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Monitoring and implementation of salt reduction initiatives in Africa: A systematic review

Abstract

This systematic review aims to document salt consumption patterns and the implementation status and potential impact of salt reduction initiatives in Africa, from studies published between January 2009 and November 2019. Studies were sourced using MEDLINE, Embase, Cochrane Library electronic databases, and gray literature. Of the 887 records retrieved, 38 studies conducted in 18 African countries were included. Twelve studies measured population salt intake, 11 examined salt level in foods, 11 assessed consumer knowledge, attitudes, and behaviors, 1 study evaluated a behavior change intervention, and 3 studies modeled potential health gains and cost savings of salt reduction interventions. The population salt intake studies determined by 24-hour urine collections showed that the mean (SD) salt intake in African adults ranged from 6.8 (2.2) g to 11.3 (5.4) g/d. Salt levels in foods were generally high, and consumer knowledge was fairly high but did not seem to translate into salt lowering behaviors. Modeling studies showed that interventions for reducing dietary sodium would generate large health gains and cost savings for the health system. Despite this evidence, adoption of population salt reduction strategies in Africa has been slow, and dietary consumption of sodium remains high. Only South Africa adopted legislation in 2016 to reduce population salt intake, but success of this intervention has not yet been fully evaluated. Thus, rigorous evaluation of the salt reduction legislation in South Africa and initiation of salt reduction programs in other African countries will be vital to achieving the targeted 30% reduction in salt intake by 2025.

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Monitoring and implementation of salt reduction initiatives in Africa: A systematic review

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Abstract

This systematic review aims to document salt consumption patterns and the implementation status and potential impact of salt reduction initiatives in Africa, from studies published between January 2009 and November 2019. Studies were sourced using MEDLINE, Embase, Cochrane Library electronic databases, and gray literature. Of the 887 records retrieved, 38 studies conducted in 18 African countries were included. Twelve studies measured population salt intake, 11 examined salt level in foods, 11 assessed consumer knowledge, attitudes, and behaviors, 1 study evaluated a behavior change intervention, and 3 studies modeled potential health gains and cost savings of salt reduction interventions. The population salt intake studies determined by 24-hour urine collections showed that the mean (SD) salt intake in African adults ranged from 6.8 (2.2) g to 11.3 (5.4) g/d. Salt levels in foods were generally high, and consumer knowledge was fairly high but did not seem to translate into salt lowering behaviors. Modeling studies showed that interventions for reducing dietary sodium would generate large health gains and cost savings for the health system. Despite this evidence, adoption of population salt reduction strategies in Africa has been slow, and dietary consumption of sodium remains high. Only South Africa adopted legislation in 2016 to reduce population salt intake, but success of this intervention has not yet been fully evaluated. Thus, rigorous evaluation of the salt reduction legislation in South Africa and initiation of salt reduction programs in other African countries will be vital to achieving the targeted 30% reduction in salt intake by 2025.

1 | INTRODUCTION

Non-communicable diseases (NCDs), such as cardiovascular diseases (CVD), diabetes, chronic obstructive pulmonary diseases (COPD), and cancers, are now the leading causes of death globally contributing to more deaths each year than all other causes combined.¹ It has been

estimated that NCDs cause 41 million of the world's 57 million deaths (71%).² Global projections indicate that NCDs disproportionately affect low- and middle-income countries (LMICs), with three-quarters (32 million deaths) of NCD-related deaths occurring in LMICs, populations and communities, where they impose large, avoidable costs in human, social, and economic terms.³ Africa is facing a double burden

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of both communicable diseases notably HIV/AIDS, malaria, tuberculosis, and an urgent but “neglected epidemic” of NCDs, the burden of which are already substantial.⁴ Indeed, the biggest increase in NCD deaths globally in the next decade is expected in Africa, where they are likely to become the leading cause of death by 2030.³

The rise in NCDs largely stems from four behavioral risk factors: tobacco use, unhealthy diet, insufficient physical activity, and harmful use of alcohol. The contribution from unhealthy diet to the burden of NCDs exceeds the combined contribution from alcohol, tobacco, and physical inactivity,^{5,6} which is largely due to an observed change in diet at the population level. This change, dubbed the “nutrition transition,” is characterized by a shift from traditional diets based largely on staple grains or starchy roots, legumes, vegetables, and fruits but minimal animal foods, toward more energy-dense, foods of animal origin and processed foods, high in sugar, saturated fat, artificial trans-fatty acids, and sodium—which are cheaply available to consumers.⁷⁻⁹

According to the 2017 Global Burden of Disease (GBD) Study, a diet high in sodium is ranked as the leading dietary risk factor for deaths and disability-adjusted life years (DALYs) globally,¹⁰ and habitual consumption of excessive sodium—most commonly through the consumption of salt—predispose individuals to hypertension¹¹⁻¹³ which is a major risk factor for CVD, leading cause of premature death worldwide.^{3,14} In addition, high salt consumption increases the risk of other NCDs, such as gastric cancer,¹⁵ kidney stones,¹⁶ and osteoporosis.¹⁷

In view of the overwhelming evidence linking high salt intake to CVDs and a range of other illnesses, the World Health Organization (WHO) has identified population salt reduction as a priority intervention for ameliorating the global burden of NCDs. WHO member states agreed on a global target of a 30% relative reduction in population salt intake to be achieved by 2025 and to an absolute level of no more than 5 g/d.¹⁸ Despite these targets as part of the WHO Global Action Plan to reduce the burden of NCDs,¹⁸ there are still limited examples of effective strategies to reduce population-level dietary salt consumption globally, especially from African countries.¹⁹⁻²¹

Two previous separate reviews have collated evidence on evaluated salt reduction interventions¹⁹ and salt intakes²² in sub-Saharan Africa. However, there is currently no up-to-date comprehensive review on salt reduction initiatives in the region. Thus, the objective of this review was to systematically document salt consumption patterns and implementation status and potential impact of salt reduction initiatives in Africa aiming to inform recommendations to support the future development, implementation, and evaluation of national salt reduction programs in the region.

2 | METHODS

2.1 | Search strategy

A literature search was conducted in November 2018 using the MEDLINE, Embase, and the Cochrane Library databases and updated on November 2019. This search was supplemented by a gray literature search using the same search terms in OpenGrey, Google, and WHO web sites and expert consultation. The search strategies used

for the bibliometric databases are shown as a supplementary material. Hand searching of reference lists was performed from review papers retrieved from these databases.

2.2 | Study selection and eligibility criteria

Criteria for inclusion were as follows: complete publications available online, in English and studies published between January 2009 and November 2019 regarding population-level salt intake, salt levels in foods, consumers' knowledge, attitudes, and behavior (KAB), and economic evaluation and modeling studies were included in this review, whereas criteria for exclusion were as follows: duplicate publications, conference abstracts, and review articles.

Two reviewers (DT and JS) conducted the searches, extracted potential papers, and removed duplicates. The two reviewers then independently screened titles and abstracts for eligibility. Furthermore, full texts were retrieved for all papers deemed potentially eligible, and these were screened independently by the two reviewers with disagreements resolved through discussion.

2.3 | Data extraction and risk of bias assessment

An Excel data extraction template was developed DT to collect the following information authors, study years, publication year, country of study, study design, population characteristics, and summary of results. Data extraction was completed by the lead author (DT) and reviewed by the second author (JS).

Three authors (DT, JS, and KT) independently assessed the risk of bias for the salt intake and evaluation studies with disagreements resolved through discussion. Studies were appraised using an adapted version of the Cochrane risk of bias tool^{23,24} that included seven bias domains: sampling, confounding, reliability/validity of outcome measure, blinding of outcome assessment, representativeness of sample, risk of selective outcome reporting, and other sources of bias. The same 3 authors independently assigned a rating of high, low, or unclear risk of bias for each domain. After discussing on the assigned rating among the authors, the overall rate will be taken.

2.4 | Data analysis

A narrative synthesis of findings (descriptive approach) was undertaken due to the heterogeneous nature of the outcomes reported in the studies.

3 | RESULTS

3.1 | Search results

Figure 1 shows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram from our search, which

yielded 451 citations after de-duplication. From these, 342 were excluded based on title and abstract screening. Full-text screening of the remaining 109 review papers identified 38 studies that met our inclusion criteria.

The studies included 12 population-level salt intake studies, 11 salt levels in food studies, 11 consumers' knowledge, attitudes, and behavior (KAB) studies, 1 behavior change evaluation study, and 3 modeling studies (see Table 1).

3.2 | Study characteristics

The characteristics of the included studies are shown in Tables 2-6. Eighteen out of 54 African countries were represented in these 38 study reports. The studies included a range of study designs including 29 cross-sectional studies, 2 case-control studies, 4 cohort studies, 1 evaluation, and 3 modeling studies.

3.3 | Population salt intake

Twelve studies from eight countries reported population-level salt intake (Table 2). Six countries reported using 24-hour urine collection, and two countries (Ethiopia and Cape Verde) reported using random spot urine collection and 24-hour dietary recall, respectively. The daily salt intake in African adults ranged from 6.8 (2.2) in

South African adults aged 50 and older (50) to 11.3 (5.4) g/day adults 25-64 years in Benin.²⁶ In addition, the daily urinary salt excretion was generally higher in men than in women.³⁵

3.4 | Salt level in foods

Ten studies from six countries (Table 3) reported salt level in foods through food analysis^{30,37,38,40,43,44} nutrition information panels,⁵² and 24-hour dietary recalls.^{39,53} Salt levels in foods were high and variable, both within and between countries. For example, mean (SD) sodium levels in foods ranged from 21.6 (0.2) mg/100 g on Nigerian local dishes called Eba and Okro Soup⁴³ to 88 mg/100 g on "stifpap," which is a traditional food of South Africa made of refined maize meal, water, and salt.⁵³

3.5 | Consumers' knowledge, attitude, and behavior (KAB)

Eleven studies from 11 African countries measured KAB in relation to salt (Table 4). Most participants had fairly high knowledge of the adverse health effects of excessive salt intake, regarded salt reduction as of low importance, and did not practice salt reduction behaviors. In addition, women have higher knowledge regarding salt intake than men.^{41,59}

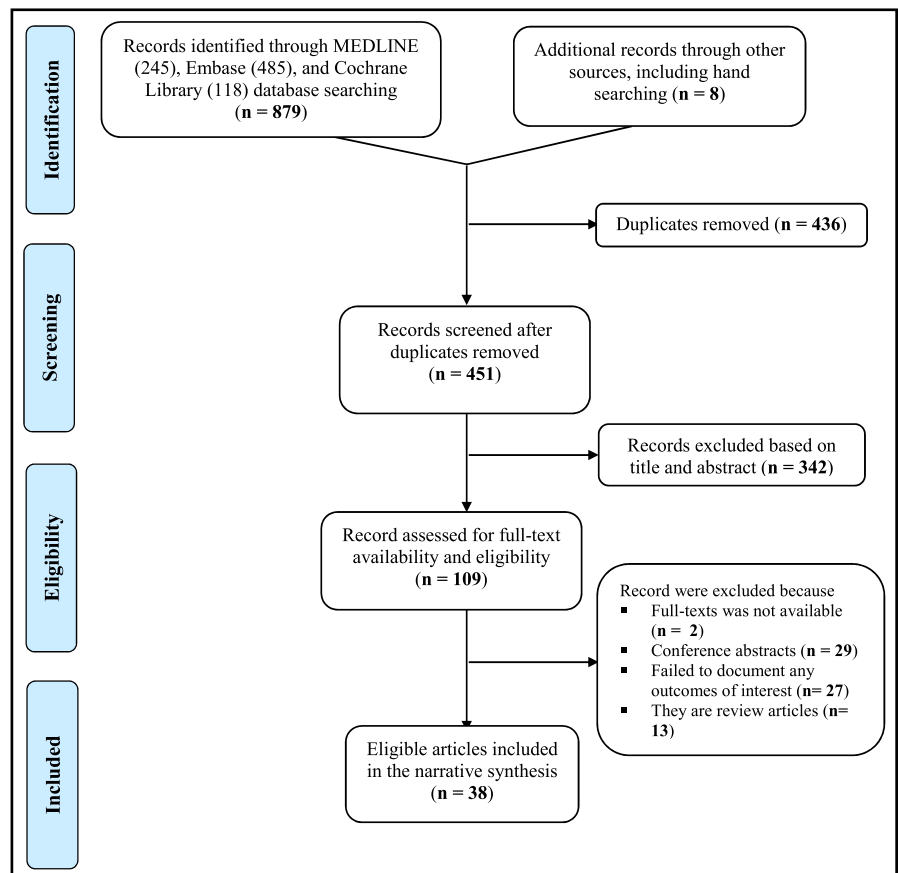


FIGURE 1 Studies included in this systematic review from January 2009 to November 2019

Country name	Evaluation studies	Salt intake	Salt levels in food	Knowledge, attitudes, and behaviors	Modeling
Angola				25	
Benin		26		27	
Cameroon					28
Cape Verde		29			
Egypt			30		
Ethiopia		31			
Ghana				32	
Guinea				27	
Kenya				27,33	
Malawi		34			
Morocco		35,36	37,38		
Mozambique		39	39,40	27,39,41	
Nigeria		42	43,44	45	
Seychelles				27	
South Africa	46	47-50	51-54	32,55,56	57,58
Tunisia			30		
Uganda				59	
Zambia				60	

TABLE 1 Classification of studies conducted in African countries

3.6 | Evaluation studies

One behavior change evaluation study was conducted in South Africa⁴⁶ (Table 5). Following the “mass-media campaign to increase the awareness of the need to reduce discretionary salt,” significantly more participants (increased from 38% to 50%, $P < .0001$) reported that they were taking steps to control salt intake. Less people reported adding salt while cooking and at the table (63% decreased to 40% and 21% decreased to 15%, respectively) after the campaign compared with pre-campaign levels.⁴⁶

3.7 | Modeling studies

Three modeling studies were conducted in South Africa and Cameroon, two modeling the health impacts only and the other modeled the cost-effectiveness of salt reduction interventions^{28,57,58} (Table 6). Bertram et al estimated that if the sodium content of all bread, margarine, soups, and gravies was reduced, 7400 CVD deaths and 4300 nonfatal strokes would be averted in 2008.⁵⁷ In addition, Aminde et al reported reducing salt intake by 30% could lead to a 16.8% change (reduction) in premature mortality from CVD between 2016 and 2030.²⁸ Subsequently, Watkins et al estimated that the South African government's salt policy would avert 5600 CVD deaths in 2012 and save households US \$4 million in out-of-pocket expenditure and save the government US \$51 million in health care subsidies each year.⁵⁸

3.8 | Risk of bias assessment

From the 12 population salt intake studies and 1 evaluation study for which risk of bias assessment (RoB) was performed, a high risk of bias was observed in one or more domains for 10 studies. Nine studies were at high risk of selection bias because of the representativeness of participants. Four studies scored high risk of detection bias relating to reliability and validity of exposure and outcome assessment, which may affect the outcome measurement as the outcome was likely influenced by a lack of an unreliable measurement method. None of the studies had a high RoB in the domains reporting bias or other bias. We reported the risk of bias for all studies in Table 7.

4 | DISCUSSION

Although WHO Member States have agreed on a global NCD target for a 30% relative reduction in average population salt intake with the aim of achieving a target of <5 g per day by 2025,^{37,38} this review identified limited action to reduce sodium consumption in Africa. Only one country, South Africa, had a strategy to reduce salt. One other, Mauritius, had plan in place but had to implement. All the studies included in this review were observational studies except one evaluation and three modeling studies.

Twelve studies included in this review measured salt intake. Of these, four were nationally representative studies from South Africa

TABLE 2 Characteristics of included population salt intake studies undertaken between January 2009 and November 2019 (n = 12)

Author, year, and design	Country	Study population	Method of assessment	Summary result
Alves et al ²⁹ Cross-sectional study	Cape Verde	≥18 years of age with at least 6 months living history in Plateau (formal area), in part of Vila Nova (informal area) and Palmarejo (formal and informal areas)	24-h dietary recall	<ul style="list-style-type: none"> Median (range) sodium intake among the adult Cape Verdeans age ≥18 was 3707.4 mg/d (IQR: 2308.6-5219.7 mg/d) 79.9% of women and 70.6% of men exceeded the WHO recommendations for sodium intake Sex differences were observed in daily sodium intake, with higher values for men ($P = .006$)
Challa et al ³¹ Cross-sectional study	Ethiopia	15-69 years of age and with more than 6 months of residential history in all regions of the country, including Addis Ababa and Dire Dawa city administration	Random spot urine sample collection	The mean salt intake among the adult Ethiopia population age 15-69 was 8.3 (95% CI 8.2-8.4) g/d, and most participants (96.2%) consumed more than the maximum recommended daily salt intake of 5 g salt/d. Mean salt intake was higher among males (9.0 g/d, 95% CI 8.9-9.1) than in females (7.4 g/d, 95% CI 7.3-7.4)
Charlton et al ⁴⁹ Cross-sectional study	South Africa	20- to 65-year-old adult men and women in Cape Town, South Africa	Three 24-h urine sample collections	Mean (SD) urinary salt excretion was higher in white participants (9.5 g/d) than in mixed ancestry (8.5 g/d) or black participants (7.8 g/d)
Charlton et al ⁴⁸ Nested observational study	South Africa	Men and women aged over 50 years old from WHO-SAGE South Africa Wave 2	24-h urine sample collection	Median (range) daily salt excretion was 6.3 (1-43) g/d
Derouiche et al ³⁵ Cross-sectional study	Morocco	24- to 64-year-old adult men and women from the central region of Morocco	24-h urine sample collection	Mean (SD) daily salt excretion for all participants was 7 (3.5) g/d, with 7.4 (3) g/d in men and 7 (4) g/d in women
Mizehoun-Addisoda et al ²⁶ Cross-sectional study	Benin	Adult, apparently healthy, population aged 25-64 years who lived in Bohicon, Tanvè district for at least 6 months	24-h urine sample collection	Mean (SD) daily dietary salt intake was 11.3 (5.4) g. A high intake of sodium was associated with urban area, age <44 years, administrative occupation, higher income, BMI ≥25 kg/m ² , and a high waist circumference
Prynn et al ³⁴ Cross-sectional study	Malawi	≥18-year-old adult Malawians living in Karonga District and Area 25 of Lilongwe, respectively	24-h urine sample collection	Mean salt intake was 6.8 g in the rural and 7.1 g in the urban area. Younger male and urban residents had the highest estimated salt intake
Queiroz et al ³⁹ Cross-sectional study	Mozambique	25- to 64-year-old adult workers of the Maputo Central Hospital	24-h urine sample collection and 24-h dietary recall	Mean (SD) daily urinary salt excretion was 10.6 (4.6) g. Almost half (56.4%) of women and 41.9% of men had a salt intake above twice the recommended
Saeid et al ⁶¹ Cross-sectional study	Morocco	Children 6-18 years old in Rabat City	24-h urine sample collection	The average of urinary sodium was 2235.3 ± 823.2 mg/d, and 50% of children consume more than the corresponding upper limits. Sodium consumption increased significantly with age
Swanepoel et al ⁴⁷ Cross-sectional study	South Africa	20- to 30-year-old apparently healthy black and white men and women from North West Province and KwaZulu-Natal, South Africa	24-h urine sample collection	The median daily salt intake was 7.2 g/d

(Continues)

TABLE 2 (Continued)

Author, year, and design	Country	Study population	Method of assessment	Summary result
Tayo et al ⁴² Cross-sectional study	Nigeria	African diaspora	24-h urine sample collection	Mean (SD) daily urinary sodium of Nigerian participants was 145.5 (63.1) mmol, and their sodium excretion was 123.9 (54.6) mmol
Ware et al ⁵⁰ Cross-sectional study	South Africa	Men and women aged over 18 years old from WHO-SAGE South Africa Wave 2	24-h urine sample collection and interviews	Median salt intake (6.8 ± 2.2 g/d) was higher in younger than older adults (8.6 g/day vs 6.1 g/day; $P < .001$), and in urban compared to rural populations (7.0 g/d vs 6.0 g/d; $P = .03$)

and Ethiopia, which assessed salt intake estimates using the gold standard 24-hour urine and spot urine sample collection methods, respectively. Daily salt intake in African adults ranged from 6.8 (2.2) in South Africa (50) to 11.3 (5.4) g/d in Benin,²⁶ suggesting that many populations consume well above the recommended limit of 5 g/d. The problem of high salt intake may be explained by lack of awareness of the link between salt intake and NCDs,⁶² apathy on the part of consumers, and lack of political will to reduce population salt intake.

In this review, Morocco⁴⁴ was identified as the only country with data on sodium intake of 2235.3 ± 823.2 mg/d in children which far surpasses the recommended amount by WHO. High sodium intake predisposes children to develop hypertension in adulthood.⁴⁵ High sodium intake also suppresses salt taste receptors that may cause children to prefer food with higher salt content in adulthood.⁴⁶ Data from the United States and other regions suggest that sodium consumption among children and adolescents is as high as that of adults,⁴⁷ though more studies are needed to determine whether this situation exists in Africa.

Studies in the present review, aside from being few in number, were heterogeneous in terms of sample size, age of participants, methods of estimating sodium consumption, and outcomes measured. Because of this, caution should be exercised when interpreting and comparing sodium consumption figures among countries.

This review showed that sodium intake and excretion were generally higher in men than in women.^{29,31,34,35,59} This difference may be due, at least in part, to sex differences in energy intake.⁶³ In agreement with our results,^{41,59} women have higher knowledge and healthier behaviors regarding salt intake compared with men.⁶⁴⁻⁶⁶ This observation may reflect more frequent engagement in health promoting practices among women, due to a greater use of health services,⁶⁷ and subsequent behavior changes to adhere to lower sodium diets compared with men.

Eleven studies from this review measured salt levels in foods. Salt levels were high and variable, both within and between countries. The difference could be explained by the wide sociological, geographical, and economic differences within and among the countries. The highest level of salt was found in Eba and Okro Soup, a Nigerian local dish.⁴³ This could be explained by the customary practice of discretionary use of salt during cooking or at the table. This finding indicates that consideration needs to be given to how best to reduce salt in commonly eaten homemade local dishes in addition to legislation to limit salt levels in commonly eaten processed foods and meals.

Eleven studies identified in the review assessed KAB. These results suggest that knowledge on the detrimental effects of high salt intake was fairly high among African respondents.^{25,27,59} However, this knowledge did not seem to translate into attitudes and practices related to salt intake reduction. For example, participants were frequently unable to correctly identify the maximum recommended daily salt intake, nor were they aware of the link between salt and sodium, and generally did not perceive their salt intake to be high.^{25,27,32,41,55,56,59} The latter may contribute to the low proportion

TABLE 3 Characteristics of included salt level in food studies undertaken between January 2009 and November 2019 (n = 11)

Author, year, and design	Country	Type of food assessed	Source of sodium information	Summary result
Al Jawaldeh et al ³⁰ Cross-sectional study	Egypt Tunisia	Baladi refined bread (Ayash) and Baladi ordinary (Ayash) in Egypt and French bread in Tunisia	Chemical analysis	<ul style="list-style-type: none"> • Mean (SD) salt and sodium content in bread for all countries was 7.63 (SD 3.12) and 3.0 (SD 1.23) g/kg, respectively, with a mean salt content of bread of 4.57 g/kg, contributing 1.4 g of salt intake daily. • Mean salt content of baladi refined and baladi ordinary bread in Egypt was 4.02 and 5.11 g/kg, respectively, which contributed to 1.2 and 1.5 g of salt intake daily. • The salt content of French bread in Tunisia was 12.41 g/kg, contributing 3.7 g of salt intake daily.
El-Kardi et al ³⁷ Cross-sectional study	Morocco	Tuna sandwich, merguez sandwich, minced meat sandwich, eggs sandwich, shawarma, and pizza	Chemical analysis	Mean sodium content in the various types of fast foods showed values ranging from 0.25 g/100 g in minced meat sandwiches to 0.44 g/100 g in pizzas. Regarding salt content per individual serving, pizzas had the highest average salt content (2.93 g/serving), while the minced meat sandwiches had the lowest average amount (1.42 g/serving)
Feeley et al ⁵¹ Longitudinal birth cohort study	South Africa	Consumed foods	Interviewer-assisted questionnaires on dietary practices	Mean sodium content from purchased food items was estimated 4803 mg/wk for males and 4761 mg/wk for females, respectively ($P > .05$). Fast foods contributed the greatest amount to sodium (52.5%), followed by salty snacks (31.2%), confectionery (12.7%), and sweetened beverages (3.6%)
Jafri et al ³⁸ Cross-sectional study	Morocco	Commercial white bread	Chemical analysis	Mean (SD) added salt during preparation of regular white bread was 17.37 (4.23) g/kg, which is the equivalent of a daily intake of 8-9 g of salt through bread alone
Morakimyo et al ⁴³ Cross-sectional study	Nigeria	Commonly consumed local foods in Nigeria	Chemical analysis	Mean (SD) sodium content expressed as mg/100 g dry weight in Nigerian local foods ranged from 5.0 (0.20) in Yam and Egg to 21.6 (0.2) in Eba & Okro
Nwanguma et al ⁴⁴ Cross-sectional study	Nigeria	Retail samples of white bread made from wheat flour	Chemical analysis	Mean salt content of bread samples expressed as g/100 g dry weight was 1.36. The contribution of bread to the recommended daily intake of salt varies from 0.99 to 3.33 g
Peters et al ⁵² Cross-sectional study	South Africa	Processed foods	Nutrition information panel (NIP)	<ul style="list-style-type: none"> • The food groups with the highest median sodium level were snack foods (746 mg/100 g), followed by meat and meat products (734 mg/100 g), and sauces and spreads (673 mg/100 g). • Food categories with the lowest sodium levels included several cereal products (eg, pasta, maize, rice, couscous; all <10 mg/100 g) and dairy products, excluding cheeses (all <100 mg/100 g). • The median sodium level of foods targeted by the sodium legislation ranged from 171 mg/100 g for breakfast cereals and porridges to 4782 mg/100 g for dry soup powders.
Queiroz et al ³⁹ Cross-sectional study	Mozambique	Adult workers of the Maputo Central Hospital	24-h dietary recall	Discretionary sodium contributed 60.1% of total dietary sodium intake, followed by sodium from processed foods (29.0%) and naturally occurring sodium (10.9%). Besides the use of salt added at the table (35% of the participants) and during cooking (96% of the participants), using stock powder when cooking or adding it to prepared food and salads was shown to be frequent in the present sample of the Mozambican population (70% of the participants)

(Continues)

TABLE 3 (Continued)

Author, year, and design	Country	Type of food assessed	Source of sodium information	Summary result
Silva et al ⁴⁰ Cross-sectional study	Mozambique	White bread	Chemical analysis	Mean sodium content of bread available for purchase in the most commonly frequented bakeries and markets in Maputo was 450 mg/100 g
Spearing et al ⁵³ Cross-sectional study	South Africa	Meat-based, starch-based, and legume/vegetable-based meals	24-h dietary recalls	Mean sodium content of all 16 dishes ranged from 88 mg in "stifpap" to 679 mg per 100 g in "fried spinach."
Swanepoel et al ⁵⁴ Cross-sectional study	South Africa	13 food categories <ul style="list-style-type: none"> • Bread • Raw-processed meat sausages • Processed meat—uncured • Processed meat—cured • All fat and butter spreads • All breakfast cereals • Savory snacks, excluding salt-and-vinegar flavored • Flavored ready-to-eat savory snack and potato crisp, salt-and-vinegar only • Dry savory powders with dry instant noodles to be mixed with a liquid • Flavored potato crisp, excluding salt-and-vinegar • Stock cubes/powder/granules/emulsions/pastes/jellies • Dry gravy powders and dry instant savory sauces • Dry soup powder (not instant type) 	Chemical analysis	The majority of the food products tested comply with the targets for 2016 (72%) and almost half of the products with the 2019 targets (42%). The highest variation was observed in the "all fat and butter spread" (20%) category, as well as the "raw-processed meat sausages" (32%). All of the food categories, except for "flavored potato crisp, excluding salt-and-vinegar" and "flavored ready-to-eat savory snack and potato crisp, salt-and-vinegar only," complied with the 2016 target

TABLE 4 Characteristics of included consumer's knowledge, attitudes, and behaviors (KAB) related to salt studies undertaken between January 2009 and November 2019 (n = 11)

Author, year, and design	Country	Study population	Method of knowledge, attitude, and behavior assessment	Summary result
Adika et al ⁴⁵ Cross-sectional study	Nigeria	Non-academic employees in a university community of Bayelsa state, Nigeria	Questionnaire	Despite the ability of most of the participants (72%) to identify that high salt diet as a risk factor for hypertension, they had poor knowledge
Jessen et al ⁴¹ Cross-sectional study	Mozambique	15- to 64-year-old Mozambicans	Dietary salt module of the STEP-wise approach to Surveillance questionnaire	<ul style="list-style-type: none"> A total of 7.4% of the participants perceived that they consumed too much/far too much salt whereas 16.5% referred that they consumed foods high in salt often/always. The percentage of addition of salt or salty seasoning often/always to prepared foods or during preparation was 25.9% and 61.4%, respectively. The proportion of participants that considered that it was not important to decrease the salt contents of their diet was 8.0%, and 16.9% of the participants were not aware that too much salt in diet could have deleterious effects on health. Prevalence of lack of behaviors for reducing salt intake ranged from 74.9% for not limiting consumption of processed foods, to 95% for not buying low salt alternatives.
Kaddumukasa et al ⁶⁹ Case-control study	Uganda	Adults older than 18 years with a history of hypertension who had a confirmed stroke at least 1 month previously at Uganda's Mulago National Referral Hospital	Questionnaire	Only 43% of the study population had basic dietary salt knowledge, 39% had adequate diet-disease-related knowledge, and 37% had procedural knowledge (report of specific steps being taken to reduce salt consumption).
Leyvraz et al ²⁷ Cross-sectional study	Benin Guinea Kenya Mozambique Seychelles	25- to 65-year-old urban residents	Structured closed-ended questionnaire	<ul style="list-style-type: none"> Majority (85%) of the participants knew that high salt intake can cause health problems and 91% thought that it is important to limit salt intake. Majority (92%) of participants reported that salt was added to the foods most of the time during cooking and 11% reported adding salt to meals at the table.
Magalhaes et al ²⁵ Cross-sectional study	Angola	Undergraduate medical students aged 17-43 years old from the University of Agostinho Neto in Luanda	Standardized WHO questionnaire	<ul style="list-style-type: none"> Majority (83.7%) of participants stated that salt was always added in preparing food at home, and rarely (37.4%) or sometimes (32.5%) added to food at the table. Almost all (99.2%) participants knew that a high-salt diet could cause health problems, and 91.1% of them recognized the importance of reduced salt in the diet. However, less than half of the participants (45.5%) were aware of their high dietary sodium intake, and most (83.9%) reported a preventative measure was the avoidance of adding salt at the table.
Menyanu et al ³² Multinational, prospective cohort study	Ghana, South Africa	Adults aged over 50 years old	A 5-item questionnaire adapted from the WHO/PAHO protocol	<ul style="list-style-type: none"> Knowledge related to the adverse effects of salt on health was poor. Approximately one-third (31.3%) of both Ghanaians and South Africans were not aware of the relationship between high salt intake and the possibility of a serious health problem. Three-quarters (74.9%) of all respondents perceived that they consumed just the right amount of salt. Majority (91%) reported that they frequently added salt to food at home during cooking.

(Continues)

TABLE 4 (Continued)

Author, year, and design	Country	Study population	Method of knowledge, attitude, and behavior assessment	Summary result
Muchira et al ³³ Cross-sectional study	Kenya	Rural community of Central Kenya	Questionnaire	Adding of salt during cooking (89%) and at the table (28%) was found adverse dietary patterns among the participants
Mushoriwa et al ⁵⁵ Cross-sectional study	South Africa	Female cooks and guardians from NGOs in the Eastern Cape	Voice-recorded semi-structured interviews	<ul style="list-style-type: none"> No participants were having any knowledge of the recommended daily salt intake limit nor the relationship between salt and sodium. Regarding the harm and benefit of consuming a lot of salt, almost all the participants (95%) perceived it as being harmful to one's health. 68% added discretionary salt to their food before eating and those that did not add salt during meals stated that this was because of personal preference as well as fear of the health risks associated with high salt consumption.
Newson et al ⁵⁶ Longitudinal online cohort study	South Africa	Adults aged 18-65 years old	Web-based questionnaire on salt intake and associated behaviors	<ul style="list-style-type: none"> 42% of participants reported that the main source of salt in their diet was added during food preparation followed by salt from salt containing foods (30% across all countries), and then by salt added at the table, and salt from out-of-home foods (both sources reported by 14% across all countries). In relation to recommendations, more than half of the population (55%) indicated not to know what the daily salt intake recommendations are, and only 13% of the total sample could correctly identify the salt intake recommendations. Only 10% of the population could correctly identify the recommendations and two-thirds (66%) of the participants reported that they did not know the recommendations.
Oelke et al ⁶⁰ Cross-sectional study	Zambia	Adults ≥18 years old in Western Province	A modified version of the WHO STEP-wise survey tool and semi-structured interview guide supported with online table salt conversion tool used to convert the volume measurement to grams	Salt was added to food at all meals, more at lunch and dinner than breakfast, with a mean total weight of salt added to food equaling 9.33 ± 10.03 grams, nearly double the WHO recommendation with women adding significantly more salt to food than men
Queiroz et al ³⁹ Cross-sectional study	Mozambique	25- to 64-year-old adult workers of the Maputo Central Hospital	24-hour dietary recall	Discretionary sodium contributed 60.1% of total dietary sodium intake, followed by sodium from processed foods (29.0%) and naturally occurring sodium (10.9%). Besides the use of salt added at the table (35% of the participants) and during cooking (96% of the participants), using stock powder when cooking or adding it to prepared food and salads was shown to be frequent in the present sample of the Mozambican population (70% of the participants).

of participants who reported adopting practices known to reduce salt consumption observed in the included studies. These findings call for intervention strategies and educational campaigns aiming at increasing consumers' knowledge and awareness. For instance, raising awareness about the maximal limit of daily salt intake and about the relationship between salt and sodium may help the consumer make better informed choices when purchasing processed foods, facilitate the understanding of nutrition information on food labels and become more aware and sensitive when cooking or eating.⁶⁵

A pre-/post-intervention study from South Africa reported the effectiveness of a public health awareness campaign to increase knowledge and awareness of the health consequences of a diet high in salt and suggested shifts in salt behaviors in the target population.⁴⁶ This is consistent with findings from previous studies,^{59,67} which indicated national mass-media campaigns can increase consumer awareness and make a noticeable impact on salt intake at the population level in countries where the majority of salt is added by the consumers. However, according to Webster

TABLE 5 Characteristics of included evaluation studies undertaken between January 2009 and November 2019 (n = 1)

Author, year, and design	Country	Intervention	Outcome measure	Summary result
Wentzel-Viljoen et al, 2017 ⁴⁶ <i>Community-based longitudinal cohort study</i>	South Africa	Mass-media campaigns	Increased awareness of the need to reduce discretionary salt use	<ul style="list-style-type: none"> • After mass-media campaign to increase the awareness of the need to reduce discretionary salt, significantly more participants (38% increased to 59.5%) thought that it was important to reduce the amount of salt consumed and reported that they were taking steps to control salt intake. • In particular, adding salt while cooking (45.2% increased to 59.1%) and at the table (14.2% increased to 20.1%) occurred significantly less frequently after the campaign than before.

TABLE 6 Characteristics of included modeling studies undertaken between January 2009 and November 2019 (n = 3)

Author, year, and design	Country	Intervention	Outcome measure	Summary result
Aminde et al ²⁸ <i>Modeling study</i>	Cameroon	Reducing current salt intake levels	Changes in CVD burden in adult Cameroonians	Reducing salt intake by 30% could reduce the probability of premature CVD mortality from 16.7% in 2016 to 13.9% (13.8%–14.2%) in 2030, corresponding to a 16.8% (percentage change) reduction and could gain over 700 000 health-adjusted life years (HALYs).
Bertram et al ⁵⁷ <i>Modeling study</i>	South Africa	Reducing sodium content of bread by 342 mg/100 g, margarine by 61%, soup mix by 69%, and seasoning by 51%	Change in sodium intake, effect on the population distribution of BP, consequent number of CVD deaths, and nonfatal strokes that could be avoided annually	Reducing the sodium content of high-salt foods would prevent 7400 deaths in SA each year—6400 from reducing the sodium content of bread alone. This includes deaths related to stroke (2900), ischemic heart disease (2500), and hypertensive heart disease (2000). Furthermore, approximately 4300 nonfatal strokes would be prevented
Watkins et al ⁵⁸ <i>Cost-effectiveness analysis</i>	South Africa	South Africa's salt reduction policy implementation	(a) Defining the population at risk of CVD due to high salt intake using current levels of salt consumption and blood pressure, then estimating (b) the impact of the salt reduction policy on population blood pressure levels, (c) the subsequent change in incidence and mortality from CVD, (d) the reduction in expenditures on CVD attributable to lower incidence, (e) the financial risk protection (FRP) provided by the policy, and (f) the distributional impact of the policy by income quintile.	<ul style="list-style-type: none"> • Salt policy could reduce CVD deaths by 11%, with similar health gains across income quintiles. In a model cohort of 1 million South African adults, the policy averted 403 deaths and 1680 cases of CVD per year. • In total, approximately US\$ 295 000 per year in OOP expenditures on CVD were averted in the cohort, ranging from US\$ 0.02 per capita in the poorest quintile to US\$ 1.11 per capita in the richest quintile. • The policy could save households US\$ 4.06 million (2012) in OOP expenditures (US\$ 0.29 per capita) and save the government US\$ 51.25 million in health care subsidies (US\$ 2.52 per capita) each year.

TABLE 7 Summary of risk of bias assessment (H, high risk; U, unclear risk; L, low risk; NA, not applicable) of population salt intake and evaluation studies included in the present systematic review

Author, year, and references	Type of studies	Selection bias:			Performance bias: adjustment for confounders or exposure to other factors	Detection bias: reliability and validity of exposure and outcome assessment	Attrition bias: loss to follow-up	Reporting bias: selective reporting	Other bias:
		bias: sampling	representativeness of sample underlying population	of sample underlying population					
Alves et al ²⁹	Salt intake study	L	L	NA	H	L	L	L	
Challa et al ³¹	Salt intake study	L	L	NA	H	L	L	L	
Charlton et al ⁴⁹	Salt intake study	H	H	NA	L	H	L	L	
Charlton et al ⁴⁸	Salt intake study	H	H	NA	L	H	L	L	
Derouiche et al ³⁵	Salt intake study	H	H	NA	L	L	L	L	
Mizehoum-Addisoda et al ²⁶	Salt intake study	U	H	NA	L	L	L	L	
Prynn et al ³⁴	Salt intake study	H	H	NA	H	L	L	L	
Queiroz et al ³⁹	Salt intake study	H	H	NA	L	L	L	L	
Saeid et al ⁶¹	Salt intake study	H	H	NA	L	H	L	L	
Swanepoel et al ⁴⁷	Salt intake study	L	L	NA	L	L	L	L	
Tayo et al ⁴²	Salt intake study	U	U	NA	L	L	L	L	
Ware et al ⁵⁰	Salt intake study	U	H	NA	L	H	L	L	
Wentzel-Viljoen et al ⁴⁶	Evaluation Study	H	H	L	H	L	L	L	

Abbreviations: H, high; L, low; NA, unclear/not applicable.

et al,²¹ in countries where processed or packaged foods are major sources of sodium in the diet, consumer education alone is unlikely to achieve a significant decrease in population salt consumption. For maximum impact, national salt reduction efforts need to be more broad ranging—requiring action from producers through measures such as front-of-pack nutrition labeling systems and food reformulation strategies for the population to consume less salt.⁶⁸ Furthermore, subsidizing healthy food purchases among health plan members appears to be a promising intervention to reduce salt intake.⁶⁹

Consistent with prior studies,^{68,70-72} modeling studies demonstrate that interventions for reducing dietary sodium have the potential to generate large health gains and also large cost savings for a health system. A modeling study that informed the development of the sodium legislation in South Africa estimated that a reduction of daily sodium intake of 0.85 g per person per day could avert 7400 cardiovascular deaths; 6400 of which would be due to reducing the sodium levels of bread alone.⁵⁷ The additional 4300 nonfatal strokes that could be prevented are projected to save the strained South African health care system 40 million USD a year. An extended cost-effectiveness analysis supported these findings and reported that the South African population salt reduction program could also avert poverty and reduce household out-of-pocket expenditures, particularly for the middle class, at minimal cost.⁵⁸

Despite these potential benefits, our review identified that only South Africa had an existing strategy to reduce population salt intake. South Africa sets a good precedent for the continent by adopting comprehensive mandatory regulation to limit salt levels permitted in a wide range of processed foods, in addition to conducting campaigns to raise public awareness about the dangers of excessive dietary sodium intake.^{20,73-75} However, while recent studies have examined adherence to the national targets^{54,57} its success is yet to be fully evaluated. Although vague and non-specific, Nigeria also published a dietary guideline in 2001 mentioning salt intake, merely advising individuals to limit the intake of salt and bouillon cubes.^{11,76} Mauritius also published a draft food reformulation plan,²⁰ but there is currently little evidence of further action.

Although some countries, including Nigeria, have published a guideline on salt intake, they have not taken further action. To achieve the global target of 30% relative reduction in salt intake by 2025, governments need to go beyond guidelines and implement comprehensive strategies to reduce population salt intake.

5 | STRENGTHS AND WEAKNESSES OF THE STUDY

Strengths of this systematic review include a comprehensive search of all study designs of peer-reviewed and gray literature. Additionally, two independent reviewers screened all papers, and

extracted data and three authors independently assessed the risk of bias for studies that evaluated interventions or measured salt intake. Our review demonstrates substantial heterogeneity in study designs, interventions, populations, and outcomes reported across the included studies. It was therefore not appropriate to conduct a meta-analysis, and this limits the certainty of the estimates and subsequent conclusions that can be drawn. Furthermore, studies were only included if the full text was available and in English, which means that studies in other languages may have been missed. However, as global experts were consulted it is unlikely that key studies were missed.

6 | CONCLUSIONS

This review highlights that adoption of population salt reduction strategies in Africa has been slow and remains a challenge. Existing measures of salt intake in African adults demonstrate that these remain well above the recommended limit of 5 g/d, reaffirming a need for action to reduce salt intake in Africa. Currently, only South Africa has a national strategy to reduce the average sodium intake to 5 g/d. Therefore, rigorous evaluation of the ongoing programs in parallel with urgent action to initiate salt reduction programs in the rest of African countries will be essential. Salt reduction strategies should comprise a suite of policy actions, not only consumer awareness campaigns, but also initiatives for food labeling and regulation in order to achieve the global target of a 30% reduction in salt intake by 2025.

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CONFLICT OF INTEREST

MDH has received support from the American Heart Association, Verily, and AstraZeneca for work for food system surveillance in the United States. MDH has received salary support from the American Medical Association for his role as an associate editor for JAMA Cardiology. MDH has a secondary appointment at The George Institute for Global Health, which has a patent, license, and intent to commercialize fixed-dose combination therapy through its social enterprise business, George Medicines, for which the organization has received investments. All other authors have no conflict of interest to declare.

AUTHOR CONTRIBUTIONS

DT and JW conceived the study. JS and DT conducted the search from databases. DT and JS did the screening of articles. DT, JS, and KT did the assessment for risk of bias. DT and JS did the analysis and interpretation. DT wrote the first draft of the paper. JS, KT, ST, RN, KC, AH, MH, SJ, and JW provided comments on the drafts and approved the final paper.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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