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Research report

Attitudes and beliefs of health risks associated with sodium intake in diabetes ☆

Kristy L. Gray, Kristina S. Petersen, Peter M. Clifton [1], Jennifer B. Keogh [2,*]

School of Pharmacy and Medical Sciences, University of South Australia, Australia

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ABSTRACT

Background: Despite good evidence that reducing sodium intake can reduce blood pressure (BP), salt intake in people with type 1 diabetes (T1DM) or type 2 diabetes (T2DM) remains high. The purpose of this study was to describe the knowledge and beliefs of health risks associated with a high salt diet in adults with diabetes. *Methods:* Men and women with T1DM (n = 27; age 38 ± 16 years) or T2DM (n = 124; age 60 ± 11 years) were recruited. *Results:* Nine (6.0%) respondents knew the correct maximum daily recommended upper limit for salt intake. Thirty-six (23.9%) participants were not concerned with the amount of salt in their diet. Most participants knew that a diet high in salt was related to high BP (88.1%) and stroke (78.1%) and that foods such as pizza (80.8%) and bacon (84.8%) were high in salt. Fewer than 30% of people knew that foods such as white bread, cheese and breakfast cereals are high in salt (white bread 28.5%, cheese 29.1%, breakfast cereals 19.9%) and 51.0% correctly ranked three different nutrition information panels based on the sodium content. Label reading and purchase of low salt products was used by 60–80% of the group. Estimated average 24 hour urinary sodium excretion was 169 ± 32 mmol/24 h in men and 115 ± 27 mmol/24 h in women. *Conclusion:* Label reading and purchase of low salt products was used by the majority of the group but their salt excretion was still high. Men who used label reading had a lower salt intake. Other strategies to promote a lower sodium intake such as reducing sodium in staple foods such as bread need investigation.

Introduction

People with type 1 diabetes (T1DM) or type 2 diabetes (T2DM) are at increased risk of developing cardiovascular disease (CVD) and have worse outcomes after surviving a CVD event (Eyles et al., 2013; Koivisto et al., 1996; Land et al., 2014a; Orchard, Stevens, Forrest, & Fuller, 1998). Approximately 30% of CVD in diabetes can be attributed to raised blood pressure which is the largest direct cause of death due to stroke, heart attack and heart failure in patients with diabetes (Suckling, He, & MacGregor, 2010). Blood pressure increases progressively with increasing sodium intake (Hamming et al., 2008). The National Health and Medical Research Council (NHMRC) state that the upper limit (UL) of sodium intake for the general population is 2300 mg per day (100 mmol/6 g NaCl/day) (National Health and Medical Research Council, 2006). There is some controversy regarding recommendations for reduced sodium intake with several studies finding that a low dietary sodium excretion was associated with an increase in cardiovascular disease risk and mortality (Charlton, Yeatman, Houweling, & Guenon, 2010; Land et al., 2014b; O'Donnell et al., 2011; Stolarz-Skrzypek et al., 2011). Reverse causation is a possible explanation for these findings as well as suboptimal measurement of salt intake and excretion. There is a good body of evidence that a population reduction in salt intake is likely to be effective in preventing strokes, heart attacks and other cardiovascular events (Campbell, Correa-Rotter, Neal, & Cappuccio, 2011; Hamming et al., 2008; Neal, Land, & Woodward, 2013).

Furthermore, studies suggest an inverse relationship between sodium:potassium (Na:K) ratio and hypertension (Zhang et al., 2013). The World Health Organization recommends maintaining a 1:1 ratio of sodium to potassium intake to improve blood pressure (Webster, Brian, Wilson, Grem, & Vincent, 2005). A reduction in sodium intake of 100 mmol per day can result in systolic blood pressure (SBP) reductions of approximately 6 mmHg which is similar to the effect of one blood pressure lowering medication (He, Li, & MacGregor, 2013). Despite this, sodium intake in the majority of the population as well as among people with diabetes remains above

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* Corresponding author.
E-mail address: Jennifer.Keogh@unisa.edu.au (J.B. Keogh).

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recommended levels (Villani, Clifton, & Keogh, 2012). Reducing sodium intake may be difficult for individuals as more than 80% comes from processed foods (Ni Mhurchu et al., 2011; Webster, Dunford, & Neal, 2010). This may present an opportunity as food industry action has resulted in salt reduction of approximately 15% in the UK (He, Brinsden, & MacGregor, 2014). However a regulatory approach is not without its challenges as government food agencies seek to both protect consumers and ensure fair practices in the food trade (Lawrence, 2009). In people with diabetes breads and cereals contribute the most to dietary sodium providing 23% of daily intake (Villani et al., 2012). Packaged food items in Australia are required to show the sodium content of foods in mg per 100 g of food and in mg per serving with the serve size defined by the manufacturer (Food Standards Australia New Zealand, 2013). People with chronic disease are more likely to use nutrition information panels than those without chronic disease (Kessler & Wunderlich, 1999; Lewis et al., 2009; Post, Mainous, Diaz, Matheson, & Everett, 2010). Two Australian studies have found that sodium excretion in people with T2DM was more than two-fold greater than the current recommendations for chronic disease prevention (Charlton et al., 2010; Villani et al., 2012). A previous study which aimed to educate people with diabetes to reduce their sodium intake by using food labels to choose low sodium products was unsuccessful despite the individuals believing they had lowered dietary salt intake (Petersen et al., 2013).

In a survey in a consumer population Grimes, Riddell, & Nowson (2009) found that most participants understood the relationship between hypertension and a high salt intake; however, only around half of the respondents were able to use sodium labelling on nutrition information panels to choose lower sodium foods (Grimes et al., 2009). We hypothesise that individuals with diabetes do not fully understand the risks associated with a high salt diet and are largely unaware of how much sodium they are consuming. The purpose of this study was to describe the knowledge and beliefs of health risks associated with a high sodium diet in a population with diabetes and their ability to use food labelling information to choose lower sodium options. The secondary aims of the study were to estimate sodium intake, sodium and potassium excretion and investigate if there was a relationship between label use and purchase behaviour and sodium intake and excretion. Spot urines were used to estimate group means and calculate Na/K ratio while food frequency questionnaires (FFQ) were used to examine individual variations.

Materials and methods

Participants and recruitment

Participants were men and women with T1DM or T2DM aged ≥18 years. Recruitment occurred between February 2013 and January 2014 at The University of South Australia, Adelaide, South Australia and The Diabetes Centre, The Royal Adelaide Hospital, Adelaide, South Australia. At the University of South Australia participants were recruited through flyers on campus, advertisement in the Diabetes South Australia e-newsletter and from an existing database of participants who had provided consent to be contacted. Exclusion criteria were age <18 years, pregnant or breastfeeding or having limited use of English. Participants were asked to complete a sodium knowledge survey and a food frequency questionnaire (FFQ) for sodium intake. The electronic version of the Dietary Questionnaire for Epidemiological Studies Version 2 (DQES v2) FFQ was used. This FFQ has been validated against weighed food records for nutrients including sodium (Hodge, Patterson, Brown, Ireland, & Giles, 2000). Participants provided a spot urine sample on a single visit to the university or hospital and their most recent HbA1C result and any blood pressure medications they were currently taking. Height, weight, and blood pressure were measured.

Outcome measures

Survey

The salt knowledge survey used was adapted from a survey developed by Grimes et al. (2009). It consisted of 26 predominantly multiple choice questions. The questions gathered demographic information, knowledge of health risks associated with sodium, attitudes and behaviours around sodium intake and ability to use nutrition information panels on food packages to identify lower sodium foods. There were two questions where participants were required to identify foods that were lowest or highest in sodium content based on a nutrition information panel and one question based on a front of pack percentage of daily intake (%DI) panel.

Urine

Participants were asked to provide a random spot urine sample to estimate 24 h sodium excretion and to test for Na:K excretion ratio. Samples were aliquoted and frozen at −20 °C then analysed after collection from all participants at SA Pathology (Adelaide, SA, Australia), an accredited commercial laboratory. The International Cooperative Study on Salt and Blood Pressure (INTERSALT) equations were used to estimate 24 h urinary excretion based on spot urine samples using the formula: 24 h urinary excretion men = 23 × (25.46 + [0.46 × spot Na (mmol/L)] − [2.75 × spot Cr (mmol/L)] − 2 [0.13 × spot K (mmol/L)] + [4.10 × BMI (kg/m^2)] + [0.26 × age (years)]); 24 h urinary excretion women = 23 × (5.07 + [0.34 × spot Na (mmol/L)] − [2.16 × spot Cr (mmol/L)] − [0.09 × spot K (mmol/L)] + [2.39 × BMI (kg/m^2)] + [2.35 × age (years)] − [0.03 × age^2 (years)]) (Brown et al., 2013).

Height and weight

Measurements for weight were taken on calibrated digital scales (Avery Berkel HL 122, Selacs Pty Ltd, Adelaide, Australia) with participants in light clothing. Height was measured using a stadiometer and recorded to the nearest 0.1 cm. Body mass index was calculated as kg/m^2.

HbA1C

Participants provided their most recent haemoglobin A1c (HbA1C) result from their doctor.

Blood pressure

Blood pressure was measured using an automated sphygmomanometer (SureSigns VS3; Philips, North Ryde, Australia) after fasting from 10 o'clock the previous night. A series of blood pressure measurements were taken at 1 minute apart and four measurements with consistency (SBP within 10 mmHg) were obtained. The first reading was discarded and a minimum of three consistent measurements were averaged for the final result (Ogedegbe & Pickering, 2010).

Ethical considerations

The research was conducted according to the NHMRC National Statement on Ethical Conduct in Human Research. This project was approved by The University of South Australia's Human Research Ethics Committee and The Royal Adelaide Hospital Human Research Ethics Committee. The study was registered with the Australian and New Zealand Clinical Trial Register (ANZCTR) with registration number: ACTRN12613001192774.

Data analysis

Data were analysed using SPSS statistical package for Windows (SPSS version 21.0, SPSS Inc., Chicago, IL, USA). The frequency of categorical and continuous variables was calculated using descriptive