

***Systematic review of studies comparing 24h vs spot urine collections for estimating population salt intake***

**Name: Christina Paul**

**Affiliation: Warwick Medical School, Warwick Medical School**

**Date: August 2011**

**Supervisor: Professor F Cappuccio**

**Project was funded by IATL's Student as Producer Fund**

## **Project title**

### ***Systematic review of studies comparing 24h vs partial urine collections for estimating population salt intake***

## **Abstract**

The assessment of population salt intake underpins the implementation of salt reduction policies. This study conducted a systematic review comparing 24h urine sample collections to spot urine samples and overnight urine samples to aid efficient assessment. MEDLINE and EMBASE were searched for papers that included both 24h and spot or timed urine sodium collections and analyses and the total number fitting the inclusion criteria and after discarding duplicates were 44. After reading the papers, four children studies and sixteen adult studies were found to fit the criteria for the systematic review. Three of the four children studies included in this review validated the use of overnight sampling of urine to estimate sodium levels instead of collecting 24h samples. All sixteen adult studies also validated the use of partial sampling-whether the comparison was made between overnight urine collection or spot sample collection versus the 24h urine collections.

## **Introduction**

Raised blood pressure is a major cause of cardiovascular disease, responsible for over 50% of stroke and coronary heart disease (approximately 10 million deaths a year worldwide) (1). There is overwhelming evidence that dietary salt is one of the major determinants of raised blood pressure and that a reduction in salt intake lowers blood pressure, and thus reducing blood pressure-related disease (1). Consequently assessment of population salt intake is vital, as it underpins the monitoring and surveillance of population salt reduction policies. Twenty-four-hour urine collection is the gold standard for assessing salt intake through 24-h urinary sodium (Na) excretion at population level despite the fact that the collection is usually inconvenient (2,3). Partial urine samples (for example overnight collections) and spot urine samples have been suggested as an alternative. The use of a spot urine method, or a brief timed collection, for assessing sodium excretion has previously been examined (4-6) but, has not been adopted for clinical use. Unfortunately, the spot urine sodium collections have inherent limitations in estimating 24-hour sodium excretion. Sodium excretion varies considerably from day to day and hour to hour, and, therefore, spot urine results can differ substantially from results of 24-hour collections. Also the accuracy of the sodium content is reduced by the considerable inter-individual differences in 24-hour creatinine excretion. To establish the appropriateness of utilising partial urine samples in comparison to 24-h urinary samples, this systematic review has been performed gathering all the published evidence comparing these two measures for the assessment of average salt intake. By comparing the peer reviewed work by various authors in various settings there is the possibility to assess the extent to which spot urine samples in particular could substitute 24-h urines for the assessment of salt intake in populations around the world.

## **Methodology**

MEDLINE and EMBASE were searched with a set inclusion and exclusion criteria. The inclusion criteria were set to include full papers with only human studies. The studies had to be population studies or large group studies and had to include data for 24h urinary sodium collections and partial urine sodium collections. The exclusion criteria discarded studies that were not in English and those with a sample size of less than 30 individuals. Studies conducted in special patient groups, such as those with hypertension or renal failure were excluded from this systematic review.

23 papers from EMBASE and 37 from MEDLINE were retrieved to meet these criteria. After reading and evaluating the content of the studies, further papers were excluded. 4 studies that used children as their cohort and 16 studies that used adults as their cohort were further analysed for this systematic review.

The results from the various studies were tabulated and comparisons were drawn. A statistical analysis was not performed with the ratios and figures in each study as the method and calculations of statistical analysis varied.

The final table and written comparison were put into a document and made available in the medical school.

## **Results**

### **Adult Studies:**

Table 1 denotes the details of each study. Table 2 details the various correlation coefficients and other results found in all the adult studies in this review.

### **Studies comparing 24-hour sampling to overnight samples**

Seven studies included in this review made a correlation between 24-hour (24h) urine sodium (Na) and overnight urinary sodium. Six of these studies used flame photometry for the analysis of sodium concentrations, while Pan et al, 1994 used ion-selective electrode method and Yamasue et al in 2006 used a new salt monitor. Of the seven studies that made a comparison between only the true mean overnight urinary Na and the true mean 24h urinary Na, two studies found that using the overnight would not be an appropriate substitute due to the weak correlations noted.

### **Studies comparing 24-hour sampling to spot sampling**

Eight studies included in our review made a comparison between 24h urinary sodium contents and single spot urinary sodium. Of these seven are included in this section as it only looked at spot urine versus 24h urine samples, whereas the eighth one by Yamori, 1982 looked at multiple other sampling techniques and is detailed in the next section.

Other than the one study by Kawasaki et al, 1982, all other studies that made a comparison between spot urine sampling and 24h urine collection is assessing sodium content, advocated using the spot sampling method. There was a significant consensus that a greater number of collections will be necessary for using spot urine samples, but regardless this will prove to be more convenient and feasible for ordinal populations that require monitoring.

### **Studies comparing 24-hour sampling to multiple other sampling techniques**

Yamori et al. in 1983 (Study #2) looked at 24h urine samples in three separations and found that the highest correlation of Na in the urine samples occurred in the daytime voided urine and the second in the overnight voided urine. The correlation coefficient was rather low and the single spot urine at 0.578. Despite the higher correlation of daytime voided urine to the 24h urine collection for Na, they recognized practicality favours evening and overnight collection as these can be completed at home for most individuals. Their results clearly support the use of partial urine samples to analyse Na intake, and even the use of single spot urine samples for large population surveys.

### **Children Studies:**

Table 3 denotes the details of each study.

Three of the four children studies included in this review validate the use of overnight sampling of urine to estimate Na levels instead of collecting 24h samples. They recognise it is tedious and inconvenient for many subjects. There is also a consistency that if overnight samples were used in replacement of 24h samples in large scale studies, more samples should be used to reduce the variability within and across samples.

### **Conclusion and outcome**

Despite the well established effects of sodium intake on blood pressure and on response to antihypertensive medication, sodium intake is rarely monitored in clinical practice. The current gold standard method, the 24-hour urine collection for sodium excretion, is cumbersome, often inadequately performed, and therefore not commonly requested (2). The results also have limited meaning because of the substantial day-to-day variation in sodium intake through our fluids and food. The strong correlations observed between 24h urinary sodium collections and the partial samples of urinary sodium collections, the convenience, the option of serial sampling, and the low cost all seem very beneficial and direct us to renewed consideration of the spot urine method for assessing sodium excretion in clinical practice and in epidemiologic studies. This would be particularly beneficial given the rarity of monitoring of sodium intake in clinical practice today despite the need to control hypertension in today's society.

Completing this project with the funding from IATL helped me gain a better understanding of hypertension and the complications that arise from this condition. It cemented the need for sodium control and made me aware of the excessive amounts found in processed foods and take away products that we consume without paying a second thought to the salt contents. Most importantly it gave me a better understanding of the methods of monitoring sodium excretion and statistical methods used to make sense of the ratio and figures included in the various studies I analysed.

The findings from this project were given as a presentation to the students of Warwick Medical School who were available at University Hospital Coventry Warwickshire on Tuesday August 2<sup>nd</sup> 2011. Printed copies of the results and conclusions were made available at the lobby of the Clinical Research Unit at UHCW and also to students during scheduled

lecture times. Healthy eating was promoted during open events at the hospital and the methods of monitoring were made aware to the general public.

## References

- (1) World Health Organisation. WHO Forum on Reducing Salt Intake in Populations (2006 : Paris, France) Reducing salt intake in populations : report of a WHO forum and technical meeting. Paris, France: 5-7 October 2006.
- (2) Bentley B. A review of methods to measure dietary sodium intake. *J Cardiovasc Nurs.* 2006;21:63–67.
- (3) Christopher-Stine L, Petri M, Astor BC, et al. Urine protein-to-creatinine ratio is a reliable measure of proteinuria in lupus nephritis. *J Rheumatol.* 2004;31:1557–1559.
- (4) Tanaka T, Okamura T, Miura K, et al. A simple method to estimate populational 24-h urinary sodium and potassium excretion using a casual urine specimen. *J Hum Hypertens.* 2002;16:97–103.
- (5) Kamata K, Tochikubo O. Estimation of 24-h urinary sodium excretion using lean body mass and overnight urine collected by a pipe-sampling method. *J Hypertens.* 2002;20:2191–2197.
- (6) Kawasaki T, Itoh K, Uezono K, et al. A simple method for estimating 24 h urinary sodium and potassium excretion from second morning voiding urine specimen in adults. *Clin Exper Pharmacol Phys.* 1993;20:7–14.