This is the published version:


Available from Deakin Research Online:

[http://hdl.handle.net/10536/DRO/DU:30076725](http://hdl.handle.net/10536/DRO/DU:30076725)

Reproduced with the kind permission of the copyright owner.

**Copyright**: 2015, PBMJ Publishing Group
This is the published version:


Available from Deakin Research Online:

http://hdl.handle.net/10536/DRO/DU:30076725

Reproduced with the kind permission of the copyright owner.

**Copyright**: 2015, BMJ Publishing Group
School based education programme to reduce salt intake in children and their families (School-EduSalt): cluster randomised controlled trial

Feng Ji 1, Yangfeng Wu 2,3,4, Xiang-Xian Feng 5, Jun Ma 6, Yuan Ma 1,2,3, Haijun Wang 6, Jing Zhang 2, Jianhui Yuan 5, Ching-Ping Lin 2,7, Caryl Nowson 6, Graham A MacGregor 1

ABSTRACT

OBJECTIVE
To determine whether an education programme targeted at schoolchildren could lower salt intake in children and their families.

DESIGN
Cluster randomised controlled trial, with schools randomly assigned to either the intervention or control group.

SETTING
28 primary schools in urban Changzhi, northern China.

PARTICIPANTS
279 children in grade 5 of primary school, with mean age of 10.1; 553 adult family members (mean age 43.8).

INTERVENTION
Children in the intervention group were educated on the harmful effects of salt and how to reduce salt intake within the schools' usual health education lessons. Children then delivered the salt reduction message to their families. The intervention lasted for one school term (about 3.5 months).

MAIN OUTCOME MEASURES
The primary outcome was the difference between the groups in the change in salt intake (as measured by 24 hour urinary sodium excretion) from baseline to the end of the trial. The secondary outcome was the difference between the two groups in the change in blood pressure.

RESULTS
At baseline, the mean salt intake in children was 7.3 (SE 0.3) g/day in the intervention group and 6.8 (SE 0.3) g/day in the control group. In adult family members the salt intakes were 12.6 (SE 0.4) and 11.3 (SE 0.4) g/day, respectively. During the study there was a reduction in salt intake in the intervention group, whereas in the control group salt intake increased. The mean effect on salt intake for intervention versus control group was −1.9 g/day (95% confidence interval −2.6 to −1.3 g/day; P<0.001) in children and −2.9 g/day (−3.7 to −2.2 g/day; P<0.001) in adults. The mean effect on systolic blood pressure was −0.8 mm Hg (−3.0 to 1.5 mm Hg; P=0.51) in children and −2.3 mm Hg (−4.5 to −0.4 mm Hg; P=0.05) in adults.

CONCLUSIONS
An education programme delivered to primary school children as part of the usual curriculum is effective in lowering salt intake in children and their families. This offers a novel and important approach to reducing salt intake in a population in which most of the salt in the diet is added by consumers.

TRIAL REGISTRATION
ClinicalTrials.gov NCT01821144.

Introduction
Cardiovascular disease is the leading cause of death and disability worldwide. About 80% of deaths from cardiovascular disease occur in developing countries. Raised blood pressure is a major cause of such disease, accounting for 62% of strokes and 49% of cases of ischaemic heart disease. Dietary salt intake is the main factor that increases blood pressure and is largely responsible for the rise in blood pressure with age. There is compelling evidence in adults that a modest reduction in salt intake lowers blood pressure and reduces the risk of cardiovascular disease. Indeed, salt reduction is one of the most cost effective measures to prevent cardiovascular disease in both developed and developing countries. The World Health Organization has recommended salt reduction as one of the top three priority actions to tackle the global crisis in non-communicable disease.

Although raised blood pressure and cardiovascular disease typically present in adults, the origins begin in childhood. Accordingly, the greatest long term potential to reduce these conditions is to initiate prevention activities in young people. Such a public health strategy aimed at preventing or slowing the progression of rising blood pressure altogether would have enormous
benefits. Several lines of evidence from animal experiments, epidemiological studies, and controlled trials have shown that salt intake plays an important role in regulating blood pressure in children. A lower salt diet starting from childhood could lessen the rise in blood pressure with age and therefore help to prevent the development of high blood pressure and cardiovascular disease later in life.

China is the largest developing country in the world. Raised blood pressure caused by excessive salt consumption is highly prevalent. The problem is particularly marked in northern China, where salt intake is high in both adults and children. Unlike in developed countries, the major source of salt in the Chinese diet is salt added by the consumers themselves during food preparation. An important strategy to reduce population salt intake would be to encourage the general public to reduce the amount of salt used at home. To date, no country has demonstrated a successful programme where salt intake has fallen because consumers have been educated to use less salt. Indeed, it is difficult to persuade individuals to change their diet.

The School-EduSalt (School-based Education Programme to Reduce Salt) study aimed to develop a novel approach to lowering salt intake. In China, children have a big influence on the family. Our approach was to educate primary school children about the harmful effects of excessive salt intake and to empower them to educate their families to reduce the amount of salt used at home. We hypothesised that such an education programme could lower salt intake in both children and their families. To test this hypothesis, we carried out a cluster randomised controlled trial in Changzhi, northern China.

Methods
A detailed description of the methods of the School-EduSalt study has been published elsewhere.

Study design and participants
The study was a cluster randomised controlled trial. Primary schools in urban Changzhi were eligible. We excluded schools in rural areas to avoid contamination from school meals as some children in such schools have lunch and dinner at school because of the long distance from home, whereas in urban schools most children have lunch and dinner at home.

There are 36 primary schools in urban Changzhi. We excluded eight schools: three special Muslim schools, two schools that were far from the study centre, and three schools with headteachers who were not willing to participate. The 28 remaining schools were included.

In primary schools in Changzhi, there are six grades for children aged 7–12. Our study was carried out in grade 5 children (age about 10) only. From each school, we selected one class (if there was more than one) in grade 5. With the headteacher we selected a class whose teacher in charge was willing to collaborate with the researchers.

We used a random number list (created by a researcher who was blind to the identity of the participants) to randomly select children from each class until 10 children were recruited. To be eligible for inclusion in the assessments, children had to eat homemade meals at least three days a week and live not too far from the school (<3 km). In two schools where the class had fewer than 15 children, we invited all children to take part in the assessments.

From each child’s family we invited two adults for assessments. All adults who shared the same meals with the child were eligible. If more than two adults in one family were willing to participate, we selected two of them (one man and one woman) in the order of grandparents, parents, uncles, and aunts.

Randomisation
Schools (clusters) were randomly assigned (1:1) to either the intervention or the control group. Randomisation was stratified by the location of schools (urban or suburban) and the size of the class. Among all schools in urban Changzhi, the size of the class varied from 14 to 75 children a class. Usually, a larger class size indicates that the school is at the upper level of the league table in terms of exam results.

An independent statistician who was blind to the identity of the schools carried out the randomisation using a computer generated random number system. The randomisation took place after written consents had been obtained and the baseline assessments had completed. The participants, the schoolteachers, and the local investigators who undertook participant recruitment and data collection were therefore unaware of the allocation until the point before the start of the intervention.

Intervention
Our aim was to reduce salt intake by a minimum of 20%. To achieve this, we set 50% reduction as the target, toward which an intervention strategy was developed and implemented. The intervention duration was one school term (about 3.5 months). Our slogan was “small hands leading big hands, together let’s reduce salt.” The salt reduction curriculum and materials were developed around the key messages: the harmful effects of salt on health and the salt reduction target; the recommended level of salt intake; and how to reduce salt intake.

Local health educators who were trained by research staff over a four day workshop delivered the salt reduction education programme. A detailed intervention manual and resources were provided. The programme materials consisted of lesson plans, activity work-sheets, and homework assignments. The materials were developed around cartoon characters. A detailed description of the education programme is provided in the appendix.

Main components of programme
Classroom component
For the selected classes, the usual health education lessons (a 40 minute lesson, every two weeks; a total of eight lessons in one school term of about 3.5 months) were replaced with lessons on salt reduction. The lessons were delivered to the whole class, despite
only 10 children being selected for assessments. The lessons included three proactive and interactive lectures, one themed class meeting to share experiences, one class meeting for family participation, and three other activities to assist in salt reduction, such as competitions on writing and illustration, plays among children, and salt reduction knowledge involving both children and adults with family as a unit (see appendix). Schoolteachers assisted in the lessons and coordinated all events. Posters on the harmful effects of salt and how to reduce salt intake were put up in the classroom.

Children were asked to complete the following tasks as homework: emphasise the 50% salt reduction target and remind the whole family of this target after each lesson; deliver the salt reduction messages, salt reduction methods, and skilful tips to the whole family; and develop a salt reduction action plan for their own family and supervise the actions at home.

**Family component**

Children needed to persuade the people who did the cooking to reduce the amount of salt, soy sauce, and bean paste used. Garlic, ginger, and herbs were recommended for enhancing food flavour. We also recommended replacing pickles with fresh vegetables and replacing salted eggs and peanuts with unsalted ones. We encouraged participants to replace the usual salt with a mineral salt that is low in sodium and high in potassium. No special foods or salt substitutes were provided, and the important message was to reduce the total amount of salt used.

Parents were provided with educational materials in the form of a newsletter (see appendix) that covered topics such as salt and its effect on blood pressure and cardiovascular disease, the major sources of salt in the diet, and cooking with reduced salt. The newsletter also had a question and answer column and a family quiz. Homework set for the students was related to the newsletter.

**Monitoring of family use of salt**

As more than 75% of salt in the diet came from salt added during food preparations at home, we estimated the approximate amount of salt used per family and monitored it every two weeks. Each family was provided with a container, and parents were asked to put all of the salt in their household into the container and use salt from this container only. Children brought the salt container to school every two weeks, and the teachers measured the weight. The amount of salt used by the household for those two weeks was calculated with a computer programme that also provided information on how far the family’s salt use was different from the target set (that is, 50% reduction). The results were communicated back to the families.

We reported the amount of salt used as grams per person per day (that is, the total amount of salt used by the family divided by the number of family members). Each family was also provided with a salt control spoon (2 g salt). Parents were asked to use this spoon if they thought it was necessary to add salt during cooking as it would help them to estimate the amount used.

**Control group**

Children in the control group carried on with their usual health education lessons as in the curriculum, and these lessons did not contain information on salt.

**Outcome measures**

Our primary outcome was the difference between the intervention and the control group in the change of salt intake as measured by 24 hour urinary sodium from baseline to the end of the trial. The secondary outcome was the difference between the two groups in the change of blood pressure.

All outcome assessments were carried out at baseline and at the end of the trial in exactly the same way in all schools for all participants, irrespective of their assignment to intervention or control group.

We carried out two consecutive 24 hour urine collections. Trained research staff carefully instructed participants on how to accurately collect 24 hour urine samples. On the first visit to the participants’ home, the researchers asked the participants to empty their bladder and discard the urine. The researchers recorded the start time and date of the 24 hour urine collection. They then gave the participants the collection equipment including containers and collection aids such as carrier bags. The participants were instructed to collect all subsequent urine voids over the next 24 hour period. On the second day at the same time, the researchers revisited the participants’ home and asked them to pass the last urine into the container. The researchers recorded the finish time of the first 24 hour urine collection. The researchers then gave the participants the collection equipment for the second 24 hour urine collection and repeated the process. Participants were told to take spare urine containers with them when they went to school or work. Spare collection equipment was also available in the schools, in case children forgot to bring containers. For most families, collections were made on the same days of the week for baseline and follow-up. In the event that the participant missed one or more urine voids or split >10% of the total 24 hour urine volume, the participant was asked to do a further 24 hour collection.

The urine samples were measured for volume and sodium, potassium, and creatinine concentrations. An ion selective electrode method was used for sodium and potassium analysis (AC9102 electrolyte analyzer, Audi- com Medical Technology, Jiangsu) and Jaffe method for creatinine (Hitachi 7080 automatic biochemical analyzer, Japan). The biochemists who performed the urinary electrolyte measurements were not aware of the participants’ group allocation.

We used the average of the two 24 hour urinary measurements at each time point in the analysis. In one child and six adults, however, we had only one 24 hour urine collection at baseline; and in one adult we had only one 24 hour urine collection at follow-up. In these cases, we used one 24 hour urinary measurement.