 3.0 IGO.

Cataloguing-in-Publication (CIP) data. CIP data are available at http://apps.who.int/iris.

Sales, rights and licensing. To purchase WHO publications, see http://apps.who.int/bookorders. To submit requests for commercial use and queries on rights and licensing, see http://www.who.int/about/licensing.

Third-party materials. If you wish to reuse material from this work that is attributed to a third party, such as tables, figures or images, it is your responsibility to determine whether permission is needed for that reuse and to obtain permission from the copyright holder. The risk of claims resulting from infringement of any third-party-owned component in the work rests solely with the user.

General disclaimers. The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

The mention of specific companies or of certain manufacturers' products does not imply that they are endorsed or recommended by WHO in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

All reasonable precautions have been taken by WHO to verify the information contained in this publication. However, the published material is being distributed without warranty of any kind, either expressed or implied. The responsibility for the interpretation and use of the material lies with the reader. In no event shall WHO be liable for damages arising from its use.

CONTENTS

ACKNOWLEDGEMENTS

This document was prepared by the WHO Collaborating Centre for Nutrition of the University of Warwick, United Kingdom (Head of Centre: F.P. Cappuccio), for use and adaptation by countries, with support from Ivo Rakovac and Stephen Whiting from the WHO European Office for the Prevention and Control of Noncommunicable Diseases, WHO Regional Office for Europe. Appreciation is expressed to Jo Jewell, Marieke Hendriksen, Zhanibek Yerubayev, Assel Abakova, Artyom Gil and Clare Farrand for their specific contributions to this document and to João Breda and Nino Berdzuli for their overall leadership and supervision of the project.

This document is an update and expansion of a similar protocol developed for the WHO Regional Office for the Eastern Mediterranean (2013), originally developed by the Pan American Health Organization (PAHO/WHO) Sub-Group on Surveillance of the Regional Expert Group for Cardiovascular Disease Prevention through Population-Wide Dietary Salt Reduction (2009–2011) and published as Salt Smart Americas.

ABBREVIATIONS

BMI body mass index

BP blood pressure

DBP diastolic blood pressure

IDD iodine deficiency disorder

NCD noncommunicable disease

SBP systolic blood pressure

1 INTRODUCTION

1.1 Rationale for population-level sodium determination in 24-hour urine samples

1.1.1 Background

The impact of the major noncommunicable diseases (NCDs) – diabetes, cardiovascular diseases, cancer, chronic respiratory diseases and mental disorders – in the WHO European Region is alarming: taken together, these five conditions account for an estimated 89% of deaths and 84% of the disease burden.

Excess body weight (body mass index > 25 kg/m^2), excessive consumption of energy, saturated fats, trans fats, sugar and salt, as well as low consumption of vegetables, fruits and whole grains, are leading risk factors and priority concerns *(1)*.

The cost of treatment of NCDs is high. If it is not addressed, the economic impact will be enormous to both people living wth NCDs and society. Interventions aimed at reducing the burden of NCDs and the main modifiable risk factors will provide the highest return on investment *(2)*.

There is compelling evidence (epidemiological, clinical and animal experimental) of the direct relationship between salt consumption and blood pressure (BP) and that current levels of salt intake are a major factor in increasing BP *(3–5)*. If people reduce dietary salt, whether they are normotensive or hypertensive, raised BP can be avoided, hypertension better controlled, thousands of deaths from stroke, heart and renal disease prevented *(6)*, and health-care systems spared substantial treatment and health-related costs *(7–11)*.

WHO is coordinating initiatives globally to reduce dietary salt intake at the population level across the different regions of the world. In 2007 *(12)* and 2012 *(13)*, WHO restated the objective of reducing population salt intake to a recommended target of less than 5 g of salt per adult per day to prevent cardiovascular disease. Finally, Articles 43 and 44 of the United Nations Political Declaration of the High-level Meeting of the General Assembly on the Prevention and Control of Non-communicable Diseases (2011) endorsed the policy and gave a mandate to WHO to implement it worldwide *(14)*.

1.1.2 Rationale for surveillance of salt intake

The fundamental rationale underlying salt intake surveys is to estimate a baseline of population-level dietary salt intake and, from there, to monitor trends in intake and the effectiveness of any interventions within and between populations.

1.1.3 Rationale for complementary food consumption information

To guide policy development and associated population-level interventions aimed at reducing dietary salt, not only is information needed on salt intake, but also on the main food sources of salt in the diet and the typical frequency of their consumption. There are several methods available for collecting information on food consumption *(15)*.

The best estimate of the population profile distribution and average level of dietary salt intake is provided by measuring 24-hour urinary sodium excretion in a representative sample of individuals *(16)*.

It is recommended that the food products to be measured are grouped into a smaller number of broader food categories (such as breads, meats, cheeses, breakfast cereals, etc.). These can then be used as the basis for raising awareness among consumers as to the food categories that contribute most salt to the diet; they also provide the basis for policies and interventions with industry that include target-setting by category. If a category is too wide and varied, it is difficult to set a target; if there are too many categories, target-setting and monitoring can become unmanageable.

There are a number of examples of food categories to consider *(17,18)*.

1.1.4 Rationale for joint surveillance of potassium

Low dietary potassium is associated with hypertension *(19)* and stroke *(20)*, and supplementing potassium to hypertensive individuals lowers BP *(21,22)* and reduces the use of antihypertensive medications *(23)*. WHO now recommends increasing the dietary intake of potassium for the prevention of cardiovascular disease *(24)*. Some populations are deficient in dietary potassium if they rely on processed foods. However, there is a deficiency in data on the intake of potassium in most populations. Estimating potassium and sodium intake at the same time can inform the design of potential population interventions to improve both sodium and potassium intakes *(25)*.

1.1.5 Rationale for joint surveillance of iodine

To address the concern regarding the possible detrimental effect of dietary salt reduction on programmes to prevent iodine deficiency disorder (IDD) that rely on salt as a carrier of iodine, it is recommended that iodine intake be assessed along with salt *(26)*. The inclusion of this variable in studies of salt intake that use 24-hour urine samples would in fact benefit IDD-prevention programmes *(27,28)*. The method provides the most accurate and appropriate indicator of whether populations, regardless of age, gender or climatic environment, are receiving the recommended amounts of this nutrient, which – judging by current salt intake and salt iodization levels – may be insufficient, sufficient or even excessive *(29,30)*.

1.1.6 Use of gold-standard methods

Collecting 24-hour urine samples is considered the gold-standard method. Use of the spot urine method has been proposed as an alternative *(31)*. However, a number of papers have assessed the validity, reliability and reproducibility of several methods available in the literature that claim to be able to estimate 24-hour urinary sodium output from spot or timed collections *(32–37)*. The results of these methodological assessments are all concordant in showing that every method leads to biased estimates of 24-hour urinary sodium excretions, although some are less biased than others.

To estimate intake of sodium, potassium and iodine with high level of accuracy, the use of spot urine is not recommended by the WHO Regional Office for Europe, in line with other international health organizations *(38–40)*.

1.2 Overview of how to obtain measures of population-level sodium intake in 24-hour urine samples

This protocol on how to obtain measures of population-level sodium intake in 24-hour urine samples is a resource for countries that wish to start dietary salt-reduction initiatives and to contribute to and share the information obtained. The protocol will assist with:

- planning and preparing the scope of a survey study to estimate dietary salt intake
- recruiting and training field staff for data collection
- reporting and disseminating the results.

While the substance of concern to health is sodium, strategies to reduce its intake are aimed at its main source in the diet – salt (sodium chloride), which is used in the household at the table and in cooking and as an additive in industrially manufactured foods.

1.2.1 Primary aims of the study

The primary aims of the study are to:

- estimate the average intake of dietary salt in men and women in the age stratum 18–69 through measurement of 24-hour urinary sodium excretion;
- provide information for designing and implementing interventions aimed at reducing population-level dietary salt;
- determine subsequent estimates of salt intake in the same population to assist monitoring intake over time; and
- provide trends in salt intake against which to monitor and evaluate the effectiveness of interventions aimed at population-level dietary salt reduction.

1.2.2 Additional aims

Additional aims are to:

- estimate the average intake of dietary potassium through joint measurement of 24-hour urinary potassium excretion;
- estimate the average intake of iodine through joint measurement of 24-hour urinary iodine excretion; and
- determine creatinine excretion.

1.2.3 Other possible aims

Other possible aims are to:

- estimate intake of sodium, potassium and iodine in populations otherwise differentiated, e.g. by ethnicity, socioeconomic status, geographical location, other target age groups, etc.;
- support health economic analysis by estimating salt intake for specific age strata; and
- estimate fluoride excretion (if required).

1.2.4 Intended audience

The protocol is primarily intended for principal investigator(s) of studies of sodium, potassium and iodine intake. Parts of the manual are also intended for field staff who may interact with survey participants.

1.2.5 Structure

The following sections provide detailed guidance on how to implement population-level sodium, potassium and iodine determination in 24-hour urine samples.

There is both general information and specific instructional material that can be extracted and used for:

- training
- data collection.

Important conversions

5 g salt (Na^+Cl^-) = 2000 mg Na^+ = 87 mmol (or mEq) Na^+
23 mg Na^+ = 1 mmol (mEq) Na^+
39.1 mg K^+ = 1 mmol (mEq) K^+
126.9 mg I^- = 1 mmol (mEq) I^-
113.12 g Cr = 1 mol Cr

Na+: sodium; K+: potassium; I–: iodine, Cr: creatinine.

2 FIELD PROTOCOL

2.1 Overview of the field protocol

2.1.1 Components

The protocol on how to obtain measures of population-level sodium intake in 24-hour urine samples can stand alone or be an additional module to an existing NCD risk-factor instrument, such as the WHO STEPwise approach to risk factor surveillance *(41)*. For a stand-alone protocol, the required components (with their related data elements) are set out in Table 1. If performed as part of another risk-factor study that collects the data described in components 1 to 3, only components 4 and 5 of the protocol are required.

Table 1. Components of a stand-alone protocol

	Description	Purpose
1	Questionnaire on demographic, food consumption and behavioural information	*To obtain data on:* • sociodemographic information • tobacco and alcohol use • dietary habits • physical activity • knowledge, attitudes and behaviour towards dietary salt
2	Questionnaire on personal medical history, including drug treatment	*To determine the proportion of adults who:* • currently have NCDs, and their complications • are under daily long-term medical treatment for any condition
3	Physical measurements with simple methods	*To determine the proportion of adults who:* • are overweight and obese • have high BP
4	24-hour urine sample collection	*To determine:* • sodium, potassium and iodine excretion • creatinine excretion as a quality control marker
5	A 50–100 g sample of household salt	*To determine:* • iodine content of household salt

2.1.2 Core and expanded data

Each of the first three components of the protocol has a minimum core of required data and a set of expanded desirable data for collection, as shown in Table 2. Whether core or core plus expanded data are collected depends on what can realistically be accomplished in each country setting (financially, logistically, and in terms of human and clinical resources).

Table 2. Core and expanded sets for data collection

	Core	Expanded
1	*Basic demographic information including:* • country and region of origin (if relevant) • age • sex • tobacco use • alcohol consumption • physical activity • sedentary behaviour • fruit and vegetable consumption • knowledge, attitudes and behaviour towards dietary salt and iodine • ethnicity • highest level of education • employment	*Expanded demographic information including:* • household income • history of tobacco use • patterns of alcohol drinking • oil and fat consumption • history of raised BP • history of diabetes
2	• antihypertensive medication used • personal medical history	• family medical history
3	• height (cm) and weight (kg) • waist circumference (cm) • systolic and diastolic blood pressures (mmHg) • heart rate (beats/minute)	• hip circumference (cm)

2.2 Planning and conducting a 24-hour urine collection study

The recommended tasks to plan and conduct a 24-hour urine collection study are set out in Table 3. The timeframes will be situation-specific and should be estimated to support the planning process.

2.2.1 Intended audience

The information in this section is primarily intended for those fulfilling the following roles:

- site coordinator
- coordinating committee.

Table 3. Recommended tasks for a 24-hour urine collection study

Tasks and timeframes	
Task	Approximate timeframe
Develop implementation plan	4–6 months
Identify scope of study	1 month
Gain ethical approval	1–6 months
Adapt and translate the field protocol questionnaire	2–8 weeks
Conduct pilot test	2–8 weeks

2.3 Selecting the population sample

2.3.1 Sample population

The objective of sampling is to select and conduct the study in a limited number of participants, so that study results are representative of the target population. This implies that a degree of uncertainty needs to be accepted. The sample size and methodology are determined by precision, variability within and between subjects, statistical power, play of chance, representativeness, sampling methods, feasibility and cost.

Sample size is calculated under the assumption that salt consumption is normally distributed in the population and that the primary objective is to detect a change in mean population salt intake at a repeated survey. Sample size can be calculated using the following formula:

$$n = 2 \times \frac{\left(z_{\left(1-\frac{\alpha}{2}\right)} + z_{(1-\beta)}\right)^2}{\left(\frac{d}{sd}\right)^2}$$

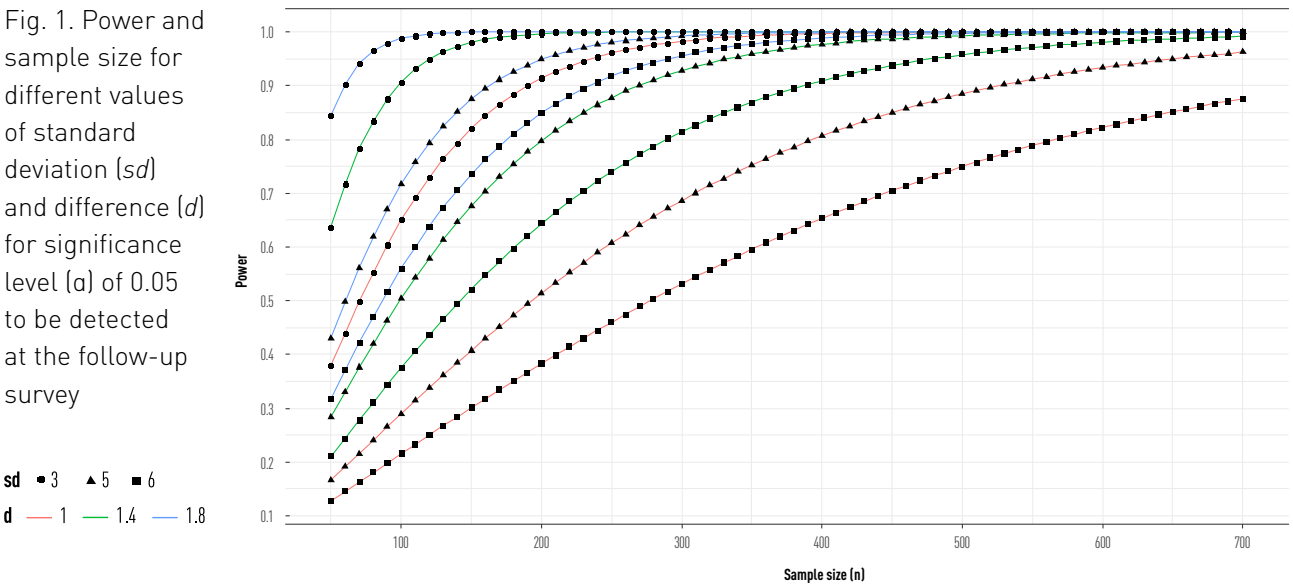
Where:

- n is sample size
- α is the significance level, usually 0.05
- (1-ß) is the power of the test, usually 0.8
- Z is the inverse of the standard normal cumulative distribution function for the supplied probability value
- d is the difference of salt intake in the population to be detected at a repeated survey
- sd is the standard deviation of salt intake in the population.

Fig. 1 shows the relationship between power, sample size, precision in the difference and variation in excreted salt to be detected for significance level (α) of 0.05 for selected *sd* and *d* values. For example, to detect 1 g/day reduction in salt intake at repeated survey using 24-hour urinary sodium excretion, with a standard deviation of 3 g/day, a sample of 141 individuals is required to reach power of 0.8.

To account for attrition (e.g. non-participation, incomplete collection or implausible values), which may be as high as 50%, up to 282 people should be invited to participate. If the survey is conducted with the aim of monitoring trends in four age and sex groups, the overall calculated required sample size is 1128 participants.

Fig. 1. Power and sample size for different values of standard deviation (*sd*) and difference (*d*) for significance level (α) of 0.05 to be detected at the follow-up survey



If complex sampling is used instead of simple random sampling, additional adjustment for sampling design is necessary. For example, in household surveys cluster sampling is commonly used. In this design, the primary selection unit is a geographical cluster, and in each cluster a number of participants is randomly selected. The participants in the same cluster may share similarities and their salt consumption may have common determinants. Thus, the salt consumption levels of participants in one cluster may not represent independent observations. Therefore, the sample size would need to be adjusted for the design effect of the sampling based on values from similar studies. In a cluster design with 10–20 participants per cluster, often a design effect of 1.5 is assumed. Larger cluster size results in larger design effect and thus smaller overall power.

An Excel spreadsheet is available to calculate the sample size for a 24-hour urine excretion salt survey. This can be accessed from the WHO European Office for the Prevention and Control of NCDs website. In addition, a spreadsheet for random sampling is available from the WHO STEPwise approach to surveillance (STEPS) website and can be used also for selection of a random sample for the 24-hour salt survey *(42)*. This spreadsheet supports the PPS (probability proportional to size) sampling method, which is recommended for cluster sampling and can also calculate sampling weights.

2.3.2 Recommendations for sample selection

Recommendations are for:

- random or otherwise probabilistic sample;
- sample selected using culturally appropriate methods;
- stratification by age group and sex with a minimum of two groups (i.e. men and women in two age groups, 18–44 and 45–69; or in four age groups, 18–29, 30–44, 45–54, 55–69);
- if a sentinel site is selected, long-term monitoring must be justifiable and feasible; and
- age and sex of respondents and non-respondents are noted.

2.3.3 Exclusion criteria

Exclusion criteria are:

- people unable to provide informed consent
- those with a known history of heart or kidney failure, stroke, or liver disease
- pregnant women
- those who recently began therapy with diuretics (less than two weeks)
- any other conditions that would make 24-hour urine collection difficult.

2.4 Implementation plan

2.4.1 The purpose of the implementation

The purpose of the implementation plan is to:

- set out the scope of the surveillance and desired goals
- identify required resources
- lay out an action plan
- develop a communication strategy
- provide a budget as the basis for funding.

A detailed implementation plan for the 24-hour urine sample study is needed for all stakeholders involved in the surveillance process.

2.4.2 Core parts of the implementation plan

The core parts needed for the implementation plan are shown in Table 4.

Table 4. Core parts required for the implementation plan

Core parts	Detail
Executive summary	*High-level summary of main points including:* • current situation • goals and objectives • scope • resources • budget
Current situation	*Specify:* • whether the study will determine a baseline of sodium intake • whether the study will assess change in intake (if so, reference the baseline study) • whether a risk factor survey has already been conducted • whether there is an existing infrastructure (human capacity, equipment, other studies) on which the 24-hour urine sample collection could be built
Goals and objectives	*Identify planned goals and use of the information collected:* • to describe the current level of dietary salt intake in populations (if available) • to track the direction and magnitude of trends in salt consumption • to plan and evaluate a health promotion or preventive campaign • to collect data from which to predict likely future demands for health services • to specify objectives that support gathering essential information only • to describe broad timeframes
Scope	*Specify:* • the scope of surveillance to be conducted (coverage of core and expanded data) • whether future sodium determination surveillance can be assured
Sampling method	*Identify:* • the sample size and sample frame that will be used • the geographical coverage *Describe* sample design
Resources	*Specify* the resources in terms of all personnel and equipment required for sodium determination in 24-hour urine sampling study *Describe* resources that have been committed or are expected, including support from particular countries *Specify* resources from other organizations
Action plan	*Prepare* a chart of the main tasks with estimated start date and timeframe for completion of each
Communication strategy	*Specify* the methods for informing and involving all stakeholders relevant to the sodium determination project, including community leaders, members of the public and media
Budget	*Provide a detailed budget that includes:* • total funds required for each year planned to implement all sodium determination activities as identified in the scope (including future surveys) • sources of funding • funding gaps

2.5 Applying for ethical approval

Ethical approval is necessary to ensure that the study:

- is conducted in a technically and ethically sound manner
- recognizes and protects the rights of participants
- ensures wide access to the information collected in the study.

2.5.1 Process

Usually, ethical approval should be sought by submission of a proposal and application to a national ethics review committee or other equivalent body. However, if such a body is not institutionalized, it is recommended that an application for ethical review be prepared and submitted through an ad-hoc local mechanism within the ministry of health.

2.5.2 Informed consent

Informed consent, preferably in writing, must be obtained from every survey participant before conducting any interviews or collecting any samples.

2.5.3 Making a submission

The existing template for proposals supplied by the appropriate ethics committee or equivalent body should be used. If such a template does not exist, the relevant body should be identified and contacted to seek guidance on rules, the submission process and any procedures that need to be followed.

> Studies that plan to use the protocol on how to obtain measures of population-level sodium intake in 24-hour urine samples must undergo technical and ethical review and approval.

2.6 Timeframes and data-collection considerations

2.6.1 General timeframes

Table 5 shows the recommended phases of a sodium determination study. Timeframes are situation-specific.

Table 5. Recommended phases of a sodium determination study

Phase	Approximate timeframe
Planning and scoping	2–4 months
Recruiting and training	2–3 months
Data collection	3–6 months
Data analysis and reporting	3–9 months

2.6.2 Data collection

Some key factors to consider when identifying an appropriate time to conduct the study are shown in Table 6.

Table 6. Key factors to be considered when establishing timeframe

Factor	Guideline(s)
Season	• Consider dietary changes that might occur between seasons • Avoid festive seasons (e.g. Ramadan, Christmas, Holy Week, and other national or religious holidays) • Avoid seasons when food is in unusually short supply (if applicable)
Calendar year	• Confine the study to one calendar year if possible
Major events	• Avoid data collection during periods prior to local, regional or national elections to avoid confusion with political campaigns
Civil unrest, turmoil, famine, etc.	• Avoid conducting a study at any time when pressing matters occupy the minds and lives of the population
Collection timeframe	• Keep the timeframe as close as possible (within reason) to the recommended timeframe

2.6.3 Data-collection locations

It is recommended that all components of the study be conducted/administered in the household setting. Ideally, participants/respondents should collect all their urine samples at home; if this is not possible, they should bring home any urine passed away from home. The total urine passed in the 24-hour period should be picked up at the household within one day of the 24-hour collection period. It is recommended that measurements and food consumption information are collected during the second visit to the household.

Data collection should be carefully planned to take place over a defined period of time and during an appropriate season.

2.7 Adapting the protocol for sodium determination in 24-hour urine samples to local context

Using a standardized protocol for sodium determination in 24-hour urine samples allows comparisons to be made between countries. However, some adaptations may be required to take account of differences in cultures or settings.

2.7.1 When to adapt the protocol

Adaptations may be needed to provide valid data from the surveillance. Adaptation is often needed to the terminology used and additional information provided, while questions on behaviours that do not apply may need to be deleted.

2.7.2 Adaptation process

The process of adapting the protocol may involve the following:

- identifying the instructions or questions that require local adaptation

- adding or deleting questions
- adding other forms as appropriate
- seeking feedback and advice
- translating and back-translating the adapted instructions or questionnaires
- pilot-testing the questionnaires.

2.8 Pilot testing

Before implementing the full study, a pilot test of the entire data-collection process must be conducted using a limited number of people with a broad range of backgrounds.

Pilots should involve all aspects of the survey including:

- approaching potential participants
- seeking and obtaining informed consents
- making arrangements/appointments for second visits after the participant-led 24-hour urine sample collection
- carrying out site preparation and set-up
- collecting all data needed
- identifying participants who may need a follow-up
- conducting basic analysis.

2.8.1 Test group

Willing participants should be identified and approached to be part of the pilot test. The test group should include the following:

- both men and women
- participants covering the full age range 18–64
- more than one ethnic group (if appropriate)
- participants with different levels of education
- participants from a range of socioeconomic groups
- participants from distinctly different regions in the same country.

2.8.2 Test environment

Where possible, the pilot test should be conducted under the field conditions expected for the final full study, i.e. in the household setting.

2.8.3 Timeframe

When planning the pilot test, sufficient time should be allowed for adjustments to be made prior to starting full data collection.

3 DATA COLLECTION GUIDE

Guidelines for data collection for components 1 to 3 of the protocol (section 2.1 above) can be obtained from the WHO STEPwise manual (part 3, sections 1–4) *(41)*. The core questions on knowledge, attitudes and behaviour towards dietary salt are given in section 6 below.

The information below serves the field staff/survey team involved in components 4 and 5 of the protocol for 24-hour urine sample collection (section 2.1 above).

3.1 Instructions for field staff, equipment and analytical methods

3.1.1 Instructing participants

Field staff must explain the collection protocol, obtain informed consent, and provide the record sheet on which participants note the start and finish times of their 24-hour urine collection, any missed urine collections, and any medication taken during the collection.

In the morning of the start of the 24-hour period, the participant must void the bladder and note the time. The noting of time should be observed by the field staff. **This "first-pass urine" is discarded**. All urine passed thereafter is collected in the container provided, including the first urine of the following morning, with the final time recorded. Respondents are given detailed written instructions (see section 4).

At the time of the first visit to the household, field staff must inform the participant of the second visit.

The second visit must be made within one day of the completion of the 24-hour collection period. A sample of household salt should be taken during the second visit.

If measurements are taken and food consumption information is required, it should be collected during the second visit.

3.1.2 Equipment supplied to participants

Participants are supplied with:

- a 5-litre capacity screw-cap container to store the collected urine;
- a 1-litre plastic jug with a wide opening into which urine is voided, with or without the use of a funnel;
- an optional 2-litre capacity screw-cap container for temporary collections of urine made away from the home.
- a funnel to use for urine collection, kept inside a resealable plastic bag when not in use;
- two opaque plastic bags for carrying the equipment outside the home; and
- an aide-memoire to help participants remember to collect their urine – for example, a safety pin to pin under and outer garments together during the collection period as a reminder that urine about to be passed should be collected.

The use of PABA (para-aminobenzoic acid) to assess completeness of the urine collection is *not* recommended. It requires that each participant take three PABA pills over the 24-hour period of the urine collection, thereby increasing the risks of noncompliance and attrition. In addition, laboratory facilities for testing PABA in the urine are limited and, where they exist, will increase the costs of the study.

3.1.3 At the completion of the collection

Field staff should measure the total volume of urine by weighing the full container and then subtracting the weight of the empty container. The volume is expressed in grams and taken as a proxy for millilitres (assuming the specific weight of urine is 1 g for every 1 ml). The collected urine is then mixed thoroughly in its container and three 10 ml aliquots withdrawn into separate labelled tubes for storage and shipping for analysis. The rest of the urine is discarded.

Sodium, potassium, iodine and creatinine content in the urine is to be measured in certified laboratories, as is the iodine content of the household salt.

3.1.4 Analytic methods

Sodium and potassium content in the urine may be determined through ion-selective electrode (indirect) with a Beckman Coulter SYNCHRON CX5 PRO system or equivalent.

Creatinine content may be determined through the creatinine (urinary) Jaffe kinetic method, standardized, also to be measured by the Beckman Coulter SYNCHRON CX5 PRO system or equivalent.

Iodine in urine may be determined with the traditional kinetic method of Sandell–Kolthoff *(43)* or by inductively coupled plasma spectrometry.

Iodine content of household salt can be determined quantitatively with the titration method. In addition to the titration method, there are possibilities of using potentiometry or spectrophotometry *(43)*.

3.2 Guide to physical measurements

Selected physical measurements may be taken to determine the proportion of participants in the study who:

- have raised blood pressure
- are overweight and/or obese.

In the following sections, a description of the most important aspects of taking physical measurements is given, including:

- the physical measurements and what they mean
- the equipment needed
- how to assemble and use the equipment
- how to take the measurements and accurately record the results.

More detailed guidance on taking physical measurements can be found in the manual for the WHO STEPwise approach to NCD risk-factor surveillance *(41)*.

3.2.1 Physical measurements

BP is measured to determine the proportion of participants who have raised BP. Heart rate, measured with automated devices at the same time as BP, is a common independent cardiovascular risk factor. Height and weight measurements are taken to calculate the body mass index (BMI), which is needed to determine the prevalence of overweight and obesity in the population. Waist circumference measurements provide additional information on overweight and obesity. Hip circumference is an expanded data option to measure overweight and obesity.

3.2.2 Units of measurement

Table 7 shows the standard units used for the physical measurements in component 3 of the protocol, including their upper and lower limits for data-entry purposes.

Table 7. Standard units used for physical measurements

Physical measurement	Unit	Minimum	Max
Systolic blood pressure (SBP)	mmHg	40	300
Diastolic blood pressure (DBP)	mmHg	30	200
Height	cm	100	270
Weight	kg	20	350
BMI	kg/m^2	11	75
Waist circumference	cm	30	200
Hip circumference	cm	45	300
Heart rate	beats/minute	30	200

3.2.3 Sequence of questions and measurement

As is the case with many risk-factor studies, physical measurements should be taken immediately after the personal medical history. Physical measurement results should be recorded on the same participant instruments as personal medical history.

3.2.4 Participant instructions

Prior to taking physical measurements, explain to the participant that the following measurements will be taken.

For core data collection:

- blood pressure
- heart rate
- height
- weight
- waist circumference.

For expanded data collection:

- hip circumference.

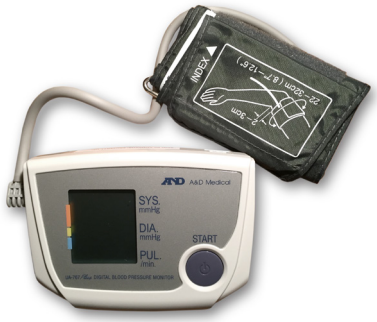
3.3 Measuring BP and heart rate

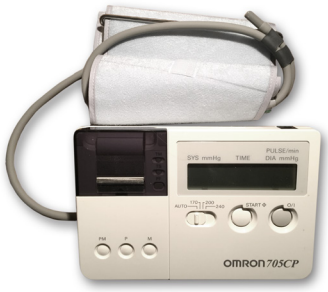
3.3.1 Equipment needed

- A validated digital automatic BP monitor (Fig. 2) is required.. An up-to-date list of recommended equipment can be obtained by contacting the WHO European Office for the Prevention and Control of NCDs: NCDoffice@who.int. Professional societies may maintain similar information. For instance, a list of BP-measuring devices validated by the British and Irish Hypertension Society is available from http://www.bihsoc.org/bp-monitors.
- Appropriate size cuffs are also necessary.

The protocol does not endorse any particular device – any monitor that has been properly validated may be used.

Fig. 2. Examples of validated BP measuring devices





3.3.2 Preparing the participant

Prior to measuring BP, the participant should be asked to sit in a quiet comfortable place for at least five minutes with their back supported and legs uncrossed. If the questions in components 1 and 2, on behaviour and personal medical history, have been asked just before the physical measurements are to be taken, the participant should rest for at least five minutes before BP measurement is started. No one should talk to the participant while BP is being taken.

3.3.3 Three measurements – BP and heart rate

WHO recommends taking three BP measurements. During the data analysis, the mean of the second and third readings is calculated. The participant must rest for one minute between each of the readings. The measurement and recording of heart rate should be done three times along with the measurement and recording of BP. Heart rate and BP results are displayed simultaneously with automated equipment.

3.3.4 Recording BP measurements

The following steps are required:

- after each of the three measurements, the result should be recorded in the participant's instrument;
- after all three readings have been taken, a double-check should be performed to ensure that all three results are correctly recorded in the instrument; and
- the participant should be informed of their BP readings only after the whole process has been completed.

3.3.5 Applying the cuff

Table 8 gives instructions on how to select an appropriate-sized cuff and how to attach it.

Table 8. Correct selection and fitting of a cuff

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>Place the left arm of the participant on the table with the palm facing upward.[a]</td></tr>
<tr><td>2</td><td>Remove or roll up clothing on the arm.</td></tr>
<tr><td>3</td><td>Select the appropriate cuff size for the participant as follows:
<table>
<tr><th>Mid-arm circumference (cm)</th><th>Cuff size</th></tr>
<tr><td>12–18</td><td>extra small (XS)</td></tr>
<tr><td>18–22</td><td>small (S)</td></tr>
<tr><td>22–32</td><td>medium (M)</td></tr>
<tr><td>32–42</td><td>large (L)</td></tr>
<tr><td>42–50</td><td>extra large (XL)</td></tr>
</table>
If the cuff is the correct size, the marker at the end of the cuff will fit between two other markers in the mid-section of the cuff. The cuff is the wrong size if the end is outside the markers. It is advisable to select the larger-size cuff if there is a question of which size is best. Some cuffs are not marked, in which case they must be labelled with markers.[b] Otherwise, use the mid-arm circumference of each arm to select the correct cuff size.</td></tr>
<tr><td>4</td><td>Position the cuff above the elbow, aligning the mark on the cuff with the brachial artery.</td></tr>
<tr><td>5</td><td>Wrap the cuff snugly around the arm and secure with the Velcro fastener.
Note: the lower edge of the cuff should be placed 1.2–2.5 cm above the inside of the elbow joint.</td></tr>
<tr><td>6</td><td>Keep the cuff at the same level as the heart during measurement.</td></tr>
</table>

[a] If the right arm is used, indicate this in the right-hand-side margin of the participant's instrument.

[b] Even if cuffs are marked by the manufacturer to indicate the acceptable range of arm circumference for the size of cuff, the markings may not agree with the current recommended range and may need to be checked and possibly re-marked *(44)*. Marking can be performed easily using a ruler and permanent marker. The ideal arm circumference for a cuff is 2.5 times the cuff's bladder width. Cuffs can be used on arms that are 4 cm smaller or larger than the "ideal" circumference. To mark or re-mark the cuff, start the measurement at the end that contains the bladder. Permanently mark the cuff at the ideal arm circumference, then draw a line across the cuff at 4 cm on either side of the ideal. The cuff is the right size if, when wrapped around the mid-arm, the end is between the two marked lines.

3.3.6 Taking the BP measurement

Table 9 gives instructions on how to use a typical automated BP monitoring device. However, more detailed operating instructions will be included with the particular device and should be reviewed before taking any BP measurements. If a different digital automatic BP monitor is used, the instructions should be read carefully before use.

Table 9. Correct operation of an automated BP measuring device

Step	Action
1	Switch the monitor ON and press the START button.
2	The monitor will start measuring when it detects the pulse, and the heart symbol will begin to flash. The SBP and DBP readings should be displayed within a few moments (SBP above and DBP below). The heart rate will also be displayed.
3	Record the reading in the participant's instrument.
4	Switch the monitor off but leave the cuff in place.
5	Wait one minute, then repeat steps 1–4 twice.
6	Inform the participant of the BP readings only after the whole process has been completed.

3.3.7 When to use a sphygmomanometer

Use of a (manual, non-digital) sphygmomanometer is generally not recommended, but may be used in the following circumstances:

- if the automated device is not functioning;
- if the display of the automated device shows multiple errors;
- if it is necessary to cross-check automatic BP readings in various clinical states, such as irregular pulse, peripheral circulatory disturbance and extreme hypotension;
- when SBP is >200 mmHg (appropriate measurement of SBP requires inflating the cuff to a pressure of 40 mmHg above SBP; usually, devices' maximum inflation pressure seldom exceeds 240 mmHg); or
- if it is necessary to calibrate the automated device monitor.

3.3.8 Procedure for using a sphygmomanometer

Measuring the BP of a participant using a sphygmomanometer involves following the steps in Table 10 and referring to the operating instructions provided with the device.

Table 10. Correct procedure for use of a sphygmomanometer

Step	Action
1	Apply the cuff (see Table 8 above).
2	Put stethoscope earpieces in ear and set to bell.
3	Palpate pulse at either brachial or radial artery. Take a pulse on count for one full minute.
4	Pump up pressure and inflate cuff until unable to feel pulse.
5	Continue to inflate cuff 40 mmHg beyond this point.
6	Apply the bell of the stethoscope to the right antecubital fossa.
7	Listen for pulse sounds while deflating the cuff slowly.
8	Record the SBP when a pulse is first audible.
9	Record the DBP when the pulse sound disappears.
10	Deflate the cuff fully and let the arm rest for one minute (between each reading).
11	Repeat steps 2–10 twice to obtain three readings. Record the readings to the nearest 2 mmHg.[a]
12	Check that all readings are correctly filled in on the participant's instrument.
13	Inform the participant of the BP readings only after the whole process has been completed.

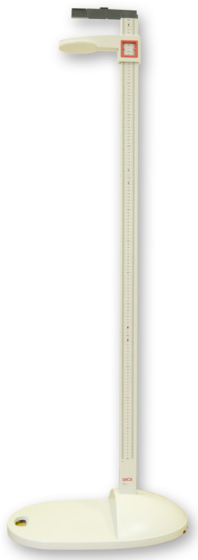
[a] Analyse BP readings by 2 mmHg to test for terminal digit preference as a quality assurance method (terminal digit preference is the tendency to record to 10 mmHg rather than 2 mmHg).

3.4 Measuring height

3.4.1 Equipment needed

- A portable height/length measuring board (stadiometer) is required (Fig. 3).

Fig. 3. A portable measuring board (stadiometer)



3.4.2 Assembling the measuring board

The steps shown in Table 11 should be followed to assemble the measuring board.

Table 11. Assembly of a measuring board

Step	Action
1	Unpack and separate the pieces of the board (usually three pieces).
2	Assemble the pieces by attaching each one on top of the other, making sure they are in the correct order.
3	Lock the latches at the back.
4	Position the board on a firm surface against a wall.

3.4.3 Measuring height

The steps shown in Table 12 should be followed to measure the height of a participant.

Table 12. Procedure to measure a participant

Step	Action
1	Ask the participant to remove their footwear (shoes, slippers, sandals, etc.) and headgear (hat, cap, hair bows, comb, ribbons, etc.). *Note:* if it would be insensitive to seek removal of a scarf or veil, the measurement may be taken over light fabric.
2	Ask the participant to stand on the board facing you.
3	Ask the participant to stand with feet together, heels against the back board, knees straight.
4	Ask the participant to look straight ahead and not tilt their head up.
5	Make sure eyes are the same level as the ears.
6	Move the measuring arm gently down onto the head of the participant and ask the participant to breathe in and stand tall.
7	Read the height in centimetres at the exact point.
8	Ask the participant to step away from the measuring board.
9	Record the height measurement in centimetres in the participant's instrument.

3.5 Measuring weight

3.5.1 Equipment needed

The equipment required is:

- a portable weighing scale (Fig. 4);
- a stiff wooden board to place under the scale, if there are likely to be problems with uneven surfaces (such as dirt or mud floors or carpet); and
- a generator, if an electronic scale is being used and electricity is not guaranteed in all survey areas (a check should be made to see if the scale can operate with batteries).

Fig. 4. Analogue (top) and digital scales

3.5.2 Set-up requirements

The scale should be placed on a firm, flat surface.

It should not be placed on:

- carpet
- a sloping surface
- a rough, uneven surface.

3.5.3 Electronic scales

The steps shown in Table 13 should be taken to put an electronic scale into operation.

Table 13. Setting up and starting an electronic scale

Step	Action
1	Put the scale on a firm, flat surface.
2	Connect the adaptor to the main power line or generator.
3	Switch on the scale.
4	Wait until the display shows 0.0.

3.5.4 Measuring weight

The steps shown in Table 14 should be followed to measure the weight of a participant..

Table 14. Procedure to weigh a participant

Step	Action
1	Ask the participant to remove their footwear (shoes, slippers, sandals, etc.) and socks.
2	Ask the participant to step onto the scale with one foot on each side of the scale.
3	Ask the participant to: • stand still • face forward • place arms by their side and wait until asked to step off.
4	Record the weight in kilograms on the participant's instrument. If the participant wants to know their weight in pounds, convert by multiplying the measured weight by 2.2.

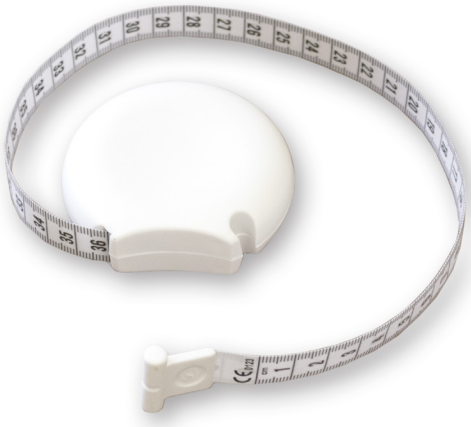
3.6 Measuring waist circumference

3.6.1 Equipment needed

The equipment required is:

- a constant-tension measuring tape (Fig. 5)
- a chair or coat stand on which the participant can place their clothes.

Fig. 5. Using a measuring tape to measure waist circumference[a]



[a] Once the tape is in position and when the measurement is about to be taken, participants should have their arms relaxed by their side.

3.6.2 Privacy

A private area is necessary for this measurement. This could be a separate room or an area that has been screened off from other people in the household.

3.6.3 Preparing the participant

This measurement should ideally be taken directly over the skin, with clothing lifted up.

If this is not possible, the measurement may be taken over light clothing. It must not be taken over thick or bulky clothing, which must be removed.

3.6.4 How to take the measurement

This measurement should be taken:

- at the end of a normal expiration
- with the arms relaxed at the sides
- at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest (hip bone).

3.6.5 Measuring waist circumference

The steps shown in Table 15 should be followed to measure the waist circumference of a participant.

Table 15. Procedure to measure a participant's waist circumference

Step	Action
1	Standing to the side of the participant, locate the last palpable rib and the top of the hip bone. You may ask the participant to assist you in locating these points on their body.
2	Ask the participant to wrap the measuring tape around themselves and then position the tape at the midpoint of the last palpable rib and the top of the hip bone, making sure to wrap the tape over the same spot on the opposite side. *Note:* check that the tape is horizontal across the back and front of the participant and as close to parallel with the floor as possible.
3	Ask the participant: • to stand with their feet together with weight evenly distributed across both feet • to hold their arms in a relaxed position by their side • to breathe normally for a few breaths, then make a normal expiration.
4	Measure the waist circumference and read the measurement at the level of the tape to the nearest 0.1 cm, making sure to keep the measuring tape snug but not so tight that it causes compression of the skin.
5	Record the measurement on the participant's instrument.

3.7 Measuring hip circumference

3.7.1 Equipment needed

The equipment required is:

- a constant-tension measuring tape (Fig. 5)
- a chair or coat stand on which the participant can place their clothes.

3.7.2 Privacy

A private area is necessary for this measurement. This could be a separate room or an area that has been screened off from other people in the household. Hip measurements are taken immediately after waist circumferences.

3.7.3 Preparing the participant

This measurement should be taken without clothing, directly over the skin.

If this is not possible, the measurement may be taken over light clothing. It must not be taken over thick or bulky clothing, which must be removed.

3.7.4 How to take the measurement

This measurement should be taken:

- with the arms relaxed at the sides
- at the maximum circumference over the buttocks.

3.7.5 Measuring hip circumference

The steps shown in Table 16 should be followed to measure the hip circumference of a participant.

Table 16. Procedure to measure a participant's hip circumference

Step	Action
1	Stand to the side of the participant and ask them to help wrap the tape around themselves.
2	Position the measuring tape around the maximum circumference of the buttocks.
3	Ask the participant: • to stand with their feet together with weight evenly distributed over both feet • to hold their arms in a relaxed position by their side.
4	Check that the tape position is horizontal all around the body and snug without constricting.
5	Record the measurement on the participant's instrument. *Note:* measure only once and record.

DETAILED INSTRUCTIONS FOR PARTICIPANTS IN 24-HOUR URINE COLLECTION

4

This section brings together instructions that can be given to participants.

4.1 Instructions for participants

We are interested in measuring the dietary intake of certain nutrients – sodium, potassium and iodine. The best way to get this information is by analysing the urine sample you collect during a 24-hour period.

We are NOT testing for drugs or viruses!
Your cooperation is very much appreciated.

We cannot get this essential information in any other way!

4.1.1. Why 24 hours?

The content of some nutrients in urine varies – it depends on what we last ate, how much fluid we drink, how much we exercise and also on what the weather is like. Collecting urine over 24 hours gives much more reliable information about the typical intakes of these nutrients in a person's diet than is possible from a single casual sample. It is also not possible to estimate salt intake using dietary recall surveys or by reporting intake because of the difficulties of measuring discretionary salt use.

4.1.2 Equipment provided

You have been provided with the following equipment to make your collections.

1. A sheet to record the essential information about the collection.
2. Urine-collecting equipment for your home:
   a) a 5-litre screw-cap plastic collection container to store the collected urine during the day. This container may contain a small amount of a preservative (powder or liquid), if the urine is kept at room temperature;
   b) a 1-litre plastic jug with a wide opening into which urine is voided; and
   c) a funnel to use for urine collection, kept inside a resealable plastic bag when not in use. It may also be used to transfer urine samples from the 1-litre plastic jug to the 5-litre collection container.
3. Urine-collecting equipment for outside your home:
   a) a 2-litre screw-cap container for temporary collections of urine; and
   b) two opaque plastic bags for carrying the equipment outside the home.
4. An aide-memoire to help you remember to collect your urine – for example, a safety pin to pin together under and outer garments during the collection period as a reminder that urine about to be passed should be collected.

4.1.3 Before making the urine collection

The field worker will help you choose the day on which you would like to make the 24-hour urine collection. You

may prefer to choose a day when you will be mostly at home or only going out for a short time.

Don't forget to take the jug and 2-litre bottle with you if you leave your home during the day.

If you are female, you should not make your collection during menstruation.

4.1.4 How to make your collection for the whole day (24 hours)

You have been asked to collect all the urine you pass in one day into the container you have been given. **It is not difficult – here is how you do it.**

On the morning of the day that you start your collection, when you first pass urine, **DISCARD IT – DO NOT put it into the container.** Record the date and time on the collection sheet as follows:

Date started	[dd/mm/yyyy]	(e.g. 07/10/2020)
Time started	[hh/mm]	(e.g. 07:35)

From then onwards until the next day, ALL the urine you pass in the next 24 hours, both during the day and the night, must be collected.

The last collection is the urine you pass on the second day at approximately the same time you started the day before. This completes the 24-hour collection. Record the following on the collection sheet:

Date finished	[dd/mm/yyyy]	(e.g. 08/10/2020)
Time finished	[hh/mm]	(e.g. 07:50)

Note: do not worry if you have not collected for *exactly* 24 hours, as long as you record the **exact start and finish time.**

You should pass all urine directly into the 1-litre plastic jug, then pour it into the large 5-litre container, using the funnel if necessary. If you need to open your bowels, always remember to pass urine first before you pass a stool.

Each time you add a new urine specimen to the large container, screw the lid tight and swirl the urine around a few times, to mix it with the preservative.

Any urine collected in the small 2-litre bottle must be transferred to the large bottle as soon as possible, e.g. after returning home.

4.1.5 If you miss a sample

If during the 24-hour collection period a sample is missed for any reason, such as because of a bowel movement, record this on the collection sheet.

4.1.6 Once you have completed your collection

As soon as possible after you have completed your 24-hour urine collection, the health professional will arrange a time to pick up the large container with the total volume of collected urine. In the meantime, store your complete collection in a cool, dark place.

Alternatively, you can arrange a suitable time when you can deliver the collected urine to the team.

4.1.7 If you have any other questions

We hope this leaflet answers the questions you may have. If you have any other questions, contact the health professional. You are free to withdraw from this study at any point.

HOUSEHOLD SALT COLLECTION AND IODINE DETERMINATION

5

This protocol includes optional assessment of the iodine content of table and cooking salt. If a decision is taken to sample salt from households, it is important to ask participants for samples of all types of salt used in the household (at least 50 g). Because the amount of salt might represent the whole supply in the household, field staff should bring sufficient amounts of both types of salt to replace the samples taken.

In the laboratory, both salt samples should be thoroughly mixed using the same procedure as for other dry samples to ensure homogeneity. Then the presence of iodate in the salt should be first identified using a qualitative test kit. For samples that produce a positive reaction (usually a change in colour), the quantity of iodine in the samples should then be determined by titration, dissolving not less than 10 g for refined and small crystal-size salt, and not less than 50 g for raw or large crystal-size salt. Samples that are negative with the test kit should be analysed for the quantitative content of iodide using an appropriate method with the same amounts of salt as specified above for the positive samples.

6 QUESTIONNAIRE

Data to be collected *before* completion of 24-hour urine collection

	Location, date, consent, name	Response
1	Centre/city name	
2	Interviewer ID	
3	Date of completion of the instrument	[dd/mm/yyyy]
4	Consent has been read and obtained	1. Yes 2. No **[if no, end questionnaire]**
5	Time of Interview	[hh:mm] [24-hour clock]
6	Unique participant ID	
	Family surname	
	First name	
7	Sex [record male/female as observed]	1. Male 2. Female
8	What is your date of birth? [Don't know – leave blank]	[dd/mm/yyyy]
Contact phone number where possible		
9		
Double-check exclusion criteria		
10	• Those with known history of heart or kidney failure, stroke, liver disease • Pregnant women • Those who recently began therapy with diuretics (less than two weeks) • Any other conditions that would make 24-hour urine collection difficult	

Essential information to collect regarding the 24-hour urine collection

24-hour urine sample

	Question	Response	
11	Date collection began	-- -- / -- -- / -- -- -- --	[dd/mm/yyyy]
12	Time collection started	-- -- : -- --	[hh:mm]
13	Date collection finished	-- -- /-- -- /-- -- -- --	[dd/mm/yyyy]
14	Time collection finished	-- -- : -- --	[hh:mm]
15	Total volume of urine collected	-- -- -- --	millilitres (ml)
16	Number of missed voids (if any)		

Data to be collected *after* completion of 24-hour urine collection

CORE – height and weight

	Question	Response
17	Device ID for height	
18	Device ID for weight	
19	Height	-- -- . _ centimetres (cm)
20	Weight [If too large for scale, write 666.6]	-- -- . _ kilograms (kg)

CORE – blood pressure

21	Device ID for blood pressure		
22	Cuff size used	---- [S/M/L]	
23	Reading 1	a) Systolic (mmHg) b) Diastolic (mmHg)	-- -- -- --
24	Reading 2	a) Systolic (mmHg) b) Diastolic (mmHg)	-- -- -- --
25	Reading 3	a) Systolic (mmHg) b) Diastolic (mmHg)	-- -- -- --

EXPANDED – physical measurements

Heart rate

26	Reading 1	Beats per minute	-- --
27	Reading 2	Beats per minute	-- --
28	Reading 3	Beats per minute	-- --

CORE – demographic information

	Question	Response
29	What is the highest level of education you have completed? [countries may adapt the response options to match the education system categories in their context]	1. No formal schooling 2. Less than primary school 3. Primary school completed 4. Secondary school completed 5. High school completed 6. College/university completed 7. Postgraduate degree 8. Refused to provide answer
30	What is your marital status?	1. Never married 2. Currently married 3. Separated 4. Divorced 5. Widowed 6. Cohabitating 7. Refused to provide answer
31	Which of the following best describes your main work status over the past 12 months? [countries may adapt the response options to match the work categories typically used in their context/by their statistical departments]	1. Government employee 2. Non-government employee 3. Self-employed 4. Non-paid 5. Student 6. Homemaker 7. Retired 8. Unemployed (able to work) 9. Unemployed (unable to work) 10. Refused to provide answer

CORE – diet

32	In a typical week, on how many days do you eat fruit?	Number of days _____ Don't know
33	How many servings of fruit do you eat on one of those days? [USE SHOWCARD]	Number of servings _____ Don't know
34	In a typical week, on how many days do you eat vegetables?	Number of days _____ Don't know
35	How many servings of vegetables do you eat on one of those days? [USE SHOWCARD]	Number of servings _____ Don't know

EXPANDED – diet

36	What type of oil or fat is most often used for meal preparation in your household? [select only one]	1. Vegetable oil 2. Lard or suet 3. Butter or ghee 4. Margarine 5. Other (if "other", go to uestion 37) 6. None in particular 7. None used 8. Don't know
37	Other (please specify)	_____
38	On average, how many meals (breakfast, lunch or dinner) per week do you eat that were not prepared at home?	Number of meals _____ 77. Don't know
39	Did you use a dietary supplement last week? (B12, vitamin C, multivitamin/minerals, calcium, vitamin D or fish oil)	1. Yes 2. No 3. Don't know

40 How often do you eat iodine-rich foods, e.g. fish, shellfish. Think about the last 12 months.

[Add below iodine-rich foods, depending on the national context]	Never	Less than 1 day a month	1–3 days a month	1 day a week	2 days a week or more
A. Fish					
B. Shellfish					
C. [Add others]					

CORE – knowledge, attitudes and behaviour with respect to dietary salt

41	How often do you add salt or salty sauce, such as soy sauce, to your food right before you eat it or as you are eating it? [select only one]	1. Always 2. Often 3. Sometimes 4. Rarely 5. Never 6. Don't know 7. Refused to provide answer
42	How often is salt, salty seasoning or a salty sauce added in cooking or preparing foods in your household? [select only one]	1. Always 2. Often 3. Sometimes 4. Rarely 5. Never 6. Don't know 7. Refused to provide answer
43	How often do you eat processed food high in salt? (By processed food high in salt, we mean foods that have been altered from their natural state, such as packaged salty snacks, canned salty food including pickles and preserves, salty food prepared at a fast-food restaurant, cheese, bacon and processed meat.) [add country-specific examples] [USE SHOWCARD]	1. Always 2. Often 3. Sometimes 4. Rarely 5. Never 6. Don't know 7. Refused to provide answer

44	How much salt or salty sauce do you think you consume? [select only one]	1. Far too much 2. Too much 3. Just the right amount 4. Too little 5. Far too little 6. Don't know 7. Refused to provide answer
45	Do you think that too much salt or salty sauce in your diet could cause a health problem?	1. Yes 2. No 3. Don't know 4. Refused to provide answer
46	What sort of serious health problems do you think a high-salt diet could cause? [mark as many as you think applicable]	1. High blood pressure 2. Osteoporosis 3. Stomach cancer 4. Kidney stones 5. None of the above 6. All of the above 7. Don't know 8. Refused to provide answer
47	How important to you is lowering the salt/sodium in your diet?	1. Very important 2. Somewhat important 3. Not at all important 4. Don't know 5. Refused to provide answer
Do you do any of the following on a regular basis to control your salt intake? [record for each]		
48	Limit consumption of processed foods	1. Yes 2. No 3. Don't know 4. Refused to provide answer
49	Look at the salt or sodium content on food labels	1. Yes 2. No 3. Don't know 4. Refused to provide answer
50	Buy low-salt/sodium alternatives	1. Yes 2. No 3. Don't know 4. Refused to provide answer
51	Use spices other than salt when cooking	1. Yes 2. No 3. Don't know 4. Refused to provide answer
52	Not add salt when cooking	1. Yes 2. No 3. Don't know 4. Refused to provide answer
53	Not add salt at the table	1. Yes 2. No 3. Don't know 4. Refused to provide answer
54	Avoid eating foods prepared outside home	1. Yes 2. No 3. Don't know 4. Refused to provide answer
55	Do other things specifically to control your salt intake	1. Yes 2. No 3. Don't know 4. Refused to provide answer
56	Other (please specify)	

CORE – knowledge, attitudes and behaviour with respect to dietary iodine

Do you agree or disagree with the following statements?

57	Iodine deficiency is an important public health problem worldwide	1. Strongly agree 2. Agree 3. No opinion 4. Disagree 5. Strongly disagree 6. Don't know 7. Refused to provide answer
58	Iodine deficiency is an important public health problem in your country	1. Strongly agree 2. Agree 3. No opinion 4. Disagree 5. Strongly disagree 6. Don't know 7. Refused to provide answer
59	Iodine content should be listed on food packaging	1. Strongly agree 2. Agree 3. No opinion 4. Disagree 5. Strongly disagree 6. Don't know 7. Refused to provide answer
60	Lack of iodine can cause goitre (enlarged thyroid gland)	1. Strongly agree 2. Agree 3. No opinion 4. Disagree 5. Strongly disagree 6. Don't know 7. Refused to provide answer
61	Lack of iodine can cause mental retardation in children	1. Strongly agree 2. Agree 3. No opinion 4. Disagree 5. Strongly disagree 6. Don't know 7. Refused to provide answer

CORE – personal medical history

62	Have you ever been told by a doctor or other health worker that you have, or have had, **heart failure**?	1. Yes 2. No 3. Don't know 4. Refused to provide answer
63	Have you ever been told by a doctor or other health worker that you have had a **heart attack**?	1. Yes 2. No 3. Don't know 4. Refused to provide answer
64	Have you ever been told by a doctor or other health worker that you have, or have had, **other heart trouble**? (if yes, please specify)	1. Yes _____ 2. No 3. Don't know 4. Refused to provide answer
65	Have you ever been told by a doctor or other health worker that you have had a **stroke**?	1. Yes 2. No 3. Don't know 4. Refused to provide answer
66	Have you ever been told by a doctor or other health worker that you have **raised cholesterol**?	1. Yes 2. No 3. Don't know 4. Refused to provide answer
67	Have you ever been told by a doctor or other health worker that you have **raised blood sugar or diabetes**?	1. Yes 2. No 3. Don't know 4. Refused to provide answer

CORE – history of raised blood pressure

68	Have you ever had your blood pressure measured by a doctor or other health worker?	1. Yes 2. No 3. Don't know 4. Refused to provide answer
69	Have you ever been told by a doctor or other health worker that you have **raised blood pressure or hypertension**?	1. Yes 2. No 3. Don't know 4. Refused to provide answer
70	Have you been told this in the past 12 months?	1. Yes 2. No 3. Don't know 4. Refused to provide answer
Are you currently receiving any of the following treatments/advice for high blood pressure prescribed by a doctor or other health worker?		
71	Drugs (medication) that you have taken in the past two weeks	1. Yes 2. No 3. Don't know 4. Refused to provide answer
72	Advice to reduce salt intake	1. Yes 2. No 3. Don't know 4. Refused to provide answer
73	Advice or treatment to lose weight	1. Yes 2. No 3. Don't know 4. Refused to provide answer
74	Advice or treatment to stop smoking	1. Yes 2. No 3. Don't know 4. Refused to provide answer
75	Advice to start or do more exercise	1. Yes 2. No 3. Don't know 4. Refused to provide answer

Additional questions about tobacco and/or alcohol use may be considered, e.g. questions from the WHO STEPwise approach manual *(41)*.

7 DATA CLEANING AND STATISTICAL ANALYSIS

The intended audienceis:

- members of research/study team with data analysis expertise.

The objective of data cleaning is to improve the quality of data by omitting implausible or unlikely values. From the total initial sample of screened participants, those with certain key missing data will be excluded. Of those participants with a complete set of data, the following exclusions will be applied as a quality control to assess completeness of urine collection:

(1) participants declaring that they have missed more than one void of urine in the collection period;

(2) urinary volume <500 mL;

(3) duration of urine collection <23h or >25h (alternatively, more inclusive criteria can be considered, e.g. <22h or >26h); and

(4) 24h urinary creatinine excretion outside two standard deviations of the sex-specific distribution.

To convert urinary output into dietary intake, the first step is to normalize "urine" of volume, sodium, potassium, creatinine and iodine quantities to a 24h period (1440 minutes). This is obtained by the following formula:

24h urinary excretion = observed value * 24h / observed time

The urinary excretion of sodium (UNa) or potassium (UK) in mmoL/24h will then be converted to mg/24h (for sodium, 1 mmol = 23 mg; for potassium, 1 mmol = 39 mg). The conversion from dietary sodium (Na) intake to salt (NaCl) intake will be made by multiplying the sodium value by 2.542. Then, sodium values will be multiplied by 1.05 to allow for non-urinary losses (assuming that approximately 95% of sodium ingested is excreted in the urine) *(45)*. For potassium, dietary intake will be calculated assuming 85% of the potassium ingested is excreted in the urine *(46)*. Total daily urinary iodine will be expressed in mcg/24h; urinary iodine concentration in mcg/L.

If needed and possible, the results obtained should be adjusted and weighted for sampling design, non-response rate and population distribution so that they are representative of the whole target population.

Data for 24h intake of salt, potassium and iodine will be reported as continuous variables and percentage of population in specific ranges based on WHO recommendations – namely, <5 g/day for salt *(13)* and >90 mmol/day for potassium *(24)*. The cut-off targets for iodine consumption set by WHO (based on urinary iodine concentrations in mcg/L derived from 24h collections) are as follows *(47,48)*:

(a) insufficient (<100 mcg/L), with subcategories: (a1) severe (<20 mcg/L), (a2) moderate (20–49 mcg/L), (a3) mild (50–99 mcg/L);

(b) adequate (100–199 mcg/L);

(c) above requirement (200–299 mcg/L); and

(d) excessive (>300 mcg/L).

Measures of variability and uncertainty such as standard deviation and confidence intervals will be reported as appropriate. If not otherwise specified, two-sided *p* below 0.05 will be considered statistically significant. *t*-test for unpaired samples or analysis of variance (ANOVA) will be used to test differences between groups for continuous variables and the chi-squared test will be used for categorical variables. The methods need to be adjusted for sampling design as appropriate. Bootstrapping methods can be used.

Details of the data-cleaning algorithm, conversion factors, any adjustments used and statistical methods used must be described in the final report.

REFERENCES[1]

1. European Food and Nutrition Action Plan 2015–2020. Copenhagen: WHO Regional Office for Europe; 2015 (https://www.euro.who.int/en/publications/abstracts/european-food-and-nutrition-action-plan-20152020-2014).
2. Maziak W, Critchley J, Zaman S, Unwin N, Capewell S, Bennett K et al. Mediterranean studies of cardiovascular disease and hyperglycemia: analytical modeling of population socioeconomic transitions (MedCHAMPS) – rationale and methods. Int J Public Health. 2013;58(4):547–53.
3. Aburto NJ, Ziolkovska A, Hooper L, Elliott P, Cappuccio FP, Meerpohl J. Effect of lower sodium intake on health outcomes: systematic review and meta-analysis. BMJ. 2013;346:f1326.
4. He FJ, Li J, MacGregor GA. Effect of longer term modest salt reduction on blood pressure: Cochrane systematic review and meta-analysis of randomized trials. BMJ. 2013;346:f1325.
5. Cappuccio FP, Capewell S. Facts, issues and controversies in salt reduction for the prevention of cardiovascular disease. Funct Food Rev. 2015;7(1):41–61.
6. Strazzullo P, D'Elia L, Kandala N-B, Cappuccio FP. Salt intake, stroke and cardiovascular disease: a meta-analysis of prospective studies. BMJ. 2009;339:b4567.
7. Sacks FM, Svetkey LP, Vollmer WM, Appel LJ, Bray GA, Harsha D et al. Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. DASH-Sodium Collaborative Research Group. N Engl J Med. 2001;344(1):3–10.
8. Kumanyika SK, Cook NR, Cutler JA, Belden L, Brewer A, Cohen JD et al. Sodium reduction for hypertension prevention in overweight adults: further results from the Trials of Hypertension Prevention Phase II. J Hum Hypertens. 2005;19(1):33–45.
9. Asaria P, Chisholm D, Mathers C, Ezzati M, Beaglehole R. Chronic disease prevention: health effects and financial costs of strategies to reduce salt intake and control tobacco use. Lancet. 2007;370:2044–53.
10. Murray CJ, Lauer JA, Hutubessy RC, Niessen L, Tomijima N, Rodgers A et al. Effectiveness and costs of interventions to lower systolic blood pressure and cholesterol: a global and regional analysis on reduction of cardiovascular disease risk. Lancet. 2003;361:717–25.
11. Bibbins-Domingo K, Chertow GM, Coxson PG, Moran A, Lightwood JM, Pletcher MJ et al. Projected effect of dietary salt reductions on future cardiovascular disease. N Engl J Med. 2010;362:590–9.
12. Reducing salt intake in populations: report of a WHO forum and technical meeting. Geneva: World Health Organization; 2007 (https://apps.who.int/iris/handle/10665/43653).
13. Guideline: sodium intake for adults and children. Geneva: World Health Organization; 2012 (https://www.who.int/publications-detail/9789241504836).
14. Political Declaration of the High-level Meeting of the General Assembly on the Prevention and Control of Non-communicable Diseases. 66th session of the United Nations General Assembly. A/RES/66/2. New York (NY): United Nations; 2011.
15. Anderson CAM, Appel LJ, Okuda N, Brown IJ, Chan Q, Zhao L et al. Dietary sources of sodium in China, Japan, the United Kingdom, and the United States, women and men aged 40 to 59 years: the INTERMAP study. J Am Diet Assoc. 2010;110(5):736–45.
16. An assessment of dietary sodium levels among adults (aged 19–64) in the UK general population in 2008, based on analysis of dietary sodium in 24-hour urine samples. London: National Centre for Social Research; 2008.
17. National salt initiatives: implementing the EU framework for salt reduction initiatives. Brussels: European Commission; 2009 (https://ec.europa.eu/health/archive/ph_determinants/life_style/nutrition/documents/national_salt_en.pdf).
18. The Choices Programme [online consumer help programme]. The Hague: Choices International Foundation (https://www.choicesprogramme.org/what-we-do/the-choices-programme).
19. Elliott P, Stamler J, Nichols R, Dyer AR, Stamler R, Kesteloot H et al. Intersalt revisited: further analyses of 24 hour sodium excretion and blood pressure within and across populations. BMJ. 1996;312:1249–53.
20. D'Elia L, Barba G, Cappuccio FP, Strazzullo P. Potassium intake, stroke and cardiovascular disease: a meta-analysis of prospective studies. J Am Coll Cardiol. 2011;57(10):1210–19.
21. Cappuccio FP, MacGregor GA. Does potassium supplementation lower blood pressure? A meta-analysis of published trials. J Hypertens. 1991;9:465–73.
22. Aburto NJ, Hanson S, Gutierrez H, Hooper L, Elliott P, Cappuccio FP. Effect of increased potassium intake on health: systematic review and meta-analysis. BMJ. 2013;346:f1378.

[1] All weblinks accessed 23 February 2021.

23. Siani A, Strazzullo P, Giacco A, Pacioni D, Celentano E, Mancini M. Increasing the dietary potassium intake reduces the need for antihypertensive medication. Ann Intern Med. 1991;115(10):753–9.

24. Guideline: potassium intake for adults and children. Geneva: World Health Organization; 2012 (https://www.who.int/publications/i/item/9789241504829).

25. Cappuccio FP. Sodium and potassium intake, blood pressure and cardiovascular prevention. Section 44.6. In: Camm AJ, Lüscher TF, Maurer G, Serruys PW, editors. The ESC textbook of cardiovascular medicine. Third edition. Oxford: Oxford University Press; 2018.

26. Salt as a vehicle for fortification. Report of a WHO expert consultation. Geneva: World Health Organization; 2007 (https://apps.who.int/nutrition/publications/micronutrients/978924159678/en/index.html).

27. Campbell N, Dary O, Cappuccio FP, Neufeld L, Harding K, Zimmermann MB. A call for action to coordinate programs to improve global health by optimizing salt and iodine intake. Bull World Health Organ. 2012;90:73–4.

28. Campbell NRC, Dary O, Cappuccio FP, Neufeld LM, Harding KB, Zimmermann MB. Need for coordinated programs to improve global health by optimizing salt and iodine intake. Rev Panam Salud Publica. 2012;32(4):281–6.

29. Andersson M, de Benoist B, Rogers L. Epidemiology of iodine deficiency: salt iodisation and iodine status. Best Pract Res Clin Endocrinol Metab. 2010;24(1):1–11.

30. D'Elia L, Obreja G, Ciobanu A, Breda J, Jewell J, Cappuccio FP. Sodium, potassium and iodine intake in a national adult population sample of the Republic of Moldova. Nutrients. 2019;11(12):2896.

31. Hawkes C, Webster J. National approaches to monitoring population salt intake: a trade-off between accuracy and practicality? PLoS One. 2012;7(10):e46727.

32. Ji C, Sykes L, Paul C, Dary O, Legetic B, Campbell NRC et al. Systematic review of studies comparing 24-hour and spot urine collections for estimating population salt intake. Rev Panam Salud Publica. 2012;32(4):307–15.

33. Brown IJ, Dyer AR, Chan Q, Cogswell ME, Ueshima H, Stamler J et al. Estimating 24-hour urinary sodium excretion from casual urinary sodium concentrations in Western populations. Am J Epidemiol. 2013;177(11):1180–92.

34. Cogswell ME, Elliott P, Wang CY, Rhodes DG, Pfeiffer CM, Loria CM. Assessing U.S. sodium intake through dietary data and urine biomarkers. Adv Nutr. 2013;4(5):560–2.

35. Cogswell ME, Wang CY, Chen TC, Pfeiffer CM, Elliott P, Gillespie CD et al. Validity of predictive equations for 24-h urinary sodium excretion in adults aged 18–39 y. Am J Clin Nutr. 2013;98(6):1502–13.

36. Wang CY, Cogswell ME, Loria CM, Chen TC, Pfeiffer CM, Swanson CA et al. Urinary excretion of sodium, potassium, and chloride, but not iodine, varies by timing of collection in a 24-hour calibration study. J Nutr. 2013;143(8):1276–82.

37. Ji C, Miller MA, Venezia A, Strazzullo P, Cappuccio FP. Comparison of spot vs 24-h urine samples for estimating population salt intake: validation study in two independent samples of adults in Britain and Italy. Nutr Metab Cardiovasc Dis. 2014;24(2):140–7.

38. Campbell NRC, He FJ, Tan M, Cappuccio FP, Neal B, Woodward M et al. The International Consortium for Quality Research on Dietary Sodium/Salt (TRUE) position statement on the use of 24-hour, spot and short duration (<24-hours) timed urine collections to assess dietary sodium intake. J Clin Hypertens. 2019;21:700–9.

39. Cappuccio FP, Beer M, Strazzullo P; European Salt Action Network. Population dietary salt reduction and the risk of cardiovascular disease. A scientific statement from the European Salt Action Network. Nutr Metab Cardiovasc Dis. 2019;29:107–14.

40. Cappuccio FP, Sever PS; British and Irish Hypertension Society. The importance of a valid assessment of salt intake in individuals and populations. A scientific statement of the British and Irish Hypertension Society. J Hum Hypertens. 2019;33:345–8.

41. WHO STEPwise approach to noncommunicable disease surveillance: manual. Geneva: World Health Organization; 2017 (https://www.who.int/ncds/surveillance/steps/manual/en/).

42. STEPS sample size calculator and sampling spreadsheet. Geneva: World Health Organization (https://www.who.int/ncds/surveillance/steps/resources/sampling/en).

43. Assessment of iodine deficiency disorders and monitoring their elimination: a guide for programme managers. Third edition. Geneva: World Health Organization; 2007 (https://www.who.int/nutrition/publications/micronutrients/iodine_deficiency/9789241595827/en).

44. Campbell NRC, McKay DW, Chockalingam A, Fodor JG. Errors in assessment of blood pressure: sphygmomanometers and blood pressure cuffs. Can J Public Health. 1994;85 Suppl. 2:S22–5.

45. Lucko AM, Doktorchik C, Woodward M, Cogswell M, Neal B, Rabi D et al. Percentage of ingested sodium excreted in 24-hour urine collections: a systematic review and meta-analysis. J Clin Hypertens (Greenwich). 2018;20(9):1220–9.

46. Stamler J, Elliott P, Chan Q; INTERMAP Research group. INTERMAP appendix tables. J Hum Hypertens. 2003;17:665–758.

47. Guideline: fortification of food-grade salt with iodine for the prevention and control of iodine deficiency disorders. Geneva: World Health Organization; 2014 (https://apps.who.int/iris/handle/10665/136908).

48. Salt reduction and iodine fortification strategies in public health: report of a joint technical meeting convened by the World Health Organization and the George Institute for Global Health in collaboration with the International Council for the Control of Iodine Deficiency Disorders Global Network, Sydney, Australia, March 2013. Geneva: World Health Organization; 2014 (https://www.who.int/nutrition/publications/publichealth_saltreduc_iodine_fortification/en/).

World Health Organization
REGIONAL OFFICE FOR Europe

The WHO Regional Office for Europe

The World Health Organization (WHO) is a specialized agency of the United Nations created in 1948 with the primary responsibility for international health matters and public health. The WHO Regional Office for Europe is one of six regional offices throughout the world, each with its own programme geared to the particular health conditions of the countries it serves.

Member States

Albania
Andorra
Armenia
Austria
Azerbaijan
Belarus
Belgium
Bosnia and Herzegovina
Bulgaria
Croatia
Cyprus
Czechia
Denmark
Estonia
Finland
France
Georgia
Germany
Greece
Hungary
Iceland
Ireland
Israel
Italy
Kazakhstan
Kyrgyzstan
Latvia
Lithuania
Luxembourg
Malta
Monaco
Montenegro
Netherlands
North Macedonia
Norway
Poland
Portugal
Republic of Moldova
Romania
Russian Federation
San Marino
Serbia
Slovakia
Slovenia
Spain
Sweden
Switzerland
Tajikistan
Turkey
Turkmenistan
Ukraine
United Kingdom
Uzbekistan

World Health Organization Regional Office for Europe

UN City, Marmorvej 51
DK-2100, Copenhagen Ø, Denmark
Tel.: +45 45 33 70 00
Fax: +45 45 33 70 01
Email: eurocontact@who.int
Website: www.euro.who.int

WHO/EURO:2021-2333-42088-57949