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## Clinical Research

# Assessment of Dietary Sodium and Potassium in Canadians Using 24-Hour Urinary Collection

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***See editorial by Graudal, pages 283-285 of this issue.***

**ABSTRACT**

**Background:** Although salt intake derived from data on urinary sodium excretion in free-living populations has been used in public policy, a population study on urinary sodium excretion has not been done in Canada. We assessed dietary sodium and potassium intake using a 24-hour urine collection in a large survey of urban and rural communities from 4 Canadian cities and determined the association of these electrolytes with blood pressure (BP).

**RÉSUMÉ**

**Introduction :** Bien que l'apport en sel provenant des données sur l'excrétion urinaire de sodium des populations d'individus autonomes ait été utilisé dans les politiques publics, aucune étude de population sur l'excrétion urinaire de sodium n'a été réalisée au Canada. Nous avons évalué l'apport alimentaire en sodium et en potassium à partir d'un recueil des urines des 24 heures dans une vaste enquête réalisée auprès de collectivités urbaines et rurales de

Sodium intake is reported to be a modifiable determinant of hypertension,[1-3] a major risk factor for cardiovascular disease and other morbidities.[4,5] It is believed that the average sodium intake in most populations is excessive and that current intake levels contribute to hypertension.

In Canada, current data on sodium consumption are limited, and there are no studies showing an association between sodium and blood pressure (BP). The best available data on sodium intake came from the Canadian Community Health Survey (CCHS) in 2004, which showed that Canadians of all ages consume on average 3100 mg/d of sodium.[6] The major limitation of the CCHS was that intake was assessed by dietary recall, which is not considered to be reliable.[7] Urine collection over 24 hours is considered the reference standard approach for estimating sodium intake.[8] However, there are no data on measured 24-hour urinary sodium excretion in a large sample of adult Canadians. Further, no study has examined the association

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**Methods:** One thousand seven hundred consecutive individuals, aged 37-72 years, attending their annual follow-up visits of the ongoing **P**rospective and **U**rban **R**ural **E**pidemiology (PURE) study in Vancouver, Hamilton, Ottawa, and Quebec City, Canada, collected a 24-hour urine sample using standardized procedures.

**Results:** Mean sodium excretion was 3325 mg/d and mean potassium excretion was 2935 mg/d. Sodium excretion ranged from 3093 mg/d in Vancouver to 3642 mg/d in Quebec City, after adjusting for covariates. Potassium excretion ranged from 2844 mg/d in Ottawa to 3082 mg/d in Quebec City. Both electrolytes were higher in men than in women and in rural populations than in urban settings ($P < 0.001$ for all). Sodium excretion was between 3000 and 6000 mg/d in 48.3% of the participants, $< 3000$ mg/d in 46.7%, and $> 6000$ mg/d in only 5%. No significant association between sodium or potassium excretion and BP was found.

**Conclusions:** Sodium consumption in these Canadians is within a range comparable to other Western countries, and intake in most individuals is $< 6000$ mg/d, with only 5% at higher levels. Within this range, sodium or potassium levels were not associated with BP.

**Méthodes :** Mille sept cents individus consécutifs âgés de 37 à 72 ans allant à leurs visites de suivi annuelles de l'étude PURE (Prospective and Urban Rural Epidemiology) en cours à Vancouver, à Hamilton, à Ottawa et à Québec, au Canada, ont recueilli des échantillons de leurs urines des 24 heures selon les protocoles standardisés.

**Résultats :** L'excrétion moyenne de sodium était de 3325 mg par jour et l'excrétion moyenne de potassium était de 2935 mg par jour. L'excrétion de sodium variait de 3093 mg par jour à Vancouver à 3642 mg par jour à Québec après l'ajustement des covariables. L'excrétion de potassium variait de 2844 mg par jour à Ottawa à 3082 mg par jour à Québec. Les deux électrolytes étaient plus élevés chez les hommes que chez les femmes et dans les populations rurales que dans les populations urbaines ($P < 0{,}001$ pour tous). L'excrétion de sodium était entre 3000 et 6000 mg par jour chez 48,3 % des participants, $< 3000$ mg par jour chez 46,7 % des participants et $> 6000$ mg par jour chez 5 % des participants seulement. Nous n'avons observé aucune association significative entre l'excrétion de sodium ou de potassium et la PA.

**Conclusions :** La consommation de sodium chez ces Canadiens se situe dans une fourchette comparable à d'autres pays occidentaux, puis l'apport chez la plupart des individus était $< 6000$ mg par jour, seuls 5 % avaient des concentrations plus élevées. À l'intérieur de cette fourchette, les concentrations en sodium et en potassium n'étaient pas associées à la PA.

between urinary measures of sodium excretion and BP in Canadians.

In addition to sodium, the amount of potassium in the diet has been reported to influence the level of blood pressure.[9] In particular, individuals with diets that are low in potassium appear to be particularly vulnerable to the proposed hypertensive effects of high sodium intake, and those with high potassium intake appear to be protected.[10-13] Therefore, although most attention has been given to reducing sodium intake, the amount of potassium individuals consume also needs to be considered.

In this study of adults residing in urban and rural communities in 4 Canadian regions, we measured sodium and potassium intake, as reflected by 24-hour urinary excretion, and determined their values according to sex, age, and household location. Our secondary objective was to describe the association of sodium and potassium intake with BP.

## Methods

### Study design and participants

The **P**rospective **U**rban **R**ural **E**pidemiological (PURE) study in Canada is part of a large international epidemiologic cohort study that has enrolled 157,543 men and women between 35 and 70 years living in 667 communities in 4 low-income, 11 middle-income, and 3 high-income countries around the world.[14,15] The sampling strategy used in the PURE study ensures unbiased representation from different geographic areas (urban/rural, community sampling), captures a representative sample of residents to estimate intake at a population level, and maximizes efficiency and economy of resources (household, individual sampling).[14,15] Within Canada, we followed the same procedures and recruited 10,464 individuals (7938 urban; 2526 rural) from 81 communities in Vancouver, Hamilton, Ottawa, and Quebec City and some of their respective rural regions. These rural regions were villages, small towns, or farming areas at least 50 km from the cities.

From this current PURE-Canada study, 1700 consecutive individuals, aged 37-72 years, from urban and rural areas attending their 3-year follow-up clinics at each site (535 from Hamilton, 402 from Quebec City, 394 from Vancouver, and 369 from Ottawa), were recruited between January 2012 and December 2013. Excluded were participants diagnosed with a debilitating disease that reduced survival; those with food restrictions because of chronic illness; and those precluded from taking para-aminobenzoic acid (PABA) if younger than 65 years of age (see further on), including individuals who were pregnant or currently breastfeeding in whom PABA was contraindicated; those allergic to hair dye, sunscreen, or vitamins; or those taking a sulfonamide drug, because PABA may interfere with its therapeutic action. Ethical approval was provided by Health Canada/Public Health Agency of Canada and each participating site, and all participants provided signed informed consent.

### Procedures

A standardized procedure for collection of 24-hour urine specimens was provided to each of the 4 study sites. Consenting individuals were provided with a kit containing all the necessary supplies and detailed written instructions on how to collect the 24-hour urine sample. Participants were asked to discard the first urine voided on the day of their collection and to collect all urine voided during the subsequent 24-hour period, ending with the first urine void the following