Review

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24-hour sodium and potassium excretion in the Americas: a systematic review and meta-analysis

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ABSTRACT

Objective. To determine the 24-hour urinary sodium and potassium excretions in the Americas.
Methods. A systematic review and meta-analysis were performed seeking for studies conducted between 1990 and 2021 in adults living in any sovereign state of the Americas in Medline, Embase, Scopus, SciELO, and Lilacs. The search was first run on October 26th, 2020 and was updated on December 15th, 2021. Of 3 941 abstracts reviewed, 74 studies were included from 14 countries, 72 studies reporting urinary sodium (27 387 adults), and 42 studies reporting urinary potassium (19 610 adults) carried out between 1990 and 2020. Data were pooled using a random-effects meta-analysis model.
Results. Mean excretion was 157.29 mmol/24h (95% CI, 151.42-163.16) for sodium and 57.69 mmol/24h (95% CI, 53.35-62.03) for potassium. When only women were considered, mean excretion was 135.81 mmol/24h (95% CI, 130.37-141.25) for sodium and 51.73 mmol/24h (95% CI, 48.77-54.70) for potassium. In men, mean excretion was 169.39 mmol/24h (95% CI, 162.14-176.64) for sodium and 62.67 mmol/24h (95% CI, 55.41-69.93) for potassium. Mean sodium excretion was 150.09 mmol/24h (95% CI, 137.87-162.30) in the 1990s and 159.79 mmol/24h (95% CI, 151.63-167.95) in the 2010s. Mean potassium excretion was 58.64 mmol/24h (95% CI, 52.73-64.55) in the 1990s and 56.33 mmol/24/h (95% CI, 48.65-64.00) in the 2010s.
Conclusions. These findings suggest that sodium excretions are almost double the maximum level recommended by the World Health Organization and potassium excretions are 35% lower than the minimum requirement; therefore, major efforts to reduce sodium and to increase potassium intakes should be implemented.

Keywords Sodium, dietary; potassium, dietary; systematic review; Americas.

Raised blood pressure is the leading risk factor for mortality and morbidity worldwide, accounting for 10.8 million annual deaths (1). Excessive sodium and low potassium intakes increase blood pressure (2, 3). Moreover, diets high in sodium are among the leading risk factor for non-communicable diseases in the Americas (4); conversely, diets high in potassium lower blood pressure and thus, have protective effects against cardiovascular diseases (5).

The World Health Organization (WHO) recommends limiting sodium intake to <87 mmol/24h (5 g/d of salt) and a minimum potassium intake of 90 mmol/24h (3.5 g/d) for adults (6, 7). However, the average salt intake in the Americas ranged from ~148 to 261 mmol/24h (8.5-15 g/d of salt) (8). Likewise, an insufficient intake of potassium in the Americas was reported as only ~5% of the adults met the WHO's recommendation (9-12).

Monitoring sodium and potassium intakes is crucial to evaluate their effects on health and improve intakes (13). As most of the sodium and potassium intakes are excreted through urine, the most accurate method to determine daily intakes is through measurement of 24-hour urinary excretions (14). However, as the 24-hour urine collection could be challenging other methods such as dietary surveys or spot urines are widely used. In 2010, international sodium intakes were estimated from urinary and

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dietary data systematically reviewed, and a study published in 2020 also estimated sodium intakes. However, these studies did not estimate potassium intakes and the latter only comprised Latin America populations (15, 16).

Due to the lack of reliable potassium intake estimates and pursuing to update sodium intake estimates, the objective of this study was to determine the 24-hour urinary sodium and potassium excretions in the Americas. Moreover, this study assessed the trends of sodium and potassium excretions over the past 30 years.

METHODS

Search strategy and selection criteria

A systematic review and meta-analysis of the published literature were performed seeking for studies conducted in any sovereign state of the Americas (North America, South America, Central America and the Caribbean) between 1990 and 2021 that reported 24-hour urinary sodium or potassium excretions for adult women and men.

Medline, Embase, Scopus, SciELO, and LILACS databases were included. No language or study design restrictions were set. The search was first run on October 26th, 2020 and was updated on December 15th, 2021.

Search terms were exploded whenever possible (Supplementary material 1) and were defined in English for Medline, Embase, Scopus and in Spanish for SciELO and LILACS, as more results were obtained. Papers in Portuguese were retrieved; as their full text were available in English, the English-language translations were used for data extraction.

Studies including outpatient participants and people living with non-communicable diseases that do not affect sodium or potassium excretions were included. Studies including only hospitalized participants, pregnant women, participants living with conditions that could affect sodium or potassium excretions (e.g., heart failure, renal diseases) or studies with controlled intakes were excluded.

Following the selection criteria, titles and abstracts were screened by IVM. Selected papers were studied in detail and reference lists were manually searched to identify eligible studies. Full papers previously published as conference/meeting abstracts were searched to assess for eligibility. If several papers reported the same study population, the paper that provided the most completed data was selected in the following order: sodium and potassium reported, data for women and men reported, the most recent data reported; uncertainties were solved by consensus with other authors.

Data extraction and analysis

Data on participants' characteristics, sample size, mean age, sex, country (geographic location), region (North America, South America, Central America and the Caribbean), study design, date and methods of data collection, 24-hour urinary excretions of sodium, potassium, creatinine, and urine volume (mean, standard deviation [SD], standard error of the mean [SEM]) were extracted.

Study authors were contacted via email when: a) date of data collection was missing (n=25), b) SD was missing (n=5) and c) medians were reported instead of means (n=1). Date of data collection was assumed to be 3 years before publication when authors left unanswered (n=15) (17-31). Response was not received from studies with missing SD: three reporting sodium (32-34), three reporting potassium (26, 34, 35), two reporting creatinine (26, 35). Therefore, missing data were imputed: estimating the mean SD from studies with full data provided carried out in the same country $\left[(X)=\left(\sum_{i=1}^{n} Xi\right)/n\right]$. No response for the study reporting medians instead of means was received (34); thus, the median was considered as the mean since previous urinary sodium data from the country was normally distributed, expecting that mean and median had similar values (36).

All measures were converted into millimoles (1 mmol sodium=1 mEq sodium=23 mg sodium; 1 mmol potassium=1 mEq potassium=39.1 mg potassium). If SEM was not reported, it was calculated from the SD and sample size. If the period of data collection covered more than a year, the midpoint was used. When both baseline and end-of-trial measurements were reported, only the former (n=15) (19, 21, 22, 24, 25, 30, 33, 37-44), or the control group were included (n=4) (28, 35, 45, 46).

Bias of each study was evaluated using a critical appraisal checklist developed for systematic reviews of observational epidemiological studies (47) adapted by Tan et al. (48) to assess the quality of sampling, reporting, measurement, analysis, rigor of 24-hour urine collection, and response rate through 9 questions (Supplementary material 2). Studies reporting sodium and potassium were assessed separately.

Data were pooled using a random-effects meta-analysis model. Main analyses were carried out with all the studies retrieved. Subgroup analyses were performed to determine sodium and potassium excretions by sex, region, rigor of 24-hour urine collection (24-hour collection was considered rigorous if its completeness was assessed or reported), decade of collection (1990s, 2000s and 2010s), and income level at the year of data collection according to the World Bank (low, lower-middle, upper-middle, high income level (49), Supplementary material 3).

Figures to illustrate trends of consumption per decade were made. Tests for subgroup differences were run. One study that collected data in 2020 was considered part of the 2010s. Further analyses to explore excretions per decade segregated by country or income level were not feasible due to the small number of studies available.

Only 5 studies were retrieved from lower-middle income countries; thus, they were grouped with the upper-middle income countries. Studies from low-income countries were not retrieved; main analyses were conducted considering only two income level groups. Due to the limited number of studies from Central America and the Caribbean (n=5) they were included as part of the South America region. There were few studies that provided data stratified by age (n=9) or by hypertension status (n=8); however, it was not feasible to subgrouping (e.g., young vs older adults) since age groups wide-ranging and due to the small number of studies.

Sensitivity analyses were run excluding studies with outpatient participants, studies including participants with hypertension, studies with imputed data, and with the original classifications for region and income level. Moreover, an alternative SD imputation method was employed considering the mean SD of all the included studies with full data provided. This decision was made to assess whether results would be significantly different when other imputation approach is used.

In exploratory analyses, meta-regression analyses were conducted with either 24-hour sodium or potassium as the dependent variable (mmol/24h) and the independent predictors were study characteristics: mean participants' age, proportion of men, geographic location (each country coded as a unit from north to south), rigor of 24-hour urine collection, data collection year, income level (high-income economies as reference) and proportion of people with hypertension.

Statistical analysis

All analyses were performed using R (version 4.0.3) with the packages "meta" (version 4.15-1) and "metafor" (version 2.4-0). A 2-sided p value of <0.05 was considered significant.

RESULTS

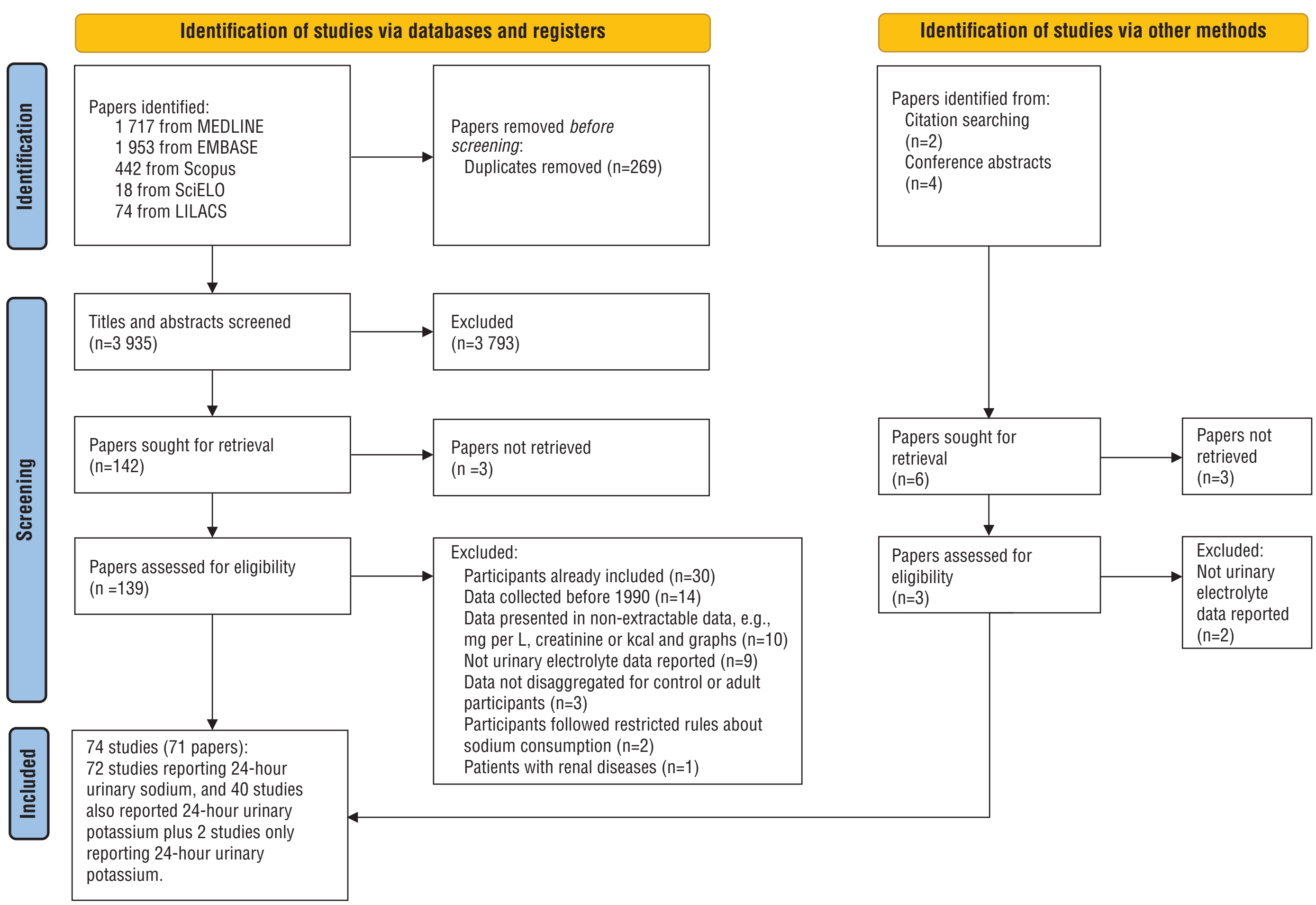
The search yielded 4 204 papers identified via databases and 6 papers via manual searching; 269 duplicates were excluded, and 3 941 titles and abstract were screened. 3 795 papers were excluded as they did not meet inclusion criteria and 6 papers were not retrieved. Finally, 142 papers plus one conference paper published were selected for full-text review. A total of 74 studies (reported in 71 papers) were included: 72 reported sodium and 40 also reported potassium, plus two studies that only reported potassium (Figure 1) (10-12, 17-46, 50-87).

One multisite study reported separate estimates for two countries (63); each site was considered as an individual study. One paper reported two different studies; however, one was carried before 1990 and was excluded (37). One paper reported individual data for three different studies, and each was treated as an individual study (88).

The 72 studies reporting 24-hour urinary sodium data were drawn from 27 387 adults: 44.6% men, mean age 47.5 years. The 42 studies reporting 24-hour urinary potassium data were drawn from 19 610 adults: 44.5% men, mean age 46.1 years.

The data spanned from 1990 to 2020 and covered 14 of the 35 sovereign states of the Americas, (Argentina, n=3 [1 study with missing sodium SD]); Barbados, n=3; Brazil, n=16 (1 study with missing creatinine SD); Canada, n=8; Chile, n=4; Ecuador, n=1; Guatemala, n=1; Jamaica, n=2; Mexico, n=5; Paraguay, n=1 (1 study with missing potassium and creatinine SD); Peru, n=1; Uruguay, n=2; United States, n=26 (2 studies with missing sodium SD and 1 with missing potassium SD);

FIGURE 1. Study selection, flow diagram based on PRISMA 2020 (98).



Source: Prepared by the authors from the study results.

Venezuela, n=1]. One 24-hour urine sample was collected per participant in 79.1% (n=57) of the studies reporting sodium and 71.4% (n=30) of the studies reporting potassium. More than half of the studies were carried out in high income countries.

24-hour urine collection was considered rigorous in 62.5% (n=45) of studies reporting sodium and 71.4% (n=30) of studies reporting potassium. The characteristics of the studies and participants are provided in Supplementary material 4. The risk of bias of each study varied substantially across criteria (Supplementary material 5).

Mean sodium excretion was 157.29 mmol/24h (95% CI, 151.42-163.16) (Figure 2) with an I^2=98.5% (95% CI, 98.3-98.6) and mean potassium excretion was 57.69 mmol/24h (95% CI, 53.35-62.03) (Figure 3) with an I^2=99.5% (95% CI, 99.5-99.6). Mean creatinine excretion was 11.70 mmol/24h (95% CI, 10.81-12.59). Mean urine volume was 1.73 l/24h (95% CI, 1.60-1.85).

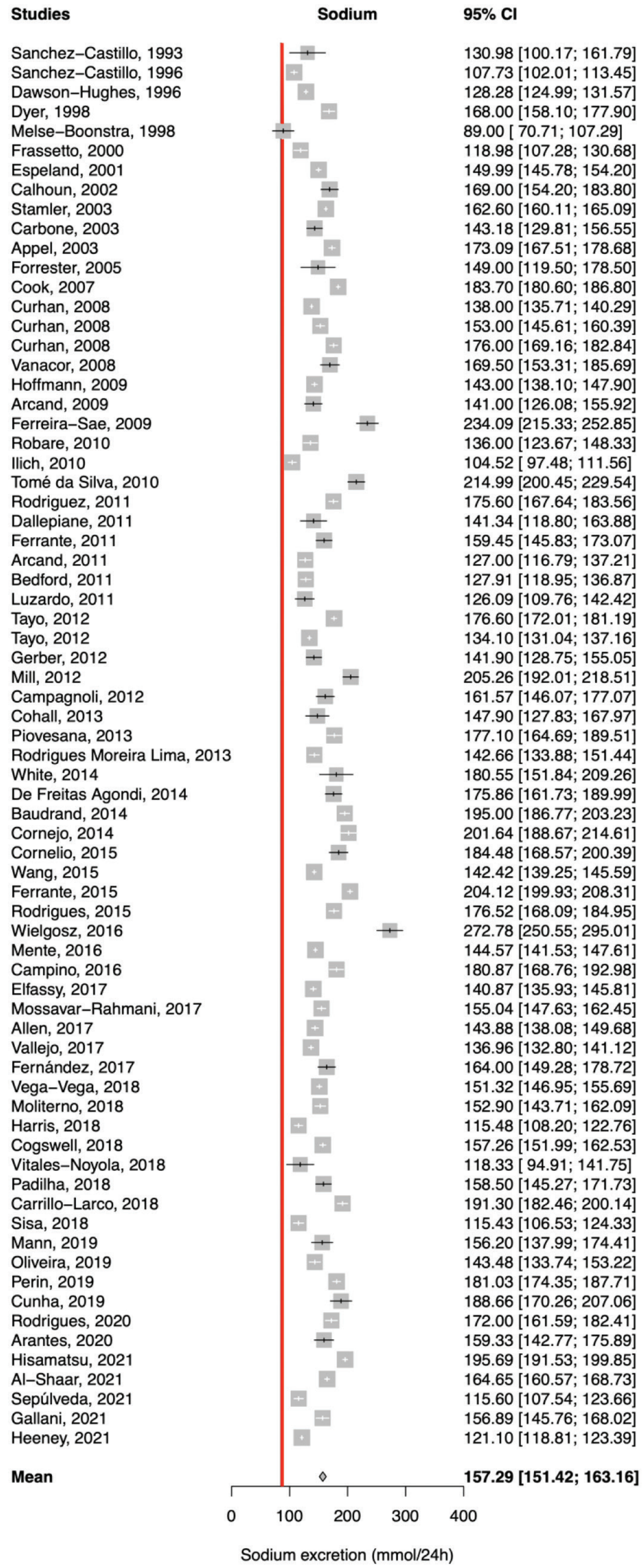
The analyses by sex showed higher excretion of both electrolytes in men with a mean sodium excretion of 169.39 mmol/24h (95% CI, 162.14-176.64), and mean potassium excretion of 62.67 mmol/24h (95% CI, 55.41-69.93). In women, mean sodium excretion was 135.81 mmol/24h (95% CI, 130.37-141.25) and mean potassium excretion was 51.73 mmol/24h (95% CI, 48.77-54.70). In meta-regression analyses, a significantly higher excretion of both electrolytes was found among men, that remained significant after adjusting for age, geographic location, rigor of 24-hour urine collection, year of data collection, income level and percentage of people living with hypertension (p<0.01; table 1).

A higher sodium excretion in Central America, South America and the Caribbean was found, 163.88 mmol/24h (95% CI, 152.83-174.92), in comparison with North America, 151.48 mmol/24h (95% CI, 144.20-158.75). Potassium excretion was higher in North America, 62.16 mmol/24h (95% CI, 57.36-66.95), in comparison with Central America, South America and the Caribbean, 52.02 mmol/24h (95% CI, 47.06-56.97) (Supplementary materials 6-7). In meta-regression analyses, geographic location was associated positively with an increased sodium excretion in the south (p<0.01) that remained significant after adjusting for other potential modifiers. A lower excretion of potassium appeared in univariate analyses (p=0.01) which was no longer significant after adjusting for other covariables (Table 1).

Subgroup analyses by income level showed that high-income countries had a lower sodium excretion, 154.19 mmol/24h (95% CI, 146.83-161.54), in comparison with lower-middle and upper-middle income countries, 160.91 mmol/24h (95% CI, 150.28-171.55). For potassium, it was found that the lower the income level, the lower the potassium excretion: lower-middle and upper-middle income countries presented an excretion of 50.07 mmol/24h (95% CI, 45.46-54.68), vs. high-income countries, 63.24 mmol/24h (95% CI, 58.20-68.27). Meta-regression analyses did not show significant association between income level and sodium excretion; for potassium, high income countries showed a higher excretion (p<0.01), but after adjustment for multiple covariates was no longer statistically significant (Table 1).

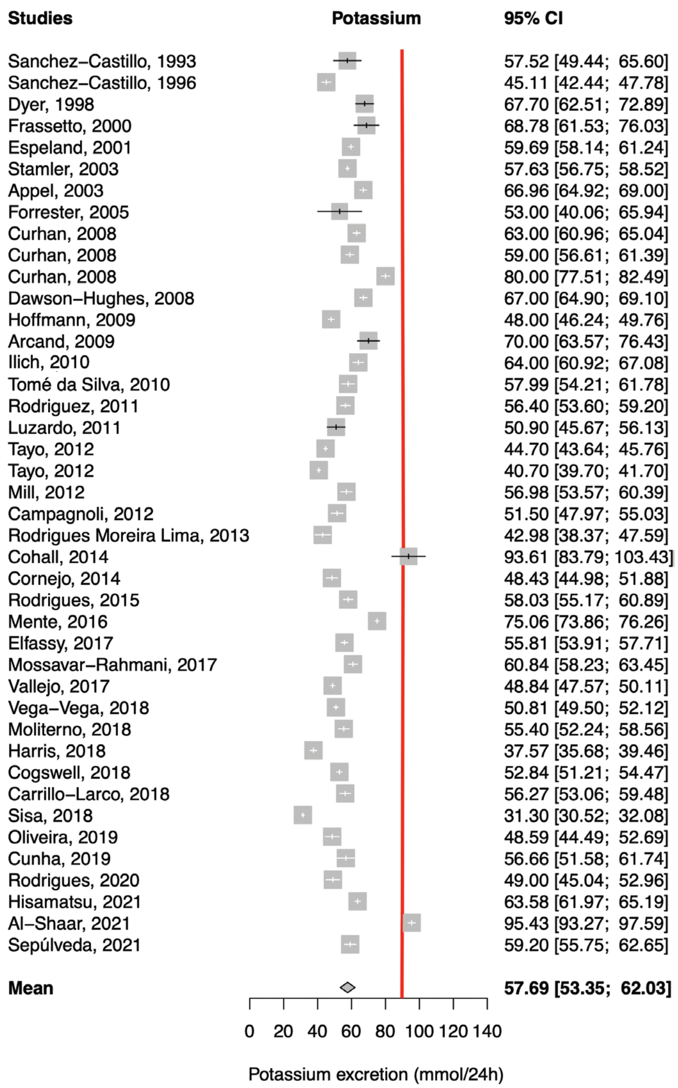
Among studies in which the 24-hour urine was assessed for completeness, mean excretions were 156.42 mmol/24h (95% CI, 149.84-163.00) for sodium and 57.35 mmol/24h (95% CI, 52.54-62.16) for potassium. Mean excretions were 158.62 mmol/24h (95% CI, 145.83-171.41) for sodium, and 58.56 mmol/24h (95%

FIGURE 2. Mean urinary sodium excretion (mmol/24h). The red line denotes the recommended maximum daily intake for adults (World Health Organization recommendations) (6).



Source: Prepared by the authors from the study results.

FIGURE 3. Mean urinary potassium excretion (mmol/24h). The red line denotes the recommended minimum daily intake for adults (World Health Organization recommendations) (7).



Source: Prepared by the authors from the study results.

CI, 47.28-69.84) for potassium (Supplementary materials 6-7) among studies with 24-hour urine completeness assessment not performed or not reported. Meta-regression analyses did not show significant association between rigor of 24-hour urine collection and urinary excretions.

The analyses per decade of data collection showed a slightly increasing trends in sodium excretion, from an excretion of 150.09 mmol/24h (95% CI, 137.87-162.30) in the 1990s, to 158.99 mmol/24h (95% CI, 143.99-173.99) in the 2000s, to 159.79 mmol/24h (95% CI, 151.63-167.95) in the 2010s (Figure 4a). For potassium, there were relatively stable trends, with an excretion of 58.64 mmol/24h (95% CI, 52.73-64.55) in the 1990s, 59.95 mmol/24h (95% CI, 53.02-66.88) in the 2000s, and 56.33 mmol/24h (95% CI, 48.65-64.00) in the 2010s (Figure 4b). However, these trends were not statistically significant, neither significant association between year of data collection and sodium or potassium excretions appeared in the meta-regression analyses (Table 1).

Sensitivity analyses findings for sodium remained unchanged apart from differences when alternative groupings were used for region and income level. In the base analyses, sodium excretions were higher in Central America, the Caribbean and South America; however, in the analyses with Central America and the Caribbean as an independent region, lower sodium excretions appeared in Central America and the Caribbean in comparison with North America and South America. The latter still presented the highest sodium excretions. Likewise, lower-middle and upper-middle income countries presented higher sodium excretions in the base analyses, but when the lower- and upper-middle income countries were split into two groups, lower sodium excretions were shown among the lower-middle income countries, without affecting the higher sodium excretions pattern among upper-middle income countries (Supplementary material 6). For potassium, all findings remained unchanged (Supplementary material 7).

DISCUSSION

This work summarizes the increasing trends of urinary sodium and relatively stable trends of urinary potassium excretions from the 1990s to the 2020s in the Americas, reported through the most accurate method of assessment, i.e., 24-hour urine collection. The most recent means (2010s) of 24-hour sodium and potassium excretions were 159.79 mmol (equivalent to 9.2 g of salt), and 56.33 mmol (equivalent to 2.2 g of potassium). Moreover, these results denote the high sodium and low potassium excretions that could be linked to the high rates of hypertension and cardiovascular disease in the Americas (89, 90).

Subgroup analyses showed different patterns of excretion per region, with a sodium excretion of 151.48 mmol/24h in North America, lower in comparison with Central America, the Caribbean, and South America of 163.88 mmol/24h.

Carrillo-Larco and Bernabé-Ortiz quantified a daily sodium excretion of 4.13 g (~179 mmol/24h) in Latin America and the Caribbean (16), while Powles et al. stated a daily sodium excretion in North America (United States and Canada) of 3.62 g (~157.3 mmol/24h), 2.61 g (~113.4 mmol/24h) in the Caribbean and 3.19 g (~138.6mmol/24h) in Central America (15); both estimations were constructed with dietary and urinary data including spot and 24-hour urine samples.

Unfortunately, these data cannot be directly compared with the mentioned estimates since each analysis employed different methods (e.g., dietary records or models to estimate excretions) but the results pointed out sodium excretions higher than the maximum level recommended by the WHO. A few studies included in this review reported sodium excretions slightly below the WHO's recommendation; these studies were based in small sample sizes (51), convenience samples (77), or control samples for diseases related to uncommon genetic alterations (46).

Higher sodium excretions and lower potassium excretions were found among lower-middle and upper-middle income countries in comparison to high-income countries. Also, more studies were carried out in high income countries as previous reviews reported (91, 92). Thus, there is a need to conduct further research to determine sodium and potassium excretions in low-income and lower-middle income countries.

TABLE 1. Potential effect modifiers of sodium and potassium excretion (mmol/24h) in adults.

	Sodium				Potassium			
	Univariate		Multivariate^		Univariate		Multivariate^	
	Slope (95% CI)	P Value	Slope (95% CI)	P Value	Slope (95% CI)	P Value	Slope (95% CI)	P Value
Age, mean age	-0.01 (-0.50-0.48)	0.96	-0.11 (-0.58-0.36)	0.64	0.54 (0.25-0.84)	0.00***	0.38 (0.04-0.72)	0.02*
Sex (% men)	0. 32 (0.08-0.57)	0.00**	0.44 (0.21-0.67)	0.00***	0.23 (0.04-0.42)	0.01*	0.19 (0.04-0.35)	0.01*
Geographic location (Each country coded as a unit from north to south)	1.89 (0.56-3.23)	0.00**	2.50 (0.84-4.16)	0.00**	-1.15 (-2.11- -0.19)	0.01*	-0.20 (-1.39-0.97)	0.72
Rigor of 24-hour urine collection (not rigorous or not reported as reference)	-2.14 (-14.70-10.40)	0.73	-1.06 (-11.73-9.61)	0.84	-1.23 (-11.28-8.82)	0.81	-0.15 (-7.78-7.47)	0.96
Year of data collection	0.29 (-0.44-1.03)	0.43	-0.35 (-1.06-0.34)	0.31	-0.15 (-0.67-0.37)	0.57	0.03 (-0.47-0.53)	0.90
Income level (high income level countries as reference)	6.71 (-5.21-18.63)	0.27	-1.87 (-15.28-11.54)	0.78	-10.01 (-15.94- -4.08)	0.00***	-5.43 (-11.66-0.79)	0.08
People living with hypertension (%)	0.16 (-0.00-0.32)	0.05	0.17 (0.01-0.32)	0.03*	-0.06 (-0.20-0.08)	0.41	-0.05 (-0.16-0.05)	0.34

Meta-regression analysis using a random effect model. Adjusted for age, sex, geographic location, rigor of 24-hour urine collection, year of data collection, income level and percentage of people living with hypertension.
Significance codes: 0 `***' 0.001 `**' 0.01 `*' 0.05 `.'
Source: Prepared by the authors from the study results.

In the analyses per decade, slightly increases in 24-hour urinary sodium excretions were observed increasing from 150.09 in 1990s to 159.79 mmol/d in 2010s. Moreover, countries located in the south showed significantly higher sodium excretions. This can be partially explained by the fact that in the Americas, especially in Latin America, the availability, and sales of processed food with high amounts of sodium had been increasing in the last decades (93). Since 2009, the Pan American Health Organization (PAHO) has been supporting the development and implementation of country level and cost effectiveness strategies to reduce sodium intake (13); these findings, however, call for more interventions and policies. Recently, new nutrition policies have been adopted in upper-middle and high income countries that are recognized by their potential to reduce sodium intake such as the front-of-pack labelling (94). Future research will be needed to determine their effectiveness in reducing sodium intakes.

Additionally, other policies have been adopted. For example, Argentina was the first country in the region to introduce mandatory sodium targets for specific food groups (32). Also, most of the countries have established public awareness programs and educational materials to reduce sodium consumption with the participation of governments, academia and civil society, e.g., salt awareness week (13). However, fiscal policies such as sodium taxes have not yet been established by any country included in this analysis and more efforts to establish supportive environments to reduce sodium consumption should be made (13).

Salt is used as a vehicle to prevent iodine deficiency disorders; thus, cutting its consumption could potentially lead to an insufficient iodine intake if fortification levels are not adjusted accordingly. In order to prevent iodine deficiency disorders, several technical groups led by the WHO and the PAHO recommend monitoring iodine intakes and adjusting the level of iodine fortification in table salt or other food products when iodine deficiency disorders appeared (95).

Furthermore, there are different methods available to estimate sodium and potassium intakes. It is recommended that countries should determine baseline intakes and monitor them ideally through 24-hour urine collection (14). However, it is a costly and burdensome data collection method, and missed or lost samples or under/over collection due to incorrect timing are commonly reported. Thus, other methods such as spot urinary sodium concentration could potentially be used to monitor the percentage change in sodium intake in the population (96).

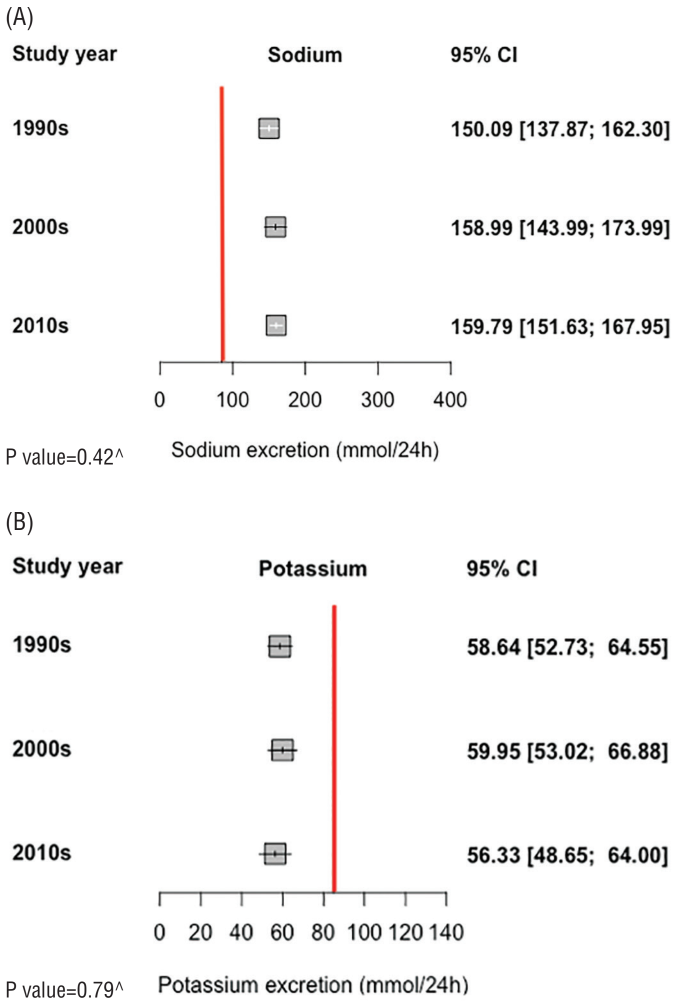
Incomplete urine samples were excluded in more than half of the studies included in this review. Incomplete urine samples were defined as, e.g., samples that do not meet minimum creatinine levels or volume. Thus, these findings could be used to inform which countries or regions had accurately estimated sodium and potassium excretions in the past three decades.

For potassium, insufficient excretions were drawn from all included countries. This data did not differ from the United States national dietary survey (NHANES) carried out in 2003-2008, that reported a median potassium excretion of ~67.28 mmol/24h. Moreover, they reported 98% of the population did not meet WHO's potassium intake recommendations (9). More recent data from the NHANES 2014 reported a median potassium excretion of ~51.15 mmol/24h, denoting a decrease of potassium intakes at populational level (81). These findings highlight the urgent need to adopt strategies to increase potassium intake, mainly through the promotion of fruit and vegetable consumption. Also, since potassium helps to maintain blood pressure levels in normal ranges, promoting its intake could help to mitigate health effects due to high sodium intakes (5).

Strengths and limitations

To the authors' knowledge, this is the first study to systematically search for 24-hour sodium and potassium excretions

FIGURE 4. Mean urinary sodium and potassium excretion (mmol/24h) trends per decade in the Americas.



a) The red lines denote the maximum recommended daily sodium intake for adults (6).
b) The red lines denote the minimum recommended daily potassium intake for adults (7).
^ Test for subgroup differences (random effects model)
Significance codes: 0 `***´ 0.001 `**´. 0.01 `*` 0.05 `.´
Source: Prepared by the authors from the study results.

in the Americas with data collected through the most accurate method to measure both sodium and potassium excretions (97). Furthermore, a comprehensive search strategy was performed, including broad search terms, no language restrictions, and ultimately retrieved almost four times the studies included in previous similar reviews.

The main limitation was the high heterogeneity and the small samples in the studies. However, the results are more accurate and robust than previous estimates for the Americas, since only studies reporting 24-hour urinary sodium or potassium were included. Also, despite of the different participants' characteristics of the studies it was possible to grouping them by regions or income level, and the excretion trends did not differ from base analyses when alternative groups where set or imputed data were excluded. Other sodium/potassium losses were not considered; thus, the figures could underestimate the true excretions. Finally, further analysis including dietary methods or spot urine samples may be considered, particularly if low- and middle-income countries are included.

Conclusion

These findings synthesized the sodium and potassium excretions in the Americas retrieving data from the published papers in the last three decades suggesting that sodium excretions are almost double the maximum level recommended by the WHO and potassium excretions are 35% lower than the minimum requirement in the Americas. Therefore, major efforts to reduce sodium and to increase potassium intakes at population level should be implemented, including a focus on food reformulation and fruits and vegetables promotion, along with health education campaigns.

Perspective

Our study provides a comprehensive overview of the sodium and potassium intakes in the Americas assessed with 24-hour urine samples, the most accurate method. We found that over the past three decades, mean potassium intakes have been consistently low across the Americas. In contrast, mean sodium intakes have been high and also slightly increasing. Importantly, our analyses also revealed a higher sodium and lower potassium intakes in lower-middle and upper-middle income countries of the Americas and a lack of data in low-income countries.

Our findings call for robust action to reduce sodium and increase potassium intakes and to undertake further efforts to monitor their consumption through 24-hour urine samples especially among lower income countries to obtain comparable data.

Author contributions. IVM, MT and FH designed the study. YP helped to define the search terms. IVM ran the search, cleaned the database, performed the statistical analyses, and wrote the first draft. IV, MT and FH discussed study findings. All authors revised the manuscript critically for intellectual content.

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Conflict of interests. FJH is an unpaid member of Action on Salt and World Action on Salt, Sugar and Health (WASSH); GAM is the unpaid chairman of Blood Pressure UK, and chairman of Action on Salt and Chairman of WASSH. The other authors declare no competing interest.

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Excreción de sodio y potasio en 24 horas en la Región de las Américas: revisión sistemática y metanálisis

RESUMEN

Objetivo. Determinar la excreción urinaria de sodio y potasio en 24 horas en la Región de las Américas.

Métodos. Se realizaron una revisión sistemática y un metanálisis en busca de estudios realizados entre los años 1990 y 2021 con adultos residentes en cualquier Estado soberano de la Región publicados en Medline, Embase, Scopus, SciELO y Lilacs. La búsqueda se llevó a cabo por primera vez el 26 de octubre del 2020 y se actualizó el 15 de diciembre del 2021. De los 3941 resúmenes revisados, se incluyeron 74 estudios de 14 países, 72 estudios sobre excreción urinaria de sodio (27 387 adultos) y 42 estudios sobre excreción urinaria de potasio (19 610 adultos) realizados entre el 1990 y el 2020. Se agruparon los datos mediante un modelo de metanálisis de efectos aleatorios.

Resultados. La excreción media de sodio fue de 157,29 mmol/24h (IC de 95%, 151,42-163,16); la de potasio, de 57,69 mmol/24 h (IC de 95%, 53,35-62,03). En los casos en que se consideraron únicamente mujeres, la excreción media de sodio fue de 135,81 mmol/24h (IC de 95%, 130,37-141,25); la de potasio, de 51,73 mmol/24h (IC de 95%, 48,77-54,70). En varones, la excreción media de sodio fue de 169,39 mmol/24h (IC de 95%, 162,14-176,64); la de potasio, de 62,67 mmol/24h (IC de 95%, 55,41-69,93). La excreción media de sodio fue de 150,09 mmol/24h (IC de 95%, 137,87-162,30) en la década de 1990 y de 159,79 mmol/24 h (IC de 95%, 151,63-167,95) en la década del 2010. La excreción media de potasio fue de 58,64 mmol/24h (IC de 95%, 52,73-64,55) en la década de 1990 y de 56,33 mmol/24h (IC de 95%, 48,65-64,00) en la década del 2010.

Conclusiones. Estos resultados sugieren que la excreción de sodio casi duplica el nivel máximo recomendado por la Organización Mundial de la Salud y las excreción de potasio es 35% más baja que el requisito mínimo, por lo que se deben invertir grandes esfuerzos para reducir el consumo de sodio y aumentar la ingesta de potasio.

Palabras clave Sodio en la dieta; potasio en la dieta; revisión sistemática; Américas.

Excreção de sódio e potássio em 24 horas na Região das Américas: revisão sistemática e meta-análise

RESUMO

Objetivo. Determinar as excreções urinárias de sódio e potássio em 24 horas na Região das Américas.

Métodos. Revisão sistemática e metanálise de estudos realizados entre 1990 e 2021, em adultos vivendo em qualquer estado soberano da região, indexados nos bancos de dados MEDLINE, Embase, Scopus, SciELO e LILACS. A pesquisa foi realizada pela primeira vez em 26 de outubro de 2020 e foi atualizada em 15 de dezembro de 2021. Dos 3.941 resumos revisados, foram incluídos 74 estudos de 14 países, 72 estudos relatando sódio urinário (27.387 adultos) e 42 estudos relatando potássio urinário (19.610 adultos), realizados entre 1990 e 2020. Os dados foram reunidos utilizando um modelo de metanálise de efeitos aleatórios.

Resultados. A excreção média foi de 157,29 mmol/24h (IC95% 151,42-163,16) para o sódio e 57,69 mmol/24h (IC95% 53,35-62,03) para o potássio. Quando somente mulheres foram consideradas, a excreção média foi de 135,81 mmol/24h (IC95% 130,37-141,25) para o sódio e 51,73 mmol/24h (IC95% 48,77-54,70) para o potássio. Nos homens, a excreção média foi de 169,39 mmol/24h (IC95% 162,14-176,64) para o sódio e 62,67 mmol/24h (IC95% 55,41-69,93) para o potássio. A excreção média de sódio foi de 150,09 mmol/24h (IC95% 137,87-162,30) na década de 1990 e 159,79 mmol/24h (IC95% 151,63-167,95) na década de 2010. A excreção média de potássio foi de 58,64 mmol/24h (IC95% 52,73-64,55) na década de 1990 e 56,33 mmol/24/h (IC95% 48,65-64,00) na década de 2010.

Conclusões. Estes achados sugerem que as excreções de sódio são quase o dobro do nível máximo recomendado pela Organização Mundial da Saúde e as excreções de potássio são 35% menores do que o mínimo exigido; portanto, será necessário envidar esforços importantes para reduzir a ingestão de sódio e aumentar a de potássio.

Palavras-chave Sódio na dieta; potássio na dieta; revisão sistemática; América.