Mauritius Salt Intake Study 2012

(MSIS 2012)

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1. EXECUTIVE SUMMARY

According to the Non-communicable Disease (NCD) Survey 2009,the prevalence of hypertension was 37.9% in the adult population in Mauritius. Deaths due to circulatory diseases and diabetes represent 56.5% of total deaths (Health statistics Report 2011). A high level of salt intake is known to be associated with high blood pressure and a greater risk of cardiovascular diseases. Knowledge of salt consumption levels and main sources of salt in the diet in the population are therefore important to inform and develop a country-specific salt reduction strategy.

Baseline data on salt intake in the Mauritian population has been generated in this cross-sectional study of 125 individuals through assessment of 24-hour urinary sodium excretion. The amount of salt intake per day has been obtained by dividing the sodium eliminated during 24 hours in mmol by a conversion factor of 17.1 (one gramme NaCl being equivalent to 17.1 mmol of sodium or 393.4 mg of sodium).

This study has revealed that the salt intake in the population is higher than generally recommended. **The overall age-sex standardized mean salt intake was estimated at 7.9 g daily** (WHO recommended level of daily salt intake is less than 5.0 gm/day). **It was also found that 83.2% of adults aged 30-59 years consumed 5 or more grams of salt daily and that salt intake level was higher among men.**

Interventions to reduce population-wide salt intake have been shown to be highly cost-effective to diminish the burden of cardiovascular diseases. Hence, this study provides much needed baseline data on salt intake in the Mauritian population and this will help to develop a national strategy for decreasing salt intake in the population.

2. INTRODUCTION

Sodium is an essential nutrient in man; it is the principal cation in extracellular fluid and plays an important role in water balance as well as in the generation of the membrane potential of cells. Physiological needs amounts to only 8–10 mmol/d (184–230 mg/d) (Dahl, 1972). Our ancestors had exposure only to sodium naturally occurring in food and water (Denton, 1982.). They were on a low salt diet of no more than 20–40 mmol sodium/day. Therefore humans are exquisitely adapted to the physiological retention and conservation of the limited salt naturally present in foods. They are not optimally adapted to the excretion (via the kidneys) of large quantities of sodium, which exceed many times physiological needs, that has become necessary with the addition of salt to foods late in human evolution (Denton, 1982).

Many epidemiological studies have demonstrated that high salt intake is associated with an increased risk of high blood pressure. **In the InterSalt Study, the association between blood pressure and salt intake was studied in 52 communities with a wide range of salt intake (INTERSALT Cooperative Research Group, 1988). Four communities studied had a low salt intake (≤ 3 g/day) and the rest had an intake of 6–12 g/day of salt**. The study showed that there was a positive relationship between salt intake and blood pressure. There was also a positive and highly significant relationship between the increase in blood pressure with age and salt intake.

Thus most populations appear to have mean sodium intakes well in excess of 100 mmol/d (2.30 g/d). Sodium intakes in men are greater than those in women, most likely reflecting the higher food consumption (energy intake) among men. In industrialized countries, it was found that about 75% of sodium consumed as common salt (sodium chloride) in the diet came from manufactured foods and foods eaten away from home, 10–12% was naturally occurring in foods and the remaining 10–15% was from the discretionary use of salt in home-cooking or at the table (Elliot & Brown, 2007; Mattes & Donnelly, 1991).

A large amount of evidence from epidemiological (Elliot et al, 1996), migration (Poulter et al, 1990), intervention (Forte et al, 1989; Sacks et al, 2001), genetic (Lifton, 1996) and animal (Denton et al, 1995; Elliott et al, 2007) studies suggest that salt intake plays an important role in regulating population blood pressure (BP).It is believed that the mechanism by which the kidney causes hypertension involves a physiological defect in sodium excretion (Guyton et al, 1972; MacGregor et al, 1982; Johnson et al, 2005).

Recent studies in animal models (Susic et al, 2010) have demonstrated that salt excess adversely affects cardiovascular and renal structure and function independently of pressure elevation, suggesting that the systemic and/or local tissue Renin-Angiotensin-Aldosterone-System (RAAS) plays an important role in causing the adverse effects of salt excess on the heart and the kidneys.

Many lines of investigation, including genetic studies, epidemiological studies and interventional studies, have provided evidence for a causal relationship between salt intake and cardiovascular disease. Several prospective studies have investigated the association between dietary sodium and the risk of cardiovascular disease. A significantly positive association between sodium intake and stroke has been reported in at least two of these studies; one in overweight adults in the United States of America (He et al., 1999) and the other in a Japanese cohort (Nagata et al., 2004). In a study of Finnish men and women, urinary sodium excretion was significantly positively associated with mortality from cardiovascular disease but not with mortality from stroke (relative risk = 1.3 in men) (Tuomilehto et al., 2001).

In the WHO World Health Report 2002 (WHO, 2002) it was estimated that globally 62% of cerebrovascular disease and 49% of ischaemic heart disease were attributable to elevated blood pressure (systolic ≥ 140 mmHg). Heart diseases were the leading cause of death for persons over 60 years of age and the second cause of death for persons aged 15–59 years. The report reviewed strategies to reduce the risks associated with CVD and stated that **in all settings population-wide salt reduction strategies were the most cost-effective.**

In 2005, 35 million people died from chronic diseases; this represented 60% of the total number of deaths (58 million) in that year. Of all deaths from chronic diseases, 30% were due to cardiovascular disease (CVD). Approximately 8% of chronic disease deaths occurred in low- and middle-income countries. Additionally, it is known that 80% of heart disease, stroke, and type 2 diabetes and 40% of cancer can be prevented through inexpensive and cost-effective interventions (WHO, 2005).

The efficacy of reduced sodium intake in lowering blood pressure is well established. In a Cochrane systematic review (including 17 trials in individuals with elevated blood pressure and 11 trials in individuals with normal blood pressure) a modest reduction in salt intake for a duration of 4 weeks or more was found to have a significant and, from a population viewpoint, important effect on blood pressure (He & Mac Gregor, 2004).

In Mauritius, in 2011, 56.5% of deaths were due to circulatory diseases and diabetes.. Furthermore the prevalence of hypertension was 37.9% in the adult population in Mauritius according to the NCD Survey 2009. Given the relationship between the amount of dietary salt (sodium chloride) consumed and cardiovascular diseases, salt reduction strategies at national level would be essential to reduce the burden of cardiovascular diseases. Knowledge of salt consumption levels and the main sources of salt in the diet are important to inform and develop a population based salt reduction strategy.

The objective of this study was to measure the average salt intake in a representative sample of the Mauritian population using the single 24-hour urine collection method. Timed 24-hour urinary sodium excretion was used as it is considered the “gold standard” method to estimate salt intake.

2. METHODOLOGY

3.1 **Study Design**

The study design consisted of a cross-sectional community-based survey.

3.2 **Target Population**

The target population was Mauritians aged 30 to 59 years

3.3 **Sampling Method**

10 clusters representing well-demarcated geographical regions defined by the Cartography Division of Statistics Mauritius (Ex CSO) were randomly selected in Mauritius. In each of the 10 randomly selected regions, 30 persons (15 men, 15 women) aged 30 to 59 years were invited. Their names were randomly selected from the listing of 150 households in each region.

3.4 **Response Rate**

216 of the 300 invited persons attended the 10 survey sites. The attendance rate was 72%. An eligibility screening form was used with those who attended the survey site. A total of 182 persons were found to be eligible. Pregnant women and those on hypertension and cardiac disease drugs have been excluded. However, only 175 of the eligible respondents agreed to participate, with a response rate of 96%.

The criteriae for exclusion were:-

- All those, who according to their date of birth are aged < 30 years or > 59 years as at the month during which the survey will be conducted.
- Pregnant women
- Hypertensive patients on medication
- Cardiac patients on medication
- Patients undergoing dialysis.
- Patients with renal impairment.

3.5 **Ethical Clearance**

Approval for conducting the survey and for the contents of the questionnaire was obtained from the Ethics Committee of the Ministry of Health and Quality of Life. Participation was voluntary, and consent was obtained prior to participation. Confidentiality and anonymity were assured throughout the survey.

3.6 **Data Collection**

Data was collected from 17 May to 9 June 2012.

3.7 **Survey Procedures**

3.7.1 **Registration**

The names of the participants were registered and a survey serial number was allocated to each subject.

3.7.2 **Blood Pressure Measurements**

Blood pressure was measured for all participants. They were requested to be in a seated position. Calibrated Electronic Blood Pressure Monitor (Omron Blood Pressure Apparatus – SEM 1) was used to measure blood pressure of participants. Two measurements were taken and the average was used.

3.7.3 **Blood sampling**

Blood specimens were collected from participants for fasting blood glucose, urea, creatinine and lipids by venepunture.

3.7.4 **Anthropometric measurements**

Anthropometric measurements were taken at the survey site. Height, weight and waist circumference were measured by trained staff. For all anthropometric measurements subjects were requested to wear light clothing and no shoes for height and weight measurements.

Weight - This was measured to the nearest 0.1 kg and scales used were calibrated with a standard weight each day.

Height - Measurements was done using a Stadiometer to the nearest 0.5 cm. Two measurements were taken and the average was used. In case of difference by more than 0.5 cm, a third measurement was taken and the average used.

Waist Circumference - Waist circumference was measured around the waist, mid-way between the last rib bone and the iliac bone, about 2.5 cm above the umbilicus. The measurement was taken to the nearest 0.5 cm after normal expiration.

3.7.5 **Filling of** Questionnaires

Questions were asked in a standard manner using the appropriate language (usually Creole), and answers recorded legibly in pencil.

3.7.6 **Urine Collection**

For the accurate measurement of sodium on a 24-hour urine sample, it was important that a complete and accurate collection be made.

Urine collection was carried out by the participants at their residence during 24 hours. Subjects were instructed by the trained survey team on the method of urine collection. They were counseled on the importance of collecting a complete sample, and were provided with a collection jar and other accessories (funnel, beaker, etc.) for the 24-hour period: equivalent to a capacity of 4–5 litres. Participants were phoned during the 24 hours to ensure that urine collection was being carried out without any problem.

The procedures for the urine collection were as follows:

- Immediately before starting the collection, the participant was asked to void his or her bladder; the time of start was recorded at this point.
- All urine voided from that moment onwards was collected until the same time the following day.
- At about the same time the next day, the participant was asked to empty his or her bladder completely, and the final urine specimen was collected. At this point the collection time was recorded.

In order to calculate an individual's sodium excretion over 24 hours three parameters were measured:

1. sodium concentration (mmol per litre)
2. total volume of urine collected (ml), and
3. collection time (hours and minutes).

The urine samples collected were placed in cool box and sent to the laboratory within 2 hours of collection.

3.7.7 Data **Entry and Analysis**

All completed questionnaires were edited, then captured and data was cleaned and analyzed using SPSS. Laboratory results of the blood tests and urine were merged separately ensuring that each result corresponded to the respective respondent's questionnaire.

Assuming that the sodium eliminated in the urine comes from the diet, the excretion would correspond to the dietary salt (NaCl) intake. According to the internationally established protocol and in line with WHO recommendations, the amount of salt intake per day is estimated by dividing the sodium eliminated per day in mmol by a conversion factor of 17.1 (l g NaCl is equivalent to 17.1 mmol of sodium or 393.4 mg of sodium).

4. **FINDINGS**

Characteristics of participants and salt intake.

Characteristics	24-hour mean salt intake (unadjusted grams)	Standard Deviation (grams)	Number of respondents per category
Sex			**125**
Male	8.8	3.9	58
Female	7.3	2.5	67
Race/Ethnicity			**125**
Indian	8.0	3.2	112
Creole	7.5	2.2	9
Other	9.7	5.9	4
Age in years			**125**
30 – 34	7.8	2.7	27
35 – 39	8.2	3.0	29
40 – 44	9.8	4.0	20
45 – 49	8.2	4.1	20
50 – 54	6.9	2.4	17
55 – 59	6.7	2.3	12
Occupation			**125**
Housewife	6.8	2.7	33
Manual/skilled worker	8.4	3.4	49
Skilled clerical	9.2	2.9	9
Administrative/Technical	8.0	3.0	8
Professional/ Managerial	8.7	1.4	4
Retired/Illness	6.8	2.3	5
Unemployed	13.2	6.4	3
Self employed	8.6	3.2	14
Characteristics	**24-hour mean salt intake (unadjusted grams)**	**Standard Deviation (grams)**	**Number of respondents per category**
Education level			**125**
Primary	9.0	4.0	41
Secondary 1-3	7.7	2.7	15
Secondary 4-6	7.5	2.9	53
Tertiary	8.3	2.3	7

None	7.3	2.4	9
Income			**125**
Less than 5000	9.0	2.2	5
5000-10,000	8.0	3.2	40
10001-15000	7.9	3.2	34
15001-20000	6,6	3.3	14
More than 20,000	8.5	2.6	29
Unknown	13.3	10.3	3

Assuming a volume of less than 700 ml of urine sample and a volume of more than 3000 ml to be doubtful, only 125 lab results have been considered as being valid. The mean volume of urine samples of which the lab test results have been considered for data analysis is 1650 (± 644 ml).

The mean sodium in the 24-hour urine was found to be 138.5 mmol/L with a Standard Deviation of 56.4 mmol/L. The median value stood at 135.1 mmol/L. The unadjusted mean salt found in the urine excretion was found to be 8.1 grams (median 7.9 grams). To obtain national estimates for the parameters to be studied, the results have been standardized by age and gender. The age-standardised mean salt in urine was 8.5 g for men and 7.4 for women. The overall age-sex standardized mean salt in urine was 7.9 grams**.**

It is therefore estimated that the overall age-sex standardized mean consumption of salt per day in the Mauritian population was 7.9 grams.

Urine sodium excretion and estimated 24 hour salt consumption

	Sodium in 24-hour urine (mmol/L)	Estimated 24 hr consumption of salt (NaCl) (grams)
Mean (unadjusted) (g)	138.5	8.1
Std. Error of Mean	5.1	0.3
Median	135.1	7.9
Std. Deviation	56.4	3.3
Variance	183.0	10.7
Minimum	17.2	1.0
Maximum	350.6	20.5

Furthermore it is estimated from the Study that:

- **20.8% of adults 30 – 59 years consumed 10 or more grams of salt.**
- **83.2% of adults 30-59 years consumed 5 or more grams of salt**.

<u>Mean estimated consumption of salt by age-group and gender</u>

Age (Years)	Mean Estimated Consumption of Salt (NaCl) grams)	Mean Estimated Consumption of Salt (NaCl) grams)
	Men	Women
30 – 34	8.1	7.7
35 – 39	9.4	7.3
40 – 44	10.4	7.3
45 – 49	8.9	7.9
50 – 54	7.8	6.5
55 – 59	5.7	7.4

The distribution by age-group and gender indicates that the mean salt consumption is higher among men in all age-group except in that of 55 - 59 years.

An in-depth analysis of the data indicates that the mean salt consumed was lower (7.6g) among respondents found to be hypertensive (≥ 140/90) compared to the non-hypertensive ones (8.2 g). It is assumed that people who may already be aware of being hypertensive make relatively more efforts to take less salt.

Further analysis of the MSIS 2012 data indicated that the mean salt in urine excretion is higher among respondents with creatinine level equal to or greater than 85 μmol/L (9.7 grams) compared to 7.3 grams among those whose creatinine level was found be less than 85 μmol/L. The mean salt was found to be 9.0 grams among respondents having urea ≥ 5 mmol/L compared to 7.7 grams among those with urea <5 mmol/L (a subjective dividing value based on the survey data as in the case of creatinine). The same type of relationship has been observed, but to a lesser extent, with the triglycerides level (7.8 grams among those with triglyceride <2.0 mmol/L versus 8.6 grams with triglycerides ≥ 2).

The mean salt in urine excretion by urban and rural localities does not indicate any difference being 8.1 grams in both regions.

7. Discussions

This is the first time that a population Salt Intake Study is being carried out in Mauritius. It is now clearly established that the age – sex standardized mean population salt intake which is 7.9 g is above the WHO recommended level of 5 g/day.

Many countries have already conducted surveys to establish their population salt intake per day. Below is a table which gives an indication of baseline population salt intake for some countries.

Baseline Salt Intake per day by country

Country	**Salt Intake / day**
Bangladesh	16 – 18 g
Canada	9 g
China	12 – 20 g
Finland	8 g
United States of America	9 g
United Kingdom (2003)	9.5 g
Barbados	12 – 15 g
Portugal	12.3 g

Many of these countries have already implemented strategies to bring about a gradual reduction in population salt intake.

It will now be essential for us in Mauritius to set realistic stepwise goals for reducing population salt intake over a specified time frame. A multi-sectoral working group needs now be set up to identify clear actions to bring about population salt reduction. Broadly speaking the actions will consist of :

- sensitization and education of the population about the relationship between salt intake and hypertension and cardiovascular diseases.
- establishing the main sources of salt intake in the diet – the National Nutrition Survey 2012 will help to identify the main sources of salt intake.
- working with all stakeholders to bring about salt reduction in foods.
- monitoring and evaluation of progress.

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Annexes

Comments on charts (Exploratory Data Analysis)

Annex I(a) - the distribution of the number of grams of salt in urine follows a more or less normal curve as it is the case with most biological parameters.

Annex I(b) - the scatter plots indicate that higher salt intake is associated with higher triglycerides level.

Annex II(a) - the scatter diagram does not indicate any relationship between salt intake and systolic blood pressure level in this study.

Annex II(b) - the scatter diagram does not indicate any relationship between salt and diastolic blood pressure level.

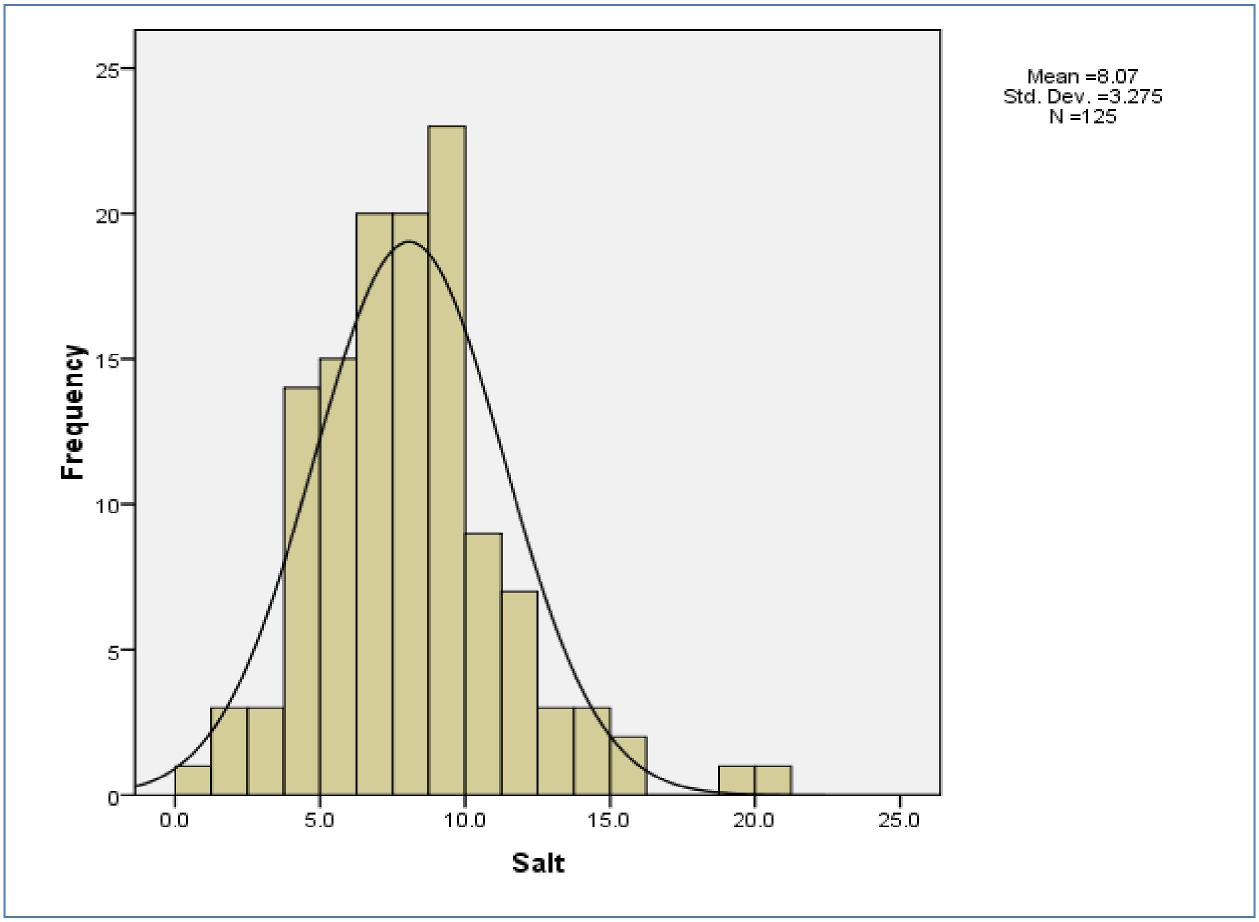
Annex III(a) - the diagram indicates that higher levels of creatinine are associated with higher salt intake.

Annex III(b) - the diagram indicates that higher levels of urea are associated with higher salt intake.

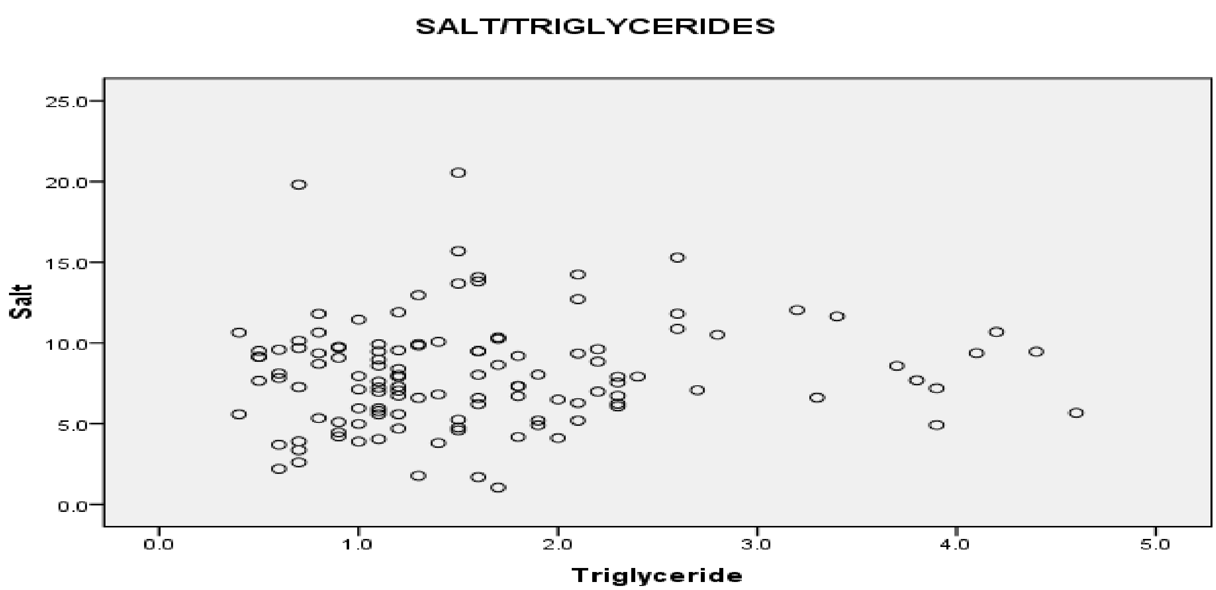
Annex IV List of Urine Collection Sites

Annex V List of Survey Staff

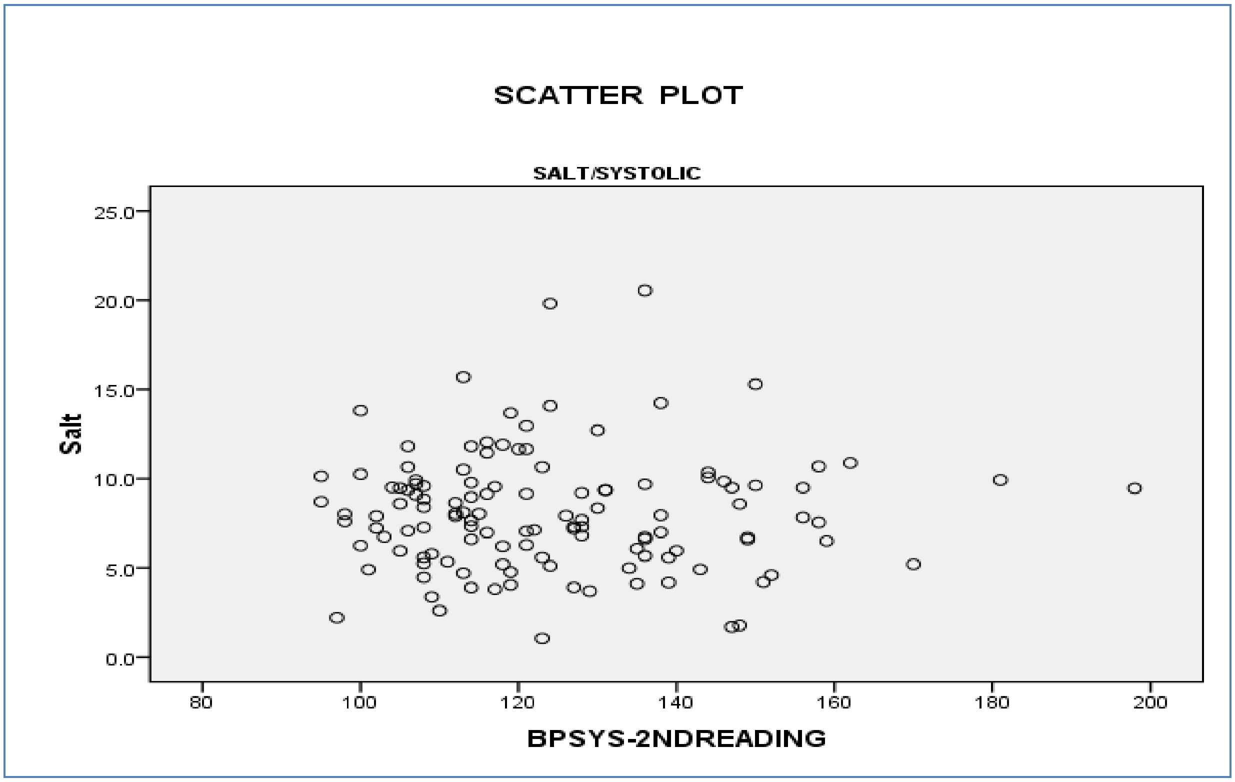
Annex I(a)



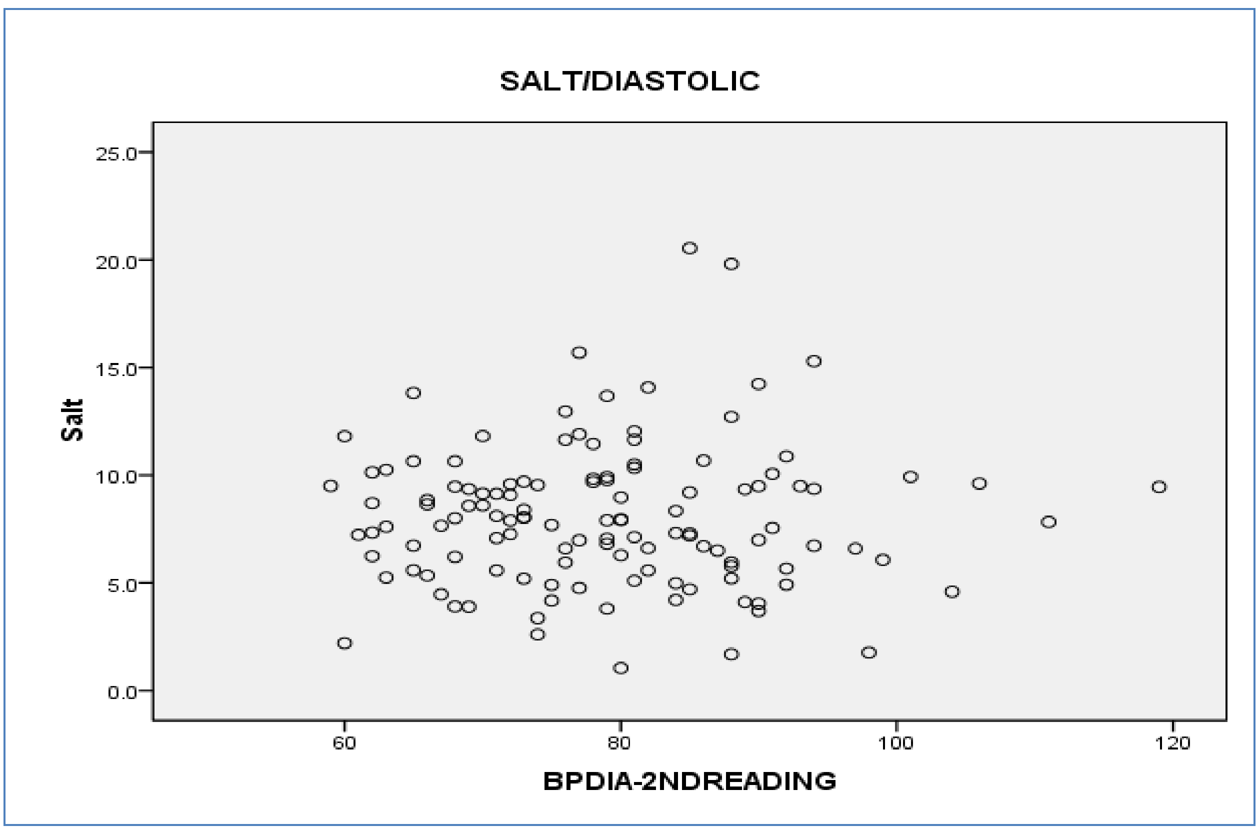
Annex I (b)



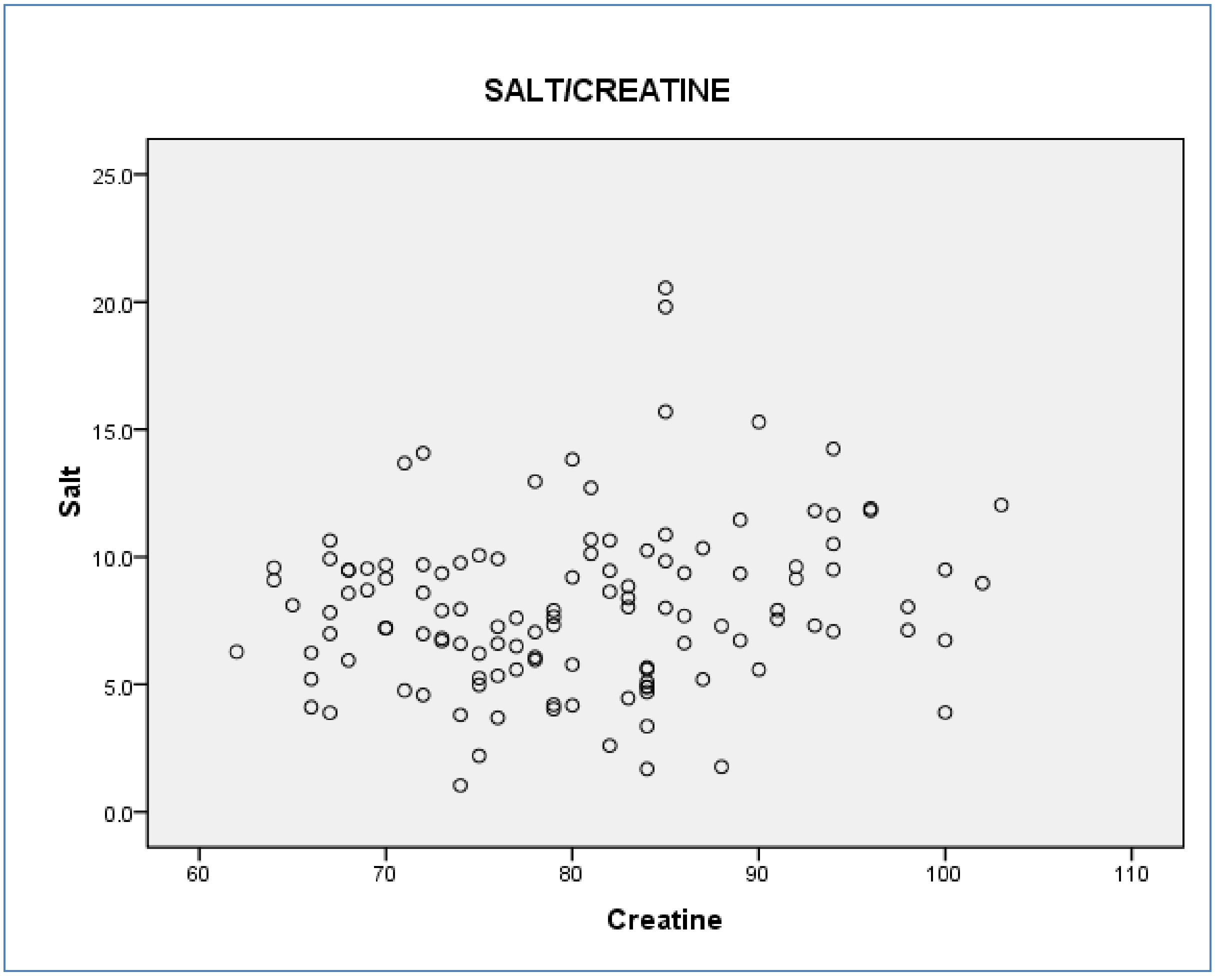
Annex II (a)



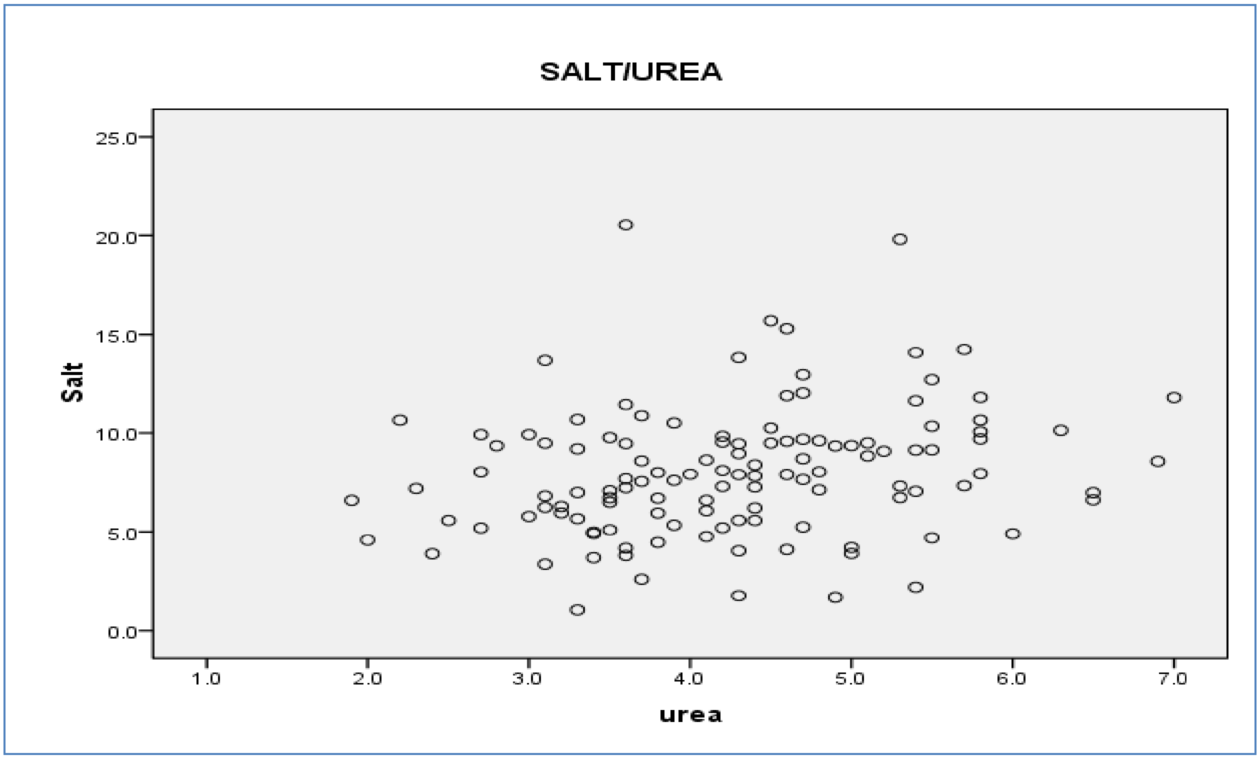
Annex II(b)



Annex III(a)



Annex III (b)



Annex IV - List of Urine Collection Sites

Mauritius Salt Intake Study 2012

SN	Urine Collection Site
1	Goodlands SWC
2	Mesnil Govt School
3	Plaine Magnien - France Boyer de la Giroday SSS
4	Belle Mare CC
5	Calebasses Village Hall
6	St Croix Women Centre
7	Quatre Bornes - Marie Marot Minicipal Centre
8	Bassin Rd - Municipal Complex
9	L'Agrement St Pierre Village Hall
10	Gros Cailloux CC

Annex V: List of Survey staff

Chief Investigators	**Officers for taking blood specimen**	**Registration Officers**	**Data Entry Officers**
Dr K. Pauvaday	Mrs J. Ramdewar	Mr J. Gaonjur	Mrs G.D.Bundhoo
Dr A. Deelchand	Mrs T. Appalasamy	Mrs A. Ramkhelawon	Mrs B.T.B Rozbully
Principal Investigator	Mr A. Karathee	Mrs A. Chellapen	**Officers for measuring height, weight, waist Hip**
Mr N. Jeeanody	Mr D. Koolash	Mr R. Bookal	Ms P. Chekhori
General Administrator/ Investigator	Mrs G. Jhoty	Mrs Y. Gunness	Mr V. Sewnundhun
Mr D. Gaoneadry	Mrs Lallmohamed	Mrs L. Audit	Mrs S. Konayernkunowdu
Survey Project Manager / Investigator	Mrs O. Teeluck	Mrs R. Rumjaune	**Survey Officer**
Mr S. Kowlessur	Mrs P. Sowaruth	Mr Kissondoyal	Mrs Z. Dedarally
Laboratory Coordinator	Mrs V. Coopen	**Survey Site Administrators**	**Survey Transport Officer**
Dr (Miss) N. Joonas	**Interviewers**	Mr V. Sookeera	Mr S. Rengasamy
Data Manager	Mr Toofany	Mrs B. Purmessur	**Attendants / General Worker**
Mrs V. Mootoosamy	Mr N.G.K. Bachoo	Mrs M. Jeetunsiv	Mr. Dussoye
Senior Survey Site Coordinator	Ms S. Sudhoye	Mrs J. Jhoomuck	Mr P. Jeetun
Mr J. Heecharan	Mrs R. Bheecarry	Mrs R. Seeruttun	Mr Tohul
Senior Survey Officer	Mrs S. Souky	Mrs M. Heecharan	Mr S. Emammally
Mr Y. Seeruttun	Mrs V. Doorgah	Mr M. Caremben	**Laboratory Staff**
Data Editing Officers	Mr I. Neetye	Mr Bahadoor	Mrs S.Hunma
Mr G. Rujjoo	Mrs W. Fakun	Ms O. Gaonjur	Mr D.Ragoo
Mr A.C. Musthun	Mrs R. Punchcoory	Mr N. Koonjoobeeharry	Mr K Futloo
Officers for taking blood pressure	Mrs Hossenbaccus	Mrs L. Mohit	Mr M Chuttoo
Mr V. Seethiah	Mrs Gowreesunkur	Mr M. Rumooa	Mr A Bonarien
Mrs N. Ramneehorah	Mrs Ragavoodoo	Mr P. Gaoneadry	Mr Brojolall
Mrs M. Dookee	Mrs V. Bhoonderowa	Mrs S. Sobrun	Mr S Gokool
Mr V. Bangalee	Mr Jowaheer	Mrs S. Bissoon	Mr R Simhadri
Mrs Z. Choychoo	Mrs Lauthan	Mrs N. Purusram	Mr D Dubarry
Mrs N. Seetal	Mrs Goolaub	Mrs M. Bholah	Mr S Padaruth
Mr V. Goolam	Mrs R. Narayadu	Mr Breezmohun	Mr J M Ramsamy
Mr A. Summun	Mr M. Hossensaib	Mr. A. Jeetoo	Mrs D Seetaram
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