Citation:

Forrester T, Adeyemo A, Soarres-Wynter S, Sargent L, Bennett F, Wilks R, Luke A, Prewitt E, Kramer H, Cooper RS. A randomized trial on sodium reduction in two developing countries. *J Hum Hypertens.* 2005 Jan; 19(1): 55-60.

PubMed ID: 15470483

Study Design:

Randomized crossover trial

Class:

A - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To investigate the effect of salt restriction on blood pressure (BP) in developing countries.

Inclusion Criteria:

- Men and women between the ages of 25 and 55 years who were able to give informed consent
- Subjects who were able to complete a four-week run-in phase that reduced sodium intake 50mEq below the population mean and who completed one 24-hour urine collection.

Exclusion Criteria:

- Inability or refusal to collect urine samples
- Pregnancy
- Breastfeeding
- History of diabetes, kidney disease or atherosclerotic vascular disease
- Body mass index (BMI) higher than 40kg/m^2.

Description of Study Protocol:

Recruitment

- Nigeria: Recruited from communities that had participated in previous research
- Jamaica: Research nurses from the Tropical Metabolism Research Unit recruited participants from five different neighborhoods.

Design

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- Subjects participated in a two-week run-in period with a low-sodium diet to assess the ability to adhere to the diet
- Those who were able to follow a low-sodium diet had a one- to two-week period with usual diet
- Subjects were randomized to either a high- or low-salt diet for three weeks
- All subjects had a wash-out period for two weeks with their usual diet between the low- or high-sodium diet
- Either a high- or low-salt diet was followed for three more weeks
- BP using both manual manometer and the Omron automatic device; weight, height, waist and hip circumference were measured at each clinic visit
- 24-hour urine samples at baseline and the end of each three-week diet intervention were assayed for sodium (Na) and potassium (K).

Dietary Intake/Dietary Assessment Methodology

- Primary sources of salt in the diet were identified by nutritionists; food frequency questionnaires, meals eaten, preparation of foods and recipes were obtained from the individual communities
- Nutritionists used the collected data to provide guidance on following a low-sodium diet in the individual community settings.

Intervention

Using a randomization scheme constructed in blocks of four, individuals were allocated to either a low-salt or high-salt diet for three weeks followed by a two-week wash-out period and a crossover phase for an additional three weeks.

Statistical Analysis

- Continuous variables were compared using the Wilcoxon rank sum test; the Wald X^2 test was used for categorical variables
- To determine the group BP and urine sodium excretion changes between the low-salt arm and the high-salt arm, a fixed-effects model was used.

Data Collection Summary:

Timing of Measurements

- Three seated BP measurements with the standard mercury manometer were taken at each visit
- Three seated BP measurements with the automatic Omrom device were also taken during each visit
- Weight (to nearest 0.1kg) and height were measured at each visit (BMI was calculated)
- Waist and hip circumference were measured (to nearest 0.1cm) at each visit (waist to hip ratio was calculated)
- 24-hour urine samples were collected at baseline and the end of the third week of the low-salt and high-salt phase.

Dependent Variables

- *Variable 1:* BP
- *Variable 2:* Urinary sodium and potassium excretion.

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Independent Variables

- Low-salt diet: 50mEq lower than usual diet
- High-salt diet: 50mEq higher than usual diet.

Control Variables

- Age
- Sex
- Weight
- Height
- BMI
- Waist:Hip ratio
- Period effects.

Description of Actual Data Sample:

- *Initial N*
  - Nigeria: 110 screened, 88 were eligible
  - Jamaica: 1,471 screened, 83 were eligible
- *Attrition (final N)*
  - Nigeria: 34 males, 24 females
  - Jamaica: 34 males, 22 females
- *Mean age*
  - Nigeria: 46.6 years
  - Jamaica: 40.8 years.
- *Ethnicity:* Either Nigerian or Jamaican
- *Other Relevant Demographics:* See table below.
- *Anthropometrics:* See table below.

Table 1. Baseline Characteristics of Participants in SORT by Study Site

	Nigeria (N=58)	Jamaica (N=56)	P-values
	Mean±SD	Mean±SD	
Age (years)	48± 8.3	40.8±7.4	0.0002
BMI	23.1±3.9	28.5±4.6	<0.0001
BP (manual)			
SBP (mmHg)	114.6±11.3	125.9±11.3	<0.0001
DBP	72.9±8.8	76.3±8.8	0.04
BP (Omron)			
SBP	114.7±12.4	118.4±11.0	0.09
DBP	73.6±9.9	75.5±6.9	0.2
BP (average)[a]			
SBP	114.8±11.4	122.3±10.2	0.0003

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DBP	73.3±9.1	75.9±7.3	0.1
24-hour urine			
Sodium (mEq per day)	93.0 52.8	149.0 112.6	0.001
Potassium (mEq per day)	52.5 21.4	53.0 49.4	0.9
Na:K ratio	2 1.4	3.4 1.6	<0.001

[a]Average of manual and Omron BP measurements.

- *Location:*
  - Nigeria: Southwest Nigeria Igbo-Ora and Idere
  - Jamaica: Peri-urban Kingston (Mona Heights, Liguanea, Papine, Ellestson Flats and Hope Pastures).

Summary of Results:

Table 2: Mean Change in BP, SORT participants, High-salt Minus Low-salt Phase, by Study Site

	Nigeria (N=58)	Jamaica (N=56)
Variable	**Mean (95% CI)**	**Mean (95% CI)**
BP mmHg (manual)		
SBP	4.8 (1.9 ,7.7)	5.1 (2.3, 8.0)
DBP	3.2 (1.2, 5.2)	2.2 (-0.7, 5.1)
BP mmHg (Omron)		
SPB	4.1 (1.0, 4.3)	5.8 (3.2, 8.4)
DBP	2.4 (0.4, 4.3)	3.0 (1.0, 5.0)
BP mmHg (average)		
SBP	4.5 (1.6, 7.3)	5.5 (3.0, 8.0)
DBP	2.7 (0.9, 4.5)	2.8 (0.5, 5.0)

The fixed-effects model included the following covariates:

- Age (continuous)
- Sex (continuous and period that subjects received low-salt or high-salt intervention).

Other Findings

- After adjustments for baseline urine sodium (UNa) excretion, period effects, age and sex, the mean net change in UNa excretion between the low-salt and high-salt phases was 72.2mEq per day in Nigeria and 78.8mEq per day in Jamaica
- There were no changes in urinary potassium.

Author Conclusion:

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- Moderate reductions in sodium intake reduce SBP an average of 5mmHg in normotensive adults living in Nigeria and Jamaica
- Public heath agencies in developing countries should examine mechanisms to achieve sustained reductions in sodium intake at the population level in order to decrease the burden of disease secondary to increased BP.

Reviewer Comments:

- *Suspect that attrition was due to subjects' inability to adhere to protocols, but this was not clearly stated*
- *The fact that it was done in a "free living population" vs. a controlled center study as the He article adds support to the conclusion that population changes perhaps in processed food regulation may be worthwhile.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions

1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes

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2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	???
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	Yes
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	N/A
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	Yes
4.	**Was method of handling withdrawals described?**	???
4.1.	Were follow-up methods described and the same for all groups?	???
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	???
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	No
4.4.	Were reasons for withdrawals similar across groups?	???
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	???
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	???

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5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	???
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	N/A
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	Yes
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	N/A
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	Yes
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes

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8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**		Yes
	8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
	8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
	8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
	8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
	8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
	8.6.	Was clinical significance as well as statistical significance reported?	Yes
	8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**		Yes
	9.1.	Is there a discussion of findings?	Yes
	9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**		???
	10.1.	Were sources of funding and investigators' affiliations described?	No
	10.2.	Was the study free from apparent conflict of interest?	???

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