KNOWLEDGE, ATTITUDE AND PRACTICES IN EFFORTS TO ELIMINATE IODINE DEFICIENCY AMONG ADOLESCENT SCHOOL GIRLS IN RURAL TANZANIA

By

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ABSTRACT

KNOWLEDGE, ATTITUDES AND PRACTICES IN EFFORTS TO ELIMINATE IODINE DEFICIENCY AMONG ADOLESCENT SCHOOL GIRLS IN SOUTHERN TANZANIA

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Universal Salt Iodation (USI) has been proposed as a long-term strategy to eliminate iodine deficiency disorders (IDD) worldwide. Although USI made progress in Tanzania since its inception in 1990, the degree of success in eliminating IDD differed among reports. This study aimed to assess in adolescent school girls in southern rural Tanzania their knowledge (K), attitude (A) and practices (P) on iodine nutrition and iodized salt (I-salt) use, and their associations with adequate iodine status determined by urinary iodine concentration (UIC > 50 µg/L). Adolescent girls (n=128, 14-19 yrs.) attending day secondary schools were recruited and completed a validated structured questionnaire on KAP level and I-salt use and provided spot urine samples for UIC assessment. Although, the median UIC was 192 µg/L, 39% of the girls had poor iodine status (UIC <100 µg/L). Sociodemographic characteristics were positively associated with iodine KAP level (p=0.04) and dietary diversity score (p=0.03). No significant association observed between KAP level and iodine status. Our study findings underscore the importance of continuous public education regarding iodine nutrition and enforcing USI program in the areas where sale of non-I-salt is still common.

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To my brother Allen-Herry and my sister Liberata-Zeresh

You have meant and continue to mean so much to me. Although you are no longer of this world, your memories continue to regulate my life.

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KEY TO ABBREVIATIONS

HHH	Head of Household
ICCIDD	International Council for Control of Iodine Deficiency Disorders
IDD	Iodine Deficiency Disorders
IDDS	Individual Dietary Diversity Score
I-salt	Iodized Salt
KAP	Knowledge Attitude Practice
ppm	Parts Per Million
RDI	Recommended Dietary Intake
SFP	School Feeding Program
TDHS	Tanzania Demographic Health Survey
TDHS - MIS	Tanzania Demographic Health Survey – Malaria Indicator Survey
TFNC	Tanzania Food and Nutrition Centre
TSH	Thyroid Stimulating Hormone
UIC	Urinary Iodine Concentration
UNICEF	United Nations Children's Funds
USI	Universal Salt Iodation
WHO	World Health Organization

Chapter 1. Introduction

1.1 Iodine Deficiency in Tanzania

Iodine is an essential element in the human diet and a deficiency can lead to a number of health outcomes collectively termed iodine deficiency disorders (IDD) (Fuge and Johnson, 2015). These include impaired mental function, goiter, hypothyroidism, cretinism, retarded physical development and even child mortality (Jooste et al., 2005). It is now generally accepted that damage to the brain resulting in mental retardation is the most significant effect of iodine deficiency (Li and Eastman, 2012), and it has been suggested that iodine deficiency is one of the world's most common causes of preventable mental development problems ranging from sub-clinical minor IQ reduction to, in its worst form, cretinism (WHO, 2006).

Given the public health importance of eliminating iodine deficiency, and the health consequences of its deficiency, consumers must be educated about iodine nutrition and IDD. Tanzania has adopted universal salt iodation (USI) as a measure to prevent IDD among children and adults. The country was highly affected by IDD but the situation has improved due to the USI program which began in 1990 and now reaches 81% of households combined (Macro, 2015). Evaluation of the level of knowledge about iodine nutrition in populations at risk of iodine deficiency is essential to the optimal functioning and implementation of USI program.

In 2014, the use of I-salt was found to be higher in urban households (94%) than in rural households (75%); However, 50% of the salts used in rural households contained inadequate iodine concentration levels of <15 ppm (Macro, 2015). It is noted that fortified salt that contains >15 ppm iodine is adequate for prevention of iodine deficiency.

In women of reproductive age (15-49 yrs.) iodine deficiency plays a role in reducing fertility and increasing the rate of spontaneous abortions (Glinoer, 2007). When these women become pregnant, their thyroid function tends to deteriorate even further as gestation progresses. Pregnancy typically acts therefore to reveal the underlying lack of iodine: the more severe the iodine deficiency, the more pronounced are the consequences for the maternal and fetal thyroid glands (Glinoer, 2007).

The two most commonly used approaches to assessing iodine nutrition in the population level are estimation of the household use of adequately fortified I-salt and the measurement of UIC (De Benoist and WHO, 2004). Almost all iodine from daily dietary intake in the body is excreted in the urine. Therefore daily urinary excretion of iodine closely reflects iodine intake and remains a valuable index for assessing current iodine status in a population (Zimmermann et al., 2008). The UIC values from populations are usually not normally distributed. Therefore, the median rather than the mean is used as a measure of trend in community or population studies

The median UIC of women of reproductive age (15-49 yrs.) in Tanzania is reported to have increased from 160 µg/L in 2010 to 180 µg/L in 2016 (Macro, 2015). However, a disparity exists among sociodemographic subgroups.

Women with secondary or higher education have almost twice as high median UIC (218.8 µg/L) as women with no education (114.9 µg/L) (Macro, 2015). These differences in median UIC among subgroups are parallel with the disparity in adequately fortified I-salt use between urban households (80%) and rural households (49%) (Macro, 2010).

The major reasons for disparity of I-salt use between urban and rural households are undocumented since studies on iodine deficiency conducted in the country focused on goiter

endemic areas when assessing the prevalence of IDD. To date no reported evaluations have been conducted on a national scale to assess the impacts and limitations of the USI (Assey et al., 2007).

1.2 Adolescent Girls' Health

The health of adolescents has not been a major public health concern and research in adolescents has consequently been limited. Adolescents are less susceptible to disease and suffer from fewer life-threatening conditions than children and elderly people (Delisle, 2005). However, during the period of adolescence, nutrient needs are the greatest (Delisle, 2005). Tanzania is among the nations with the highest rate of adolescent pregnancies (UNICEF, 2010). In 2016, the percentage of teenagers who either had a birth or are pregnant was 27%, which has increased from 23% in 2010 (Macro, 2015).

Adolescent pregnancies contribute to poor health indicators of maternal and infant mortality and childbirth-related complications (Delisle, 2005). In Tanzania the rate of adolescent pregnancies is higher among rural women (32%) than urban women (19%) (Macro, 2015). Many adolescents are in school, which provides an effective and efficient opportunity for reaching large portions of the population beyond students themselves. including school personnel, families and community members (Delisle, 2005). School aged children have been widely used in iodine studies especially in assessing the prevalence of IDD (Andersson et al., 2012). A number of nutrition programs have also succeeded when relying on the strategy of using them as agents of change at the household level (Delisle, 2005).

Adolescents are usually open to new ideas by showing curiosity and interest. With increasing age, their personal choices and preferences gain priority over eating habits

acquired in the family (Turconi et al., 2008). One expression of adolescents' search to establish themselves as autonomous members of society is through a change in eating habits. For that reason adolescents are an ideal target for nutrition education for improved nutrition status (Turconi et al., 2008). However, optimal nutritional status is achieved primarily by improving individual accessibility to a diversified diet at the household level and adequate nutrient intake at an individual level (Arimond and Ruel, 2004).

Improving adolescent girls' nutrition status and delaying their first pregnancy may be a promising intervention point to break the intergenerational cycle of malnutrition (UNICEF, 2010). Very little attention has been directed towards adolescent girls given their vulnerability to nutritional health problems compared to those in other life stages (Delisle, 2005).

1.3 Problem Statement

According to WHO, a country is poised to be iodine adequate when 90% of the households consume adequate amount of I-salt fortified with >15 ppm iodine (WHO, 2007b). However, in Tanzania only 61% of the households consume adequate I-salt (Macro, 2015). Furthermore, the disparity between urban and rural in use of I-salt fortified at an acceptable level was very serious [82% of urban households compared to 50% of rural households]. These data suggest that in Tanzania the USI program has worked to a certain extent but not to the degree that was expected by WHO in an effort to eliminate IDD (Pearce et al., 2013). Furthermore, these data collected at the national level are based on self-reported I-salt use at the household level.

Iodine requirement increases from childhood to adolescence and during pregnancy and lactation period. IDD during pregnancy can lead to such serious consequences to health of

mothers and her off springs as stillbirth, miscarriage and congenital abnormalities. Since thyroid function is important for somatic growth, we cannot rule out the possibility of IDD leading to premature birth, which contributes to the persisting rate of stunting (Lazarus, 2015). The situation in Tanzania is exacerbated by the high prevalence of teenage pregnancies.

Assessing the I-status of teenage girls and their knowledge (K), attitudes (A) and practices (P) related to I-salt use is important, particularly in regions where informal re-packing of I-salt and sale of non-I-salt are common (Kulwa et al., 2006). To date, no studies in Tanzania have reported teenage girls' iodine status (UIC) and their understanding (K), attitudes (A) and practices (P) related to I-salt use.

1.4 Objectives and Specific Aims

The goal of this study was to facilitate elimination of IDD in Tanzania by addressing the gap associated with adolescent girls understanding on the importance of using I-salt in rural setting with access to salt.

Aim 1: To assess the characteristics of study subjects including sociodemographic, iodine KAP level, food group intake and iodine status.

HO_1: Adolescent girls in southern rural Tanzania have low iodine KAP level, poor dietary diversity score and poor iodine status.

Aim 2: To examine the association between sociodemographic characteristics, levels of KAP and dietary diversity score among adolescent girls.

HO_{2a}: Sociodemographic characteristics are positively associated with KAP on iodine levels.

HO_{2b}: Sociodemographic characteristics are positively associated with dietary diversity score.

Aim 3: To determine the associations among KAP levels of iodine nutrition, dietary diversity score and UIC.

HO_{3a}: High KAP levels of iodine nutrition are positively associated with UIC.

HO_{3b}: Dietary diversity score is positively associated with UIC.

1.5 Expected Outcomes

The results will be used to

1) Design interventions to improve the nutritional status of women of reproductive age,

2) Design multi-sectoral behavior change communication models for tackling IDD at community level and

3) Empower consumers to adopt adequately I-salt for elimination of IDD.

1.6 Significance

Despite the policies and efforts of international organizations and the Tanzanian government to eliminate IDD, the current rate of success is still unacceptable based on I-salt coverage and UIC status of women of reproductive age. Serious consequences of impaired growth and cognitive impairment in children and birth outcomes can be due to mild IDD during pregnancy. This study will provide a benchmark for the implementation of sustainable nutrition education interventions by identifying the priority areas of improvement in nutrition knowledge, attitudes and practices.

Chapter 2. Literature Review

2.1 Iodine Deficiency

Iodine deficiency is the leading cause of preventable mental retardation worldwide (WHO, 2007c). Globally 1.6 billion people are estimated to be at risk of IDD. There are 760 million people with goiter, 43 million with brain damage (from maternal iodine deficiency during their fetal development) and 11 million with cretinism in the world (Andersson et al., 2012). Yet iodine deficiency is fully preventable through supplementation or salt fortification with iodine (Assey et al., 2007).

In Tanzania, iodine deficient soils are most common in inland regions, mountainous areas and areas of frequent flooding, but can also occur in coastal regions (Assey et al., 2006). Despite the known knowledge that sea foods are rich in iodine, iodine deficiency is still highly prevalent in regions that are just at the shores of the Indian ocean (Assey et al., 2007).

Iodine is an essential component of thyroid hormones and must be obtained from the diet (Jooste and Strydom, 2010). Iodine content in native foods is usually low and varies geographically and across a region (Assey et al., 2006). The variation is due to differences in geological formation, such as flooding, soil erosion, human activities especially densely populated areas and glaciations (Zimmermann et al., 2008).

Inadequate dietary iodine intake directly affects the production of thyroid hormone, leading to IDD which include goiter, stillbirth, miscarriage and impaired growth (Andersson et al., 2012). The thyroid hormone plays a significant role in regulating key aspects of numerous physiological processes, including growth, neurologic development, and reproductive function (Rohner et al., 2014). In severe cases, iodine deficiency leads to hypothyroidism, goiter and cretinism (Zimmermann et al., 2008).

2.2 Iodine Requirement

Iodine requirement increases during adolescence and pregnancy because of high growth velocity (WHO, 2007b). Adolescent girls who get married at an early age and bear children have high burden of meeting increased iodine requirements to support their own growth as well as the needs of the fetus (Delisle, 2005). Iodine deficiency during pregnancy is associated with increased incidence of miscarriages, stillbirths, birth defects and mental retardation (Zimmermann et al., 2008). Mild-moderate iodine deficiency can also pose an increased risk for secondary neurologic impairment such as decreased work capacity, physical endurance, and cognitive ability (WHO, 2007a), hence reducing the economic potential of individuals in the society and hindering development for the entire community (NBS, 2014.). Children with moderate iodine deficiency have been reported to have 10-13 less IQ points than their well-nourished counterparts (Zimmermann et al., 2008).

The recommended dietary intake (RDI) of iodine for non-pregnant adolescents and pregnant women are 150 µg/day and 250 µg/day, respectively (Delisle, 2005). However, in developing countries, few adolescents meet the RDI through diet due to poor dietary intake, use of non-iodized salt and consumption of several goitrogenic compounds (Zimmermann, 2004).

For these reasons, the USI has been considered the most cost-effective intervention and is widely practiced in an effort to reduce iodine deficiency in many countries (Pearce et al., 2013). Since iodine content in foods vary, the adequate amount of iodine added to salt should be above 15 ppm to provide the 150 µg recommended daily allowance of iodine delivered in 10g I-salt (WHO, 2007b). According to WHO, a country is poised to be iodine adequate when 90% of the households consume an adequate amount of I-salt (WHO, 2007b), assuming that all I-salt contains >15 ppm . However, in Tanzania only 59% of the households consumed I-salt and 82%

of the salt had adequate iodine of 15 ppm (TFNC, 2014).This is partially explained by the proliferation of small scale salt producers who do not iodize their salt at the recommended levels before putting the salt on the market and poor quality at the production level (Assey et al., 2007).

2.3 Assessment of Iodine Status

In assessing iodine status, two methods are recommended by WHO; spot urine for estimation of iodine status at the population level and 24-hr urine at the individual level (WHO, 2007b). Median UIC is the most widely-used indicator to determine iodine intake at the community level, but not at an individual level. Since almost all iodine in the body is eventually excreted in the urine, daily urinary excretion of iodine closely reflects iodine intake and remains a valuable index for assessing current iodine status in a population, especially when the possibility for the assessment of blood index are absent (Zimmermann, 2004). WHO/UNICEF/ICCIDD have suggested cut-off points to assess the severity of iodine deficiency by measuring the iodine concentration in casual urine samples (Table 1).

Table 1. Epidemiologic Criteria for Assessing Iodine Nutrition Based on Median UIC

Median Urinary Iodine (µg/L)	Iodine Intake	Iodine Status
< 20	Insufficient	Severe iodine deficiency
20 – 49	Insufficient	Moderate iodine deficiency
50 – 99	Insufficient	Mild iodine deficiency
100 – 199	Adequate	Adequate iodine nutrition
200 – 299	Above requirements	Good for pregnant and lactating women
≥ 300	Excessive	Risk of adverse health consequences

(WHO, 2007b)

2.4 Analytical Method to Determine Iodine Concentration In Salt and Urine

Iodine concentration in urine samples are determined by using the Sandell Kolthoff method utilizing ammonium persulfate (Melmed et al., 2015). Urine samples ranging from 1.0-5.0 mL are collected in small cups, transferred to tubes, tightly sealed with screw tops and then kept in a cool, dry place. The concentration in an individual's urine varies on a daily basis or even during the same day (Zimmermann et al., 2008). Therefore, median UIC for a population is recommended (Eastman and Zimmermann, 2000). This method requires a heating block, a spectrophotometer, and chemical reagents. For each urine sample, an aliquot of 0.25-0.5 mL is digested with ammonium persulfate at 110 °C for 1 hour; arsenious acid and ceric ammonium sulphate added to the sample and left to stand until the decrease in yellow color. Then absorbance of the solution at 405 nm is measured spectrophotometrically. Iodine standards with known concentrations between 0 and 300 µg/L are used in the analysis. The absorbance data are then entered into the computer and a standard curve constructed by plotting the log of the absorbance at 405 nm on the X-axis versus the standard iodine concentration in µg/L on the Y-axis with a scatter plot. The iodine concentration in µg/L of each specimen is calculated by using the equation of the linear trend line of this chart. There is an inverse endpoint color reaction, and all specimens that had an absorbance value lower than the acceptable standard curve (or calculated concentration >300 µg/L) are then re-assayed using a dilution of 1:3 or 1:5 (Melmed et al., 2015).

For salt samples, iodine content is quantitatively measured by iodometric titration, as described by (De Maeyer et al., 1979). The reaction mechanism occurs in two steps: i) liberation of free iodine from salt, and ii) titration of free iodine with thiosulphate. To estimate the amount of iodine in products, chlorides are precipitated by adding an excess amount of silver nitrate.

The organic matter is then oxidized with potassium permanganate in an acid solution. The excess potassium permanganate is decomposed by sucrose. The amount of unused silver nitrate is determined by titration with thiocyanate. The amount on sodium chloride (salt) is then calculated from the amount of silver nitrate used.

Validated Rapid Test Kits (RTK) are used to determine iodine content in the salt. Briefly, one teaspoon of salt sample is put on a piece of white paper where two drops of the reagent from (MBI KITS *Madras, India*) rapid testing is added. One to two drops are placed on the salt and the intensity of the color which develops gives a semi-quantitative estimate of the iodine level up to 50 ppm for the particular salt provided.

2.5 Determinants of Iodine Deficiency

Malnutrition continues to be a major public health problem throughout the developing world, particularly in sub-Saharan Africa. The diets in the population are frequently deficient in macronutrients (protein, carbohydrates and fat) and micronutrients (electrolytes, minerals and vitamins) and lead to specific micronutrient deficiencies (Schofield and Ashworth, 1996). For these reasons, there have been many quick fix programs with supplements, pills, syrups and sprinkles. However, diet-based strategies are the most promising approach for a sustainable control of micronutrient deficiencies (Prendergast and Humphrey, 2014, Campos et al., 2016).

In Africa where 40% of the population (321.1 million) has insufficient iodine intake, those of lower socioeconomic status are less informed about IDD than those of high socioeconomic status. This clearly links education and poverty with iodine status (Hetzel, 2005).

A mother's education has been reported as the strongest predictor of low iodine intake in children from urban slums and rural areas in Brazil (Campos et al., 2016). It has also been suggested that changes in global food supplies could impact both global nutritional indicators and UIC levels (De Benoist and WHO, 2004).

Food insecurity has been reported to increase the risk of iodine deficiency by 70% by linking associations between several socioeconomic factors and iodine nutritional status (Campos et al., 2016, Nazeri et al., 2010). A study by Nazeri et al (2015) in Tehran, suggested that iodine deficiency risk is higher among students who lived in homes where caregivers did not have knowledge about the concept of iodized salt than those with adequate knowledge on I-salt (Nazeri et al., 2015).

2.5.1 Insufficient Household Food Security

According to the FAO, food insecurity is a situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth, development, and an active and healthy life. Factors that may lead to a situation of food insecurity include non-availability of food, lack of access, improper utilization and instability over a certain time period (Napoli et al., 2011).

Household food insecurity affects adolescents' accessibility to safe, nutritious and adequate food due to supply deficit (Delisle, 2005). As most adolescents are dependent to their families, household food insecurity leads to inadequate dietary intake and undernutrition. Evidence suggests that children living in food insecure households have inadequate food and nutrient intake and hence experience poorer nutritional status, health and psychosocial outcomes (Cordeiro et al., 2012, Belachew et al., 2012). In adolescents, food insecurity not only affects

physical growth and health but also their intellectual development, school attendance and academic performance (Belachew et al., 2011). In Tanzania, household food insecurity varies from one region to another and also from season to season (Ntwenya et al., 2015) with the highest prevalence of household food insecurity documented during the beginning of the rainy season. Low income households that are most affected by food insecurity are largely concentrated in rural communities (Ntwenya et al., 2015). Members from these communities access food by their own production through cultivation and peasant farming (Wedgwood, 2007).Unfortunately, majority of households in Tanzania lack a diversified diet because of over reliance on home-cultivated foods, since most nutrients are obtained from one or two food groups (Ntwenya et al., 2015).

2.5.1.1 Individual dietary diversity

Dietary diversity is a widely used qualitative measure of food consumption that reflects household access to a variety of foods, and is also a proxy for nutrient adequacy of the diet of individuals (Hoddinott and Yohannes, 2002). Individual dietary diversity scores aim to reflect nutrient adequacy and serves as proxy measures for macro and/ or micronutrient adequacy of the diet (Hoddinott and Yohannes, 2002). DDS are calculated by summing the number of food groups consumed in the household or by the individual respondent over a 24-hr recall period. Studies in different age groups have shown that an increase in the individual dietary diversity score is related to increased nutrient adequacy of the diet (Azadbakht and Esmaillzadeh, 2012).

2.5.2 Sociodemographic Factors

Household characteristics play a big role in influencing adolescent's attitudes, preferences, and values towards food (Barkoukis, 2007). In Brazilian public-school children, socioeconomic status of the household and parents' lack of education on nutritional importance of iodine were important influencing factors of iodine deficiency in children (Campos et al., 2016).

It is well established that poverty and malnutrition disrupt the normal course of childhood development. Mild iodine deficiency can further interfere with the development of full intellectual potential. The socioeconomic status of a household plays an important role in determining nutrition status of individuals. Vankatesh et al (2014) reports that, the problem becomes severe for the adolescents from poor households as their households are less likely to access I-salt than more well-off ones since I-salt costs more than non-I-salt.

2.5.3 Food Behaviors

At the household level, food intake is associated with nutrition status (Cordeiro et al., 2012). As adolescents are in the process of establishing responsibility for their own health-related behaviors, the adolescent stage is an appropriate time for health promotion programming (Charlton et al., 2012). Poor nutrition in combination with inadequate or adverse influence of parents, peers and the educational experience in adolescence, sets the stage for chronic disease in adult life, with additional risk coming from cultural influences and lifestyles (Delisle, 2005).

Twenty-four-hour dietary recall is among the most commonly used methods to measure food and nutrient intake of an individual (Timon et al., 2017). The method is also referred to as the retrospective diet assessment method, because an individual is asked about foods and

beverages they consumed during the previous 24-hr. This method is a proxy measure to assess nutritional status, and nutrient adequacy (Subar et al., 2015). The 24-hr dietary recall method is inexpensive and has less recall errors. Limitations however include the failure to determine an individual's dietary habits (Subar et al., 2015) and misreporting by such respondents as adolescents. Hence more than one 24-hr dietary recall data are needed to find a reliable and precise association between food intake and nutritional status of an individual (Delisle, 2005). Several literatures have shown that the average of two days is not any better than one single day recall for assessing subgroup diets.

Table 2. Summary of literatures from developing countries on IDD

Author	Objective	Study design	Method &Subject description	Conclusion
Assey et al.,2006	To determine iodine levels in salt and iodine deficiency prevalence in school aged children in districts with previous severe iodine deficiency in Tanzania	Cross sectional	Primary-school children aged 6–18years (n=140,758) previously examined for goiter by palpitation, reexamined based on UIC analysis MBI Kits used in testing iodine in salt from households	High variability in iodine content in salt remains a challenge in eliminating IDD
(Assey et al., 2008)	To describe the status of salt iodation machines, salt producers' experiences and quality of salt produced in Tanzania	Mixed method (Qualitative & Quantitative)	Structured questionnaires for factory owners/managers. Observations at facilities used for iodation. Titration of salt samples from 85 salt production facilities to measure iodine content with a precision of 10% and recovery of 95%,	Mean Iodine content at factory level is highly variable, -iodine fortification requires reassessment of salt iodation techniques, production and monitoring systems to ensure sustainability
(Assey et al., 2009)	Examine the performance of different iodation methods to attain homogeneous iodine levels under real life conditions in Tanzania	Qualitative – cross sectional	Observation on procedures used to make potassium iodate (KIO^3) solution. Unstructured qualitative interviews with project site managers(n=3) and salt factoryworkers(n=75) on rationale of the observed iodation procedures	Supervised standardized salt iodation procedures adapted to local circumstances can yield homogenous iodine levels within required range, overcoming a major obstacle to USI

Table 2 (cont'd)

(Kulwa et al., 2006)	Determine the iodine status of school children and document the availability, price, use and storage of iodated salt in Ludewa district, Tanzania	Cross sectional	Random selection of households with school aged children aged 8-10yrs (n=150) in a goiter endemic district with varied socioeconomic status	Education and communication strategies to strengthen effective communication of messages on iodine nutrition. Need for renewed efforts to reinforce regular monitoring of iodine content of salt where informal re-packing of I-salt and sale of non-I-salt are common.
(Imdad et al., 2013)	Determine the impact of dietary pattern on the iodine status of adolescent school girls in City District, Lahore Ethiopia	Cross sectional	adolescent school girls aged 11 – 16 yrs. (n=660) sampled by multistage technique; Venous blood taken for TSH estimation; Interviewed and pretested questionnaire used for data collection	Use of I-salt has significant impact on UI level as Percentage of UI deficient subjects using non-I salt (44%) was higher as compared to those with optimal UI level using I-salt (7%).

Table 2 (cont'd)

(Jooste et al., 2005)	Determine the relation between knowledge on iodine nutrition and socio-economic status in Free state, South Africa	Cross sectional	Adults in South African households (n=2,208); Home visits and personal interviews	The knowledge level of iodine nutrition is low particularly among the low socio-economic groups. The international emphasis on brain damage resulting from iodine deficiency has not been conveyed successfully to the consumer level
(Campos et al., 2016)	Assess iodine status associated with household food insecurity, socioeconomic and demographic characteristics among public school children in Brazil	Cross sectional	School aged children aged 6-14 years (n= 1,419) Anthropometric parameters, UIC, and thyrotropin were measured from blood spots on filter paper.	Socioeconomic factors and the lack of education about nutritional importance of iodine were important influencing factors in the presence of ID in schoolchildren.
(Lowe et al., 2015)	Gain an understanding of the knowledge, attitudes and practice regarding the use of iodized salt in marginalized rural community in Pakistan	Survey	Equal number of men and women (n=50) aged 46-55yrs; Focus group discussions exploring attitudes and barriers; Spot urine for UIC	Education raised awareness on importance of? I-salt consumption; issues regarding adequate iodization by local producers and appropriate storage need to be urgently addressed

Table 2 (cont'd)

(Sebotsa et al., 2009)	To gather baseline information on the knowledge, attitudes and practices regarding iodine and iodized salt among patients with hyperthyroidism in South Africa	Cohort	The patients were interviewed in their language using a structured validated questionnaire	Lack of knowledge on iodine and storage of I-salt contributed to the persisting endemic goiter. An aggressive programme to improve awareness targeting policy makers and the public is needed to eliminate IDD
(Pathak et al., 2003)	To assess prevalence of iron, vitamin A and iodine deficiencies in rural pregnant adolescents in Uttaranchal State India	Cross sectional	Adolescent pregnant mothers (n=151); Pre-tested semi structured questionnaire; Hb estimation by HemoCue; ID by clinical examination of TG and UIE level estimation Nutrient intake by24-hr dietary recall	Anemic (46% Hb<11.0 gm/dl), Night blindness (16%), Goiter (15%). Iodine deficiency existed as public health problems in the area

2.6 Education System in Tanzania

In Tanzania, the average age to enroll in primary education level is seven years old. The majority (both urban and rural) of adolescent girls (10-19 years of age) are enrolled in schools, and expected to go to secondary school at an average age of 13 years (Burke and Beegle, 2004). The net enrollment ratio for primary schools has been increasing since the implementation of national universal education policy as part of attaining the Millennium Developmental Goals established in 1999 (Wedgwood, 2007).

In 2000, about 95% of children in Tanzania attended government schools while the remaining attended non-governmental or private schools (Wedgwood, 2007). Students are selected by schools based on merit and go to schools near their residence for easy accessibility of education services (Wedgwood, 2007). The number of government schools in each ward vary allowing some wards to have nongovernment schools. This means that some students are enrolled in schools away from their residential ward and walk long distances every day to school.

The academic year starts at the beginning of the calendar year (January) and ends in December with three school breaks in April (for Easter holidays), June (long mid-term break) and September (short mid-term break) in each year. This indicates that adolescents would be easily accessible from schools to capture information during the lean period of January through March before the start of intensive continuous assessments in later months.

To minimize dropouts and improve performance, in 2000 the government adopted school feeding programs (SFP) on basis of cost sharing (Burke and Beegle, 2004). In such programs, mainly stiff porridge and beans are provided as lunch to students. Most government schools in the district are day schools, in which students attend schools between 8:00 am and 3:00 pm. For

schools that do not have SFP, the students obtain only snacks from school canteens and the main meals of the day are consumed from households. [Only one school from the participating schools had SFP providing stiff porridge and beans as lunch for all students]. For such reasons, day schools are one of the most effective channels of promoting good nutrition (McNaughton, 2011).

Chapter 3. Methods

3.1 Lindi district

The Lindi District is among the six districts of Lindi Region with a total area of 7,538 m^2. The Lindi district is administratively divided into 10 divisions, 30 wards and 134 villages. It is bordered to the north by the Kilwa District, to the south by the Mtwara Region, to the west by the Nachingwea District, and to the east by the Indian Ocean and Lindi Urban District. The region was chosen due to the persistence of low coverage of I-salt use by 6% in 2010 and 9% in 2015 (Macro, 2015) despite its being one of the major sea salt producers in the country.

Figure 1. Map showing Lindi region and districts

3.2 Pilot survey

In November 2016, a pilot survey was carried out in Coast region to assess the tools and instruments for the study. This pilot survey was carried out at Ali Hassan Mwinyi secondary school (Mkuranga district) among adolescent girls aged 13-19 years while waiting for a permission to carry out the study in Lindi region. The adolescent girls recruited for the pilot

survey had similar characteristics to the adolescent girls in Lindi district (day scholars and same age as those to be recruited in Lindi district). The pilot study was necessary for the researcher to pretest the questionnaires to resolve any challenges while gaining confidence in administering the research instrument for the actual study.

3.3 Study Design

This cross-sectional study was conducted between January-March 2017 with a multistage, random sampling design. Three out of 19 schools in Lindi District were selected as representative sample based on the proportion of adolescent girls between 14-19 yrs. of age. Class registers were used to obtain total number of girl-students from a class in the chosen school, using proportionate sample size technique. At each school, a short briefing session was held to describe the study. Those who agreed to participate in the study were provided a consent form to be completed by class teacher. The students who consented were evaluated further to assure that they met all the inclusion criteria below to be included in the study:

- Adolescent girls enrolled in training for ordinary and advanced certificate of secondary education at the time of the data collection,
- Healthy, having no signs of physical illnesses and willing to participate.

Only day scholars were included in the study to collect representative food intake data at household level with 24-hr recalls and calculate DDS.

3.3.1 Sample size calculation

To examine the association between KAP score, sociodemographic characteristics and iodine status, multiple linear regression statistical test was used. Using G-Power software, the following input parameters were used; alpha ($\alpha = 0.05$), power 0.95, number of tested predictors: 2 (KAP score-low/high and iodine status), Total number of predictors: 10 (KAP Score) + 1 (religion) + 2 (occupation of household head) + 3 (education level of household head) + 2 (number of people in household). Effect size: 0.15 [medium effect size from Cohen (1988) for regression]. This formula gave an estimated sample size of 128.

3.3.2 Sampling Technique

We used the proportionate sampling approaching which the assigned sample for each class was determined by their relative size to the entire school. Secondary schools with advanced level were selected to ensure the representation of adolescent girls in the required age group.

The estimated sample size (n= 128) was then divided proportionate to the randomly selected schools. Class registers without identifiable data obtained from the schools were used as the sampling frames for each school. Study subjects were then recruited randomly starting in higher classes (from six to form one) on consecutive approach until the required sample size was reached.

3.3.3 School level

Prior to the survey, the research team made a courtesy call to the office of headmaster. The headmasteridentified personnel to work with during the actual data collection. The assigned personnel acquired class registers, which were used in obtaining a number of adolescent girls systematically from each classroom. An orientation session was conducted before the survey at

each school assembly on nutrition in general and description of the study with emphasis on confidentiality, sample taking and the study benefit.

3.3.4 Classroom level

After the briefing sessions (which took 15 minutes on average) and handing in of signed consent forms, the respondents were given containers to collect urine samples. Both the signed consent form, salt samples and urine samples were collected from the participating subjects on the data collection day, then a researcher assigned a corresponding code for each subject.

3.4 Research Team

The research team consisted of threeresearch assistants; one graduate student from Sokoine University of Agriculture and two graduates with Bachelor of Education from the Lindi district council. The main researcher liaised with the team, participants, supervised all activities, and was involved in data collection. Research team members were fluent in Kiswahili and local dialect language, which eased communication with study participants to get the intended responses.

The research team was trained for three days before data collection on 24-hr dietary recall methods and how to probe responses in a non-offensive manner, estimate portion size, and handling urine sample. They were trained to test iodine content in salt samples that were brought from home by the students.

3.5 Ethical Clearance

This study was conducted under permission from the Michigan State University Institute Review Board (certificate number: 16-838) and the Tanzanian National Institute for Medical Research (NIMR/HQ/R.8a/Vol. IX/2355). Correspondingly, permission to conduct research was requested on behalf of the researchers by Sokoine University of Agriculture through the

Department of Food Technology Nutrition and Consumer Sciences to the Lindi district authorities. Furthermore, participating students gave verbal consent after their guardians signed consent forms to allow them take part in the study and those above 18 consented for themselves (certificates, letters and consent forms in Appendices).

3.6 Tools and Measurements

3.6.1 Structured Questionnaire

To test knowledge, attitude and practices of subjects, an appropriate questionnaire was developed considering the following aspects of iodine nutrition status: the importance of iodine as an essential nutrient; the consequences of iodine-deficiency disorders, purchase, consumption and preservation conditions of I-salt. The general content and specific items of the questionnaire were initially derived from an intensive review of literature available in national and international sources by the main researcher. Irrelevant and unsuitable items were eliminated or changed based on experts' advice. This resulted in a questionnaire comprising twenty-five items that encompassed: (i) Knowledge section with eight items; (ii) Attitude section with eight items; and (iii) Practice section with seven items.

Validity of the questionnaire was confirmed by face and content validity. Knowledge questions included yes/no and short answer questions (8 questions, each scoring 3 point). Attitude was assessed based on the Likert criteria from 1 point, as the weakest, to 5 points, as a desirable score (8 questions). For assessing practice, questions included yes/no and multiple-choice questions (7 questions each scoring 3 point).

3.6.2 Iodine in Salt

Validated Rapid Test Kits (MBI-KITS Batch No1058, T. Nagar, Chennai- 600 017 India) were used to determine iodine content in the salt samples brought from home by the adolescent girls on day of data collection. The interviewer collected the sample from subject, took 1 teaspoon of the scooped sample put on a piece of white paper where two drops of the reagent from (MBI KITS) rapid testing was dropped. Change of color was compared with the chart present in the kit and recorded. The remaining salt samples were coded assembled and stored for qualitative measurement of iodine content.

3.6.3 UIC from Urine

Each study subject was given a small 10ml size cup with lid to collect spot urine sample at the school sites. Urine samples of 2.0-5.0 ml were transferred to sterile conical tubes with screw caps, transferred on ice, transported and stored at –20◦C until analysis in Dar es Salaam. The analytical work was carried out by Tanzania Food and Nutrition Center (TFNC) laboratory.

The analytical procedures used by the TFNC lab were the adapted Sandell–Kolthoff reaction (Melmed et al., 2015). The analytical principle was based on a catalytic reduction of ceric ammonium sulfate in the presence of arsenious acid. A spectrophotometer (Uv-Vis; wavelength 405 nm) was used to verify the ceric ammonium sulfate reduction. The resulting changes in spectrometric absorption were compared against a standard curve generated with a known concentration of potassium iodate. The UIC values from populations are usually not normally distributed. Therefore, the median rather than the mean was used as a measure of trend. The iodine nutrition status classification was based on the criteria established by WHO as explained in the literature review.

3.6.4 Twenty-Four-Hour Dietary Recall

The subjects were asked to recall the foods eaten in the previous day before the survey after it was confirmed that the previous day was a usual day. The interviewer also probed and carefully recorded the method of cooking used in all foods mentioned. The data were used to calculate DDS.

3.6.4.1 Dietary Diversity Score (DDS)

DDS is defined as the number of foods or food groups consumed by an individual in the past 24-hr. The number of food groups and the kind of food group to include in the questionnaire depends on the specific objective of the study. The tool is used as a means to calculate micronutrient adequacy and food security (Webb et al., 2006). The DDS questionnaire consisted of14 food groups which were chosen based on the target group of this study. The subjects were asked to recall the foods eaten in the previous day before the survey and from the list of food groups, respondent confirm the forgotten foods by saying “yes or no”.

3.7 Data collection and Entry

Responses to the questionnaires were checked by the lead researcher for completeness and correctness of responses on the same day of the data collection. Each error was corrected through discussion between the lead researcher and data collectors. Excel database was used for data entry. Data were entered for five days after the data collection process was completed. Database was instituted with automatic checks to reduce entry errors such as extreme values. In addition, cross tabulation and frequency tables were used to verify whether the entered data matched those in the questionnaires. Random comparison of individual’s information in the database and questionnaire was also used to optimize the quality of data. Results of laboratory investigations

were received after the data entry was done and were entered after thorough verification of individual's data from the questionnaire to avoid posting wrong test results in the database.

3.8 Data Analysis

A descriptive analysis was conducted for sociodemographic variables, KAP scores, dietary intake data derived from 24-hr recalls (DDS) and UIC. Categorical variables were presented as frequencies (n) and percentages (%) and continuous variables were presented as means with standard deviations (SDs). Pearson's correlation test was conducted to examine the strength of linear relationship between knowledge, attitude and practices.

Knowledge questions included multiple choice, yes/no, and open-ended questions (8 questions, each scoring 3 point). Attitude was assessed based on the Likert scale criteria from 1 point, as the weakest, to 5 points, as a desirable score (8 questions). For assessing practices questions included multiple choice, yes/no, and open-ended questions (7 questions, each scoring 3 point) [See Appendix F for detailed questions]. The maximum score for knowledge score was 24 and minimum 3. For attitude, the maximum score was 40 and minimum 8. The maximum score for practice was 15 and minimum 8. Finally, the KAP score was obtained by summing the individua KAP scores. [See Table 9 for distribution and rationale].

Iodine concentration in salt was categorized in four groups based on WHO/ICCIDD/UNICEF standards: 0 ppm (no iodine), less than 15 ppm (inadequate iodine), 15-80 ppm (adequate iodine) and over 80 ppm (excess iodine). UIC was classified into five categories i.e.<100µg/L, 100-299µg/L, 300-500µg/L,>500 µg/L. However, in the regression this was dichotomized into inadequate (<100 µg/L) and adequate (≥100µg/L) due to small sample size in other categories.

Logistic regression was run to determine predictors of KAP, DDS and UIC, each in separate models. Univariate analyses were performed on sociodemographic characteristics of study subjects and KAP, DDS and UIC to identify potential confounders that were to be controlled at the subsequent data analyses with main study outcomes. Variable with p-value of ≤0.50 were included in the multivatiate logistic regressions. Three separate multivariate logistic regression models forKAP with SES were fitted. Another logistic regression on DDS, with SES and overall KAP score was fit, to determine the predictors of DDS. Finally, a regression was modeled to study relationship of SES, KAP score and UIC without DDS in it. The analysis was done using statistical software STAT 14.

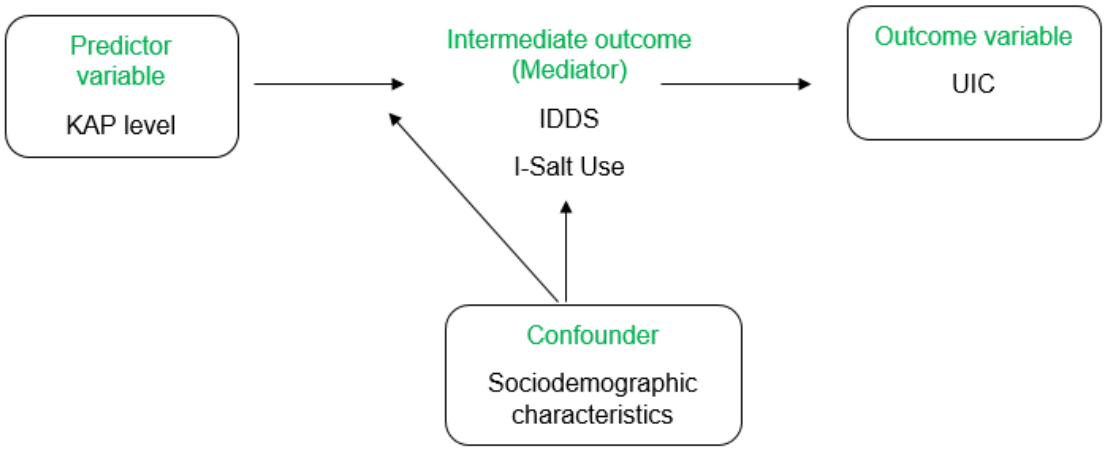

Figure 2. Summary of the logistic regression model used in the study

Chapter 4. Results

The findings are presented in the order of the following specific objectives:

Aim 1: To assess characteristics of study subjects including sociodemographic, iodine KAP level, dietary diversity scoreand iodine status.

HO_1: Adolescent girls in southern rural Tanzania have low iodine KAP levels, low dietary diversity score and inadequate iodine status.

Aim 2: To examine the association between sociodemographic characteristics, iodine KAP level and dietary diversity score among adolescent girls.

HO_{2a}: Sociodemographic characteristics are positively associated with iodine KAP levels.

HO_{2b}: Sociodemographic characteristics are positively associated with DDS.

Aim 3: To determine the association of iodine KAP levels and DDS with UIC.

HO_{3a}: High iodine KAP levels is positively associated with UIC.

HO_{3b}: Dietary diversity score is positively associated with UIC.

4.1 Sociodemographic Characteristics, Iodine KAP Level, DDS and UIC

4.1.1 Sociodemographic characteristics

The study involved 128 subjects with 32.8% from Mtama and 33.6% from Mahiwa and Madangwa secondary schools. Disaggregating by age, 56% ofthe surveyed students fell in 16–17year age bracket. More than half (73.4%) of the subjects belonged to Muslim religion and 82% reported to live with immediate family. With respect to household characteristics, 61.7% of the households were male headed and 54.7% had no formal education. On economic status, 65.6% of the caregivers engaged in pesant farming while 32.8% were employed. More than half (54.7%) of caregivers had no formal education. Furthermore, 77.3% of the households had size

ranging from 3-5 people and at least 18.7% of the household had more than threemembers who were under 18 years of age.

Table 3. Characteristics of study participants

Variable	School name			Total
	Mtama n (%)	Mahiwa n (%)	Madangwa n (%)	n (%)
Age (yrs.) Mean, SD (16.4, 1.2)				
14-15 yrs	6(14.3)	10(23.3)	15(34.9)	31(24.2)
16-17 yrs	28(66.7)	20(46.5)	24(55.8)	72(56.2)
18-19 yrs	8(19)	13(30.2)	4(9.3)	25(19.5)
Total	42(100)	43(100)	43(100)	128(100)
Pearson $chi^2 = 10.1$ p= 0.04				
Religion				
Muslim	35(83.3)	21(48.8)	38(88.4)	94(73.4)
Christian	7(16.7)	22(51.2)	5(11.6)	34(26.6)
Total	42(100)	43(100)	43(100)	128(100)
Pearson $chi^2 = 20.4$p = 0.00				
Currently living with				
Family	34(81)	39(90.7)	32(74.4)	105(82)
Relatives	8(19)	4(9.3)	11(25.6)	23(18)
Total	42(100)	43(100)	43(100)	128(100)
Pearson $chi^2 = 3.9$ p = 0.14				
Relationship with caregiver				
Father	22(52.4)	26(60.5)	24(55.8)	72(56.2)
Mother	8(19)	11(25.6)	10(23.3)	29(22.7)
Others[1]	12(28.6)	6(14)	9(20.9)	27(21.1)
Total	42(100)	43(100)	43(100)	128(100)
Pearson $chi^2 = 2.8$ p= 0.59				
Sex of the head of the household				
Male	26(61.9)	27(62.8)	26(60.5)	79(61.7)
Female	16(38.1)	16(37.2)	17(39.5)	49(38.3)
Total	42(100)	43(100)	43(100)	128(100)
Pearson $chi^2 = 0.05$ p = 0.97				
Occupation of head of household				
Peasant	31(73.8)	17(40.5)	36(85.7)	84(66.7)
Employed	8(19)	12(28.6)	3(7.1)	23(18.3)
Bussinessman	3(7.1)	13(31)	3(7.1)	19(15.1)

Table 3 (cont'd)

Total	42(100)	42(100)	42(100)	126(100)
Pearson chi² = 22.7 p = 0.00				
Marital status of head of household				
Married	25(59.5)	30(69.8)	26(60.5)	81(63.3)
Single	12(28.6)	6(14)	1(2.3)	19(14.8)
Sep/div/wid[2]	5(11.9)	7(16.3)	16(37.2)	28(21.9)
Total	42(100)	43(100)	43(100)	128(100)
Pearson chi² = 17.5p = 0.00				
Education of head of household				
Primary	28(66.7)	17(39.5)	25(58.1)	70(54.7)
No formal School	0(0)	1(2.3)	10(23.3)	11(8.6)
Secondary and above	14(33.3)	25(58.1)	8(18.6)	47(36.7)
Total	42(100)	43(100)	43(100)	128(100)
Pearson chi² = 28.7p = 0.00				
Household size				
3-5	32(76.2)	35(81.4)	32(74.4)	99(77.3)
6 - Above	10(23.8)	8(18.6)	11(25.6)	29(22.7)
Total	42(100)	43(100)	43(100)	128(100)
Pearson chi² = 0.64 p = 0.72				
No. of U18 yrs (Including subject)				
0-3	28(66.7)	38(90.5)	37(86)	103(81.1)
4 - 10	14(33.3)	4(9.5)	6(14)	24(18.9)
Total	42(100)	42(100)	43(100)	127(100)
Pearson chi² = 8.80 p = 0.01				

[1]Uncle, aunt, grandmother
[2]Divorced, separated, widowed, never married

Table 4 shows all the 128 respondents brought salt they used in cooking, 85.1% of the salt samples had at least some amount of Iodine and79.6% had an adequate amount of iodineas identified by the iodine rapid test kit

Table 4. Consumption of I-salt Among Study Subjects

Variable	Frequency (n)	Percentage (%)
Brought salt		
Yes	128	100.0
No	0	0.0
Used salt brought in cooking		
Yes	128	100.0
No	0	0.0
Presence of iodine in brought salt		
Yes	109	85.1
No	19	14.8
Amount of iodine in brought salt (ppm)		
<15	35	20.4
≥15	74	79.6

Table 5 shows 44.5% of the salt samples contained adequate iodine content and 52.3% of samples contained inadequate amount of iodine. These results indicate that a significant number of the subjects in the study area consumed salt with inadequate iodine content as identified by laboratory analysis.

Table 5. Iodine content in salt

Iodine content	Frequency (n)	Proportion (%)	Iodine Status[1]
0 ppm	30	23.4	No iodine content
<15 ppm	37	28.9	Inadequate iodine content
15-80 ppm	57	44.5	Adequate iodine content
> 80 ppm	4	3.1	Excess iodine

[1]Categorized according to WHO and ICCIDD recommendations

The overall median urinary iodine obtained was 192 µg/L with the range of 18 – 452 µg/L. Of these samples; 18.7% indicated insufficient iodine intake, 60.9% adequate iodine intake, and 21.3% more than adequate iodine intake.

Students from Mahiwa had the highest mean UIC while students from Madangwa had the lowest mean UIC (Fig 3)

Table 6. Iodine Status of study subjects

Category	Number (n)	Proportion (%)	Public health significance[1]
<100 µg/L	24	18.7	Insufficient iodine intake
100 -299 µg/L	77	60.9	Adequate intake
300 – 500 µg/L	18	13.3	More than adequate
>500 µ/L	9	7.0	Excessive iodine intake

[1]Categorized according to WHO, UNICEF and ICCIDD recommendations

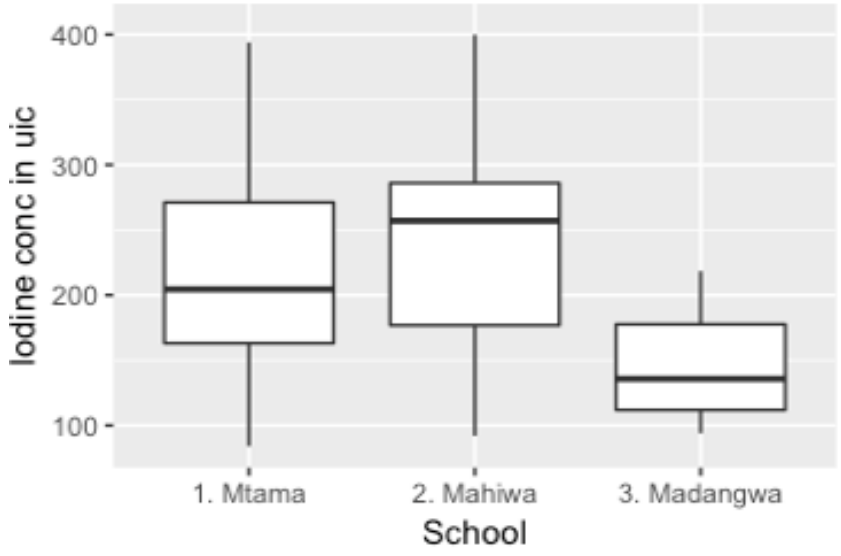

Figure 3. Median UIC of students from the schools

4.1.2 Food group intake of study subjects

DDS calculated from dietary diversity questionnaire indicated that starchy staples which includes cereals, roots and tubers were the most (100%) consumed foods (group 1). In same sequence, 48.4% of the subjects consumed legumes, nuts and seeds (group 8), followed by 48% of subjects who consumed fish (group 6), and 46.8% consumed other fruits vegetables other than Vitamin A rich fruits (group 4). Eggs, meat, milk and milk products were non-consumed food groups (Table 7). All subjects consumed at least two and at most 6 food groups (Table 8). 53% of the adolescent girls consumed one or more food groups of fish, legumes/nuts/seeds, and starchy staples.

Table 7. Frequency of food group intake consumed over the 24-hr recall period

Food group[1]	Frequency (n)	Percent (%)
Group 1: Starchy staples	128	100
Group 2: Dark green leafy vegetables	52	40.6
Group 3: Other vitamin A rich fruits and vegetables	48	37.5
Group 4: Other fruits and vegetables	60	46.8
Group 5: Meat	0	0
Group 6: Fish	61	48.0
Group 7: Eggs	0	0
Group 8: Legumes, nuts and seeds	62	48.4
Group 9: Milk and milk products	0	0

[1]Groups according to FAO Guidelines for Measuring Household and Individual Dietary Diversity (2010)

Table 8. Distribution of Dietary Diversity Scores Among Study Subjects

IDDS[1]	n	%	Starchy staples	Dark green leafy Vegetables	Other vitamin A rich Fruits and Vegetables	Other Fruits and Vegetables	Meat	Fish	Eggs	Legumes Nuts & Seeds	Milk & milk products
1	2	1.6	100	0	0	0	0	0	0	0	0
2	38	29.7	100	0	0	10.5	0	26.3	0	52.6	0
3	39	30.5	100	30.8	28.2	38.5	0	46.1	0	43.6	0
4	31	24.2	100	71.0	71.0	41.9	0	54.8	0	51.6	0
5	16	12.5	100	100	100	87.5	0	62.5	0	43.7	0
6	2	1.6	100	100	100	100	0	100	0	100	0

[1]IDDS is the number of foods or food groups consumed by an individual in the past 24 hours. Dietary diversity scores are calculated by summing the number of food groups consumed in the household or by the individual respondent over the 24-hour recall period. Individual scores are meant to reflect the nutritional quality of the diet.

4.1.3 Iodine KAP Level of Study Subjects

Table 9 shows the mean scores obtained by students for knowledge, attitude and practices were 10.3, 14.0, 10.4 with a standard deviation of 7.1, 7.6, and 1.7 respectively.

Table 9. Scores of KAP from questionnaire and their distribution for each outcome

	Number of questions		
Aspects of iodine nutrition	Knowledge[1]	Attitude[2]	Practice[3]
Importance of iodine as essential nutrient	3	2	1
Consequences of Iodine deficiency	2	1	0
Purchase of I-salt	1	2	3
Consumption of I-salt	1	3	2
Preservation condition of I-salt	1	0	1
Total	8	8	7
Composite score range	0 - 24	8 - 40	0 – 21
Median score	9	11	10
Mean score (SD)	10.3 (7.1)	14.0 (7.6)	10.4 (1.7)
IQR[4]	4.5,15.0	8.0,16.0	9.0,12.0

[1]Knowledge: 8 questions, each scoring 3-point
[2]Attitude: 8 questions assessed based on Likert scale criteria Score ranges 8 - 40 for 5-point Likert
[3]Practices: 7 questions, each scoring 3 point
[4]IQR: Interquartile range

Stratifying KAP level by school, the median score for knowledge in students attending Mtama, Mahiwa and Madangwa was10, 7, and 7.5 respectively. The median score for attitude was 7, 5, 11.5 and median score for practice was 10, 10.5 and 9 respectively (Fig 7). Distribution of KAP score among the students was uneven (Fig 8).

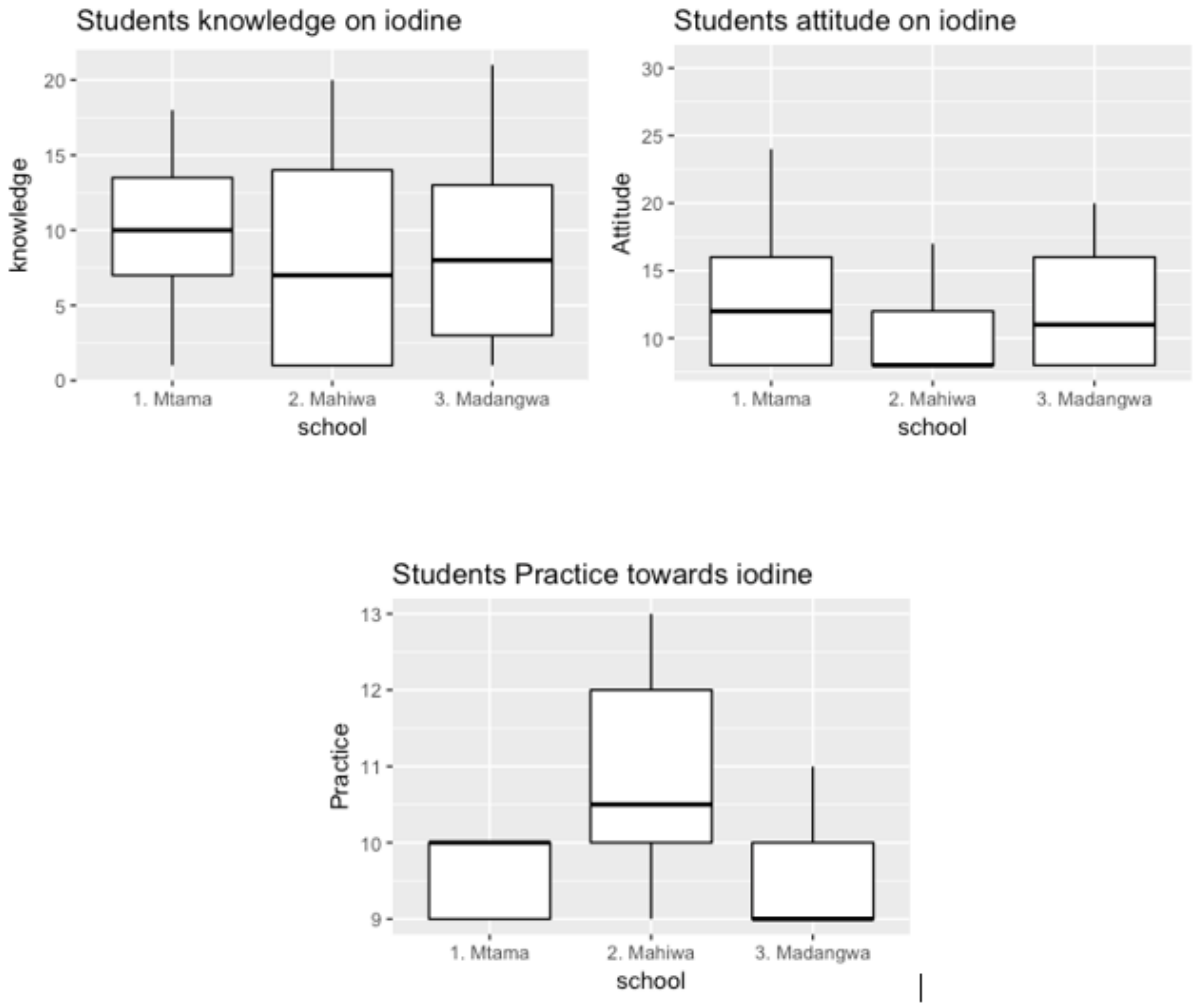

Figure 4. Median KAP scores of study subjects by schools

4.2 Association between Variables

4.2.1 Sociodemographic Characteristics, Iodine KAP level and DDS

Spearman's correlation analyses indicated no strong correlation between practice and attitude (r =-0.17), practice and knowledge (r =0.01), attitude and knowledge (r =-0.19). This suggest no strong correlation between the three measures.

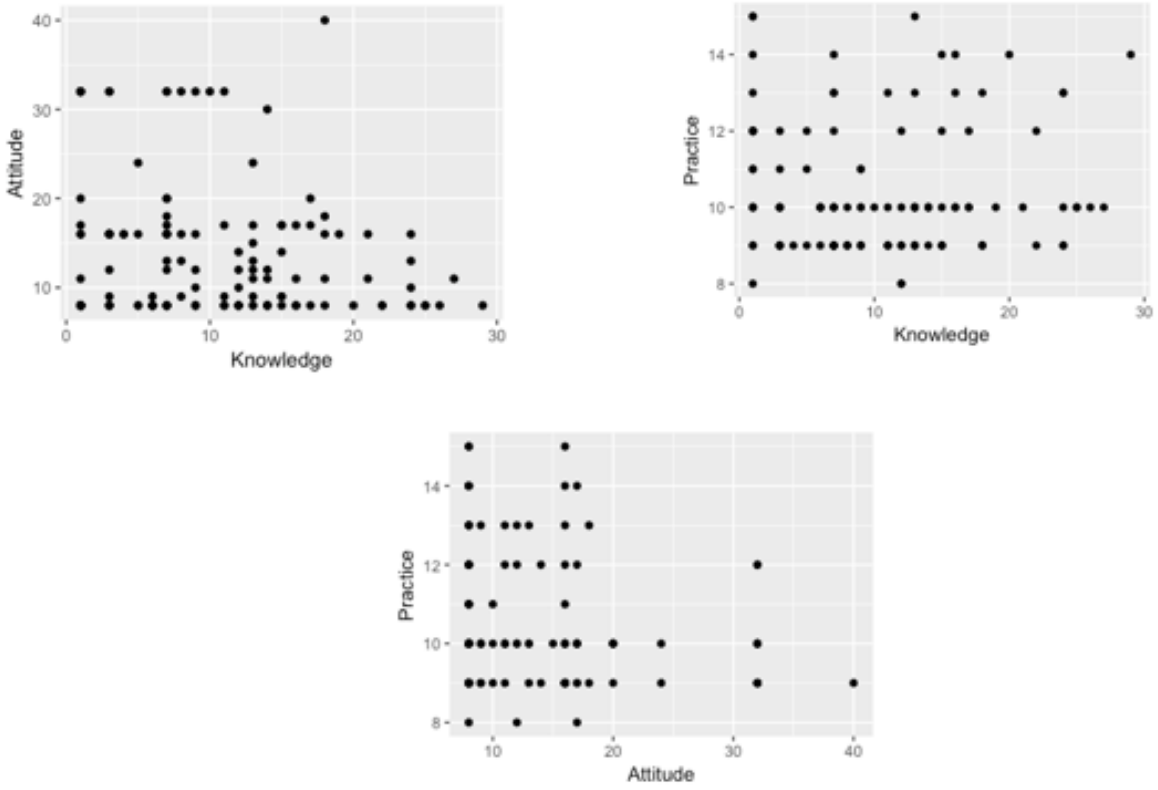

Figure 5. Scatter plots showing coefficients among KAP

Table 10 below presents urinary iodine levels by school. The difference of the urinary iodine level among the schools was significant at p value = 0.00.

Table 10. Urinary iodine levels by school

Urinary iodine levels	Overall n (%)	Mtama n (%)	Mahiwa n (%)	Madangwa n (%)	Iodine Intake
<100 µg/L	23 (18)	2 (4.8)	4 (9.3)	17 (39.5)	Insufficient
100 -299 µg/L	78 (60.9)	26(61.9)	29(67.4)	23 (53.5)	Adequate
300 – 500 µg/L	17 (13.3)	8 (19)	9 (20.9)	0 (0)	More than adequate
>500 µg/L	10(7.8)	6 (14.3)	1 (2.3)	3 (7)	Excessive
Total	128(100)	42(100)	43(100)	43(100)	
Pearson Chi² = 30.3 p = 0.00					

Table 11 below shows salt iodine levels by school. The difference of the amount of iodine in the salt among the schools was significant at p value = 0.00.

Table 11. Salt Iodine Content by School

Salt iodine levels	Overall n (%)	Mtama n (%)	Mahiwa n (%)	Madangwa n (%)	Iodine content
0 ppm	30 (23.4)	10(23.8)	16 (37.2)	4(9.3)	No iodine
<15 ppm	37 (28.9)	6(14.3)	10(23.3)	21(48.8)	Inadequate iodine
15 - 80 ppm	57 (44.5)	22(52.4)	17(39.5)	18(41.9)	Adequate iodine
> 80 ppm	4 (3.1)	4(9.5)	0 (0)	0(0)	Excess iodine
Total	128 (100)	42(100)	43(100)	43(100)	
Pearson Chi² = 25.7 p = 0.00					

Table 12 below presents a multivariate association between sociodemographic characteristics and salt iodine content. Before adjusting for potential confounders, students attending Madangwa secondary school had 5 times the odds of having salt with adequate iodine than students from Mtama. After adjusting for school name, age, religion, occupation, education level of the head of household, number of household members and number of under 18 years living in the household; number of under 18 years living in the household, was significantly associated with the amount of iodine in salt.

[1]Table 12. Association between Sociodemographic Characteristics and Salt Iodine Content

	Unadjusted		Adjusted[1]	
Characteristics	OR (95% CI)	*p-value*	OR (95% CI)	*p-value*
School Name				
Mtama (Ref)				
Mahiwa	1		1	
Madangwa	4.93(1.44-16.88)	0.01	4.82(0.61-37.81)	0.13
Age	0.73(0.50-1.08)	0.12	1.00(0.52-1.93)	0.99
Religion				
Muslim (Ref)				
Christian	0.49(0.15-1.64)	0.25	2.44(0.34-17.39)	0.37
Stay with				
Family (Ref)				
Relatives	1.53(0.43-5.47)	0.51		
Head of household				
Father (Ref)				
Mother	0.40(0.08-1.95)	0.26		
Others	1.04(0.29-3.75)	0.95		
Sex of head of HH				
Male (Ref)				
Female	1.08(0.38-3.07)	0.89		
Occupation of HHH				
Peasant (Ref)				
Employed	0.46(0.12-1.78)	0.26	1.23(0.13-11.24)	0.85

[1]Variable with p-value of ≤0.50 were included in the multivatiate logistic regressions.
[2]Salt content <15ppm vs ≥15 ppm)

Table 12 (cont'd)

Marital status of HHH				
Married (Ref)				
Single	0.56(0.11-2.80)	0.50	0.40(0.04-3.43)	0.41
Separated/Divorced/Widowed	1.51(0.45-5.05)	0.51	0.75(0.13-4.38)	0.75
Education level of HHH				
Primary (Ref)				
No formal education	2.30(0.34-15.57)	0.39	0.73(0.05-10.02)	0.82
Secondary and above	0.63(0.21-1.89)	0.41	1.10(0.14-8.90)	0.93
Number of HH members				
3 – 5 (Ref)				
6 - Above	0.58(0.15-2.23)	0.43	0.28(0.04-2.23)	0.23
Number of under 18				
0 – 3 (Ref)				
4 - 10	0.52(0.29-0.91)	0.02	0.52(0.28-0.94)	0.03
Iodine status (UIC)	0.99(0.99-1.00)	0.32		

Adjusted for School name, and number of under 18[1]

4.2.2 Multivariate analysis of sociodemographic characteristics and KAP Scores

Table 13 below shows the multivariate analysis of sociodemographic characteristics with KAP Scores. In a model that tested the association between sociodemographic characteristics and KAP scores before adjustment of School name, Religion, Occupation of HHH, Household size and number of under 18 years (potential confounders), the mean scores for knowledge and practices differed significantly between the schools (p-value 0.02). After adjustment, the mean scores of knowledge was significantly associated with religion (Mean diff 3.43, 95% CI 0.13-0.71, p value 0.04). The mean score of practices differed significantly between occupation of the head of household (p-value, 0.00) and religion (p-value, 0.03) in univariate analysis. After adjusting for school name, religion, household size and number of under 18, occupation of the head of household was significantly associated with the practice scores (Mean diff 1.2, 95% CI 0.33-1.91, p value 0.00). There was no significant difference in the mean scores for attitude.

[1]Variable with p-value of ≤0.50 were included in the multivatiate logistic regressions.

Table 13. Multivariate Analysis of Sociodemographic Characteristics and KAP Scores[1]

Variables	Knowledge				Attitude				Practices			
	Unadjusted		Adjusted[1]		Unadjusted		Adjusted		Unadjusted		Adjusted	
	Mean Score	p-value	Mean diff[1] (95% CI)	p-value	Mean Score	p-value	Mean diff[1] (95% CI)	p-value	Mean Score	p-value	Mean diff[1] (95% CI)	p-value
School **name**							1.52					0.00
Mtama Ref	11	0.02	-0.61	0.04	15	0.47	(0.60-2.45)	0.00	10	0.00	1.46	
Mahiwa	10		(-3.88-2.66)	0.68	13			0.97	12		(0.73 -2.20)	
Madangwa	10		-0.83 (-4.07-2.41)		13		-0.01 (-1.02-0.99)		10		-0.12 (-0.79 -0.54)	0.71
Age	N/A	0.09	0.41 (-0.73-1.56)	0.66	N/A	0.08	0.07 (-0.20-0.34)	0.59	N/A	0.05	-0.02 (-0.24 -0.17)	0.78
Religion											Ref	0.48
Muslim	10	0.20	3.43	0.04	15	0.60			10	0.03	0.23	
Christian	11		(0.15-6.71)		11				11		(-0.43 -0.90)	
Living with							0.18					
Family	10	0.20	2.47	0.36	14	0.26	(-0.10-3.34)	0.70	10	0.54		
Relatives	12		(-2.84-7.79)		15				10			
Relationship with HHH	10	0.27	-2.56		14	0.78			10	0.45		
Father	10		(-7.43-2.31)	0.30	14				10			
Mother	10		-2.88	0.27	14				10			
Others			(-8.08-2.32)									
Sex of HHH												
Male	11	0.38	0.43	0.83	13	0.66			10	0.64		
Female	10		(-3.70-4.55)		15				10			
Occupation of HHH											Ref	0.44
Peasant	10	0.44	0.12		14	0.87			10	0.00	0.29	
Employed	10		(-3.44-3.69)	0.94	16				11		(-0.45 -1.03)	
Businessman	13		0.41 (-0.73-1.56)		11				12		1.12 (0.33 - 1.91)	0.00

[1]Variable with p-value of ≤0.50 were included in the multivatiate logistic regressions. Model included KAP Scores (continuous) and sociodemographic characteristics

Table 13 (cont'd)

Marital status of HHH			-2.22									
Married	10	0.07	(-3.43-3.67)	0.31	13	0.25			10	0.54		
Single	8		1.21	0.58	15				10			
Separated	12		(-6.57-2.11)		15				10			
Education level of HHH												
No formal education	7	0.18	1.37		13	0.68			12	0.53		
Primary education	10		(-0.05-2.80)	0.06	14				13			
Secondary and above	11		0.68	0.13	13				11			
			(-0.20-1.56)									
Household size			0.30				Ref	0.53				
3-5	10	0.09	(0.05-0.55)		14	0.05	-1.04		10	0.07		
6-Above	11				13		(-4.30-2.21)		10			
No. of Under 18 years			Ref	0.60			Ref					
0-3	11	0.06	0.23		12	0.04	0.23	0.61	10	0.67		
4-10	10		(-0.60 -1.06)		13		(-0.64-1.10)		10			
Amount of Iodine in salt				0.55			0.53				0.53	
<15 ppm	11	0.06	Ref		15	0.09	(-0.41-1.48)	0.26	11	0.27	(-0.41-1.48)	0.10
≥15 ppm	10		-0.01		11				10			
			(-0.04 -0.02)									

[1]Adjusted for School name, Religion, Occupation of HHH, Household size and number of under 18 years

4.3 Identification of Predictors

4.3.1 Association of Iodine KAP Level, DDS and UIC

Table 14 presents the multiple logistic regression on the association between KAP score, sociodemographic characteristics and DDS. In a model testing for sociodemographic characteristics, KAP score and DDS; school name (O.R 6.63, 95% CI 2.00-22.00, p-value 0.00) and occupation level of the head of household (O.R 0.30, 95% CI 0.12-0.90.00, p-value 0.03) was significantly associated with DDS.

Table 14. Multiple Logistic Regression of Sociodemographic Characteristics, KAP level and DDS[1]

	Unadjusted		Adjusted[1]	
Characteristics	OR (95% CI)	*p-value*	OR (95% CI)	*p-value*
School Name				
Mtama (Ref)				
Mahiwa	0.86(0.36-2.03)	0.73	0.56(0.21-1.43)	0.22
Madangwa	6.63(2.00-22.00)	0.00	4.32(1.03-18.10)	0.05
Age	0.75(0.55-1.01)	0.05	0.94(0.67-1.31)	0.71
Religion				
Muslim (Ref)				
Christian	0.65(0.28-1.48)	0.31	6.32(0.08-466.4)	0.40
Stay with				
Family (Ref)				
Relatives	1.80(0.62-5.25)	0.28	0.03(0.00-15.44)	0.28
Head of household				
Father (Ref)				
Mother	1.67(0.63-4.45)	0.30	0.01(0.00-3.87)	0.14
Others	1.26(0.48-3.29)	0.63	30.5(0.05-17380.05)	0.70
Sex of head of HH				
Male (Ref)				
Female	1.05(0.48-2.27)	0.90		

[1]Variable with p-value of ≤0.5 were included in the multivatiate logistic regressions. Model included KAP Scores, UIC and Sociodemographic characteristics

Table 14 (cont'd)

Occupation of HHH				
Peasant (Ref)				
Employed	0.46(0.18-1.20)	0.11	0.30(0.12-0.90)	0.03
Marital status of HHH				
Married (Ref)				
Single	0.32(0.12-0.92)	0.03	0.39(0.13-1.22)	0.11
Separated/Divorced/Widowed	2.68(0.84-8.53)	0.10	2.10(0.59-7.48)	0.25
Education level of HHH				
Primary (Ref)				
No formal education	1			
Secondary and above	0.63 (0.29-1.37)	0.24	18.69 (0.08-4094.798)	0.29
Number of HH members				
3 – 5 (Ref)				
6 – Above	1.57(0.61 -4.05)	0.35	0.00(5.00-20.16)	0.14
Number of under 18				
0 – 3 (Ref)				
4 – 10	1.48(0.54 - 4.06)	0.55		
Iodine status (UIC)	0.99(0.99-1.00)	0.09	0.48(0.23-1.01)	0.05
Knowledge	1.00 (0.95-1.05)	1.00		
Attitude	0.99(0.94-1.04)	0.64		
Practice	0.83(0.67-1.04)	0.11		

[1]Adjusted for School name, age, marital status and iodine status

Table 15 shows multiple logistic regression of sociodemographic characteristics, KAP Score and UIC. In a model testing for Sociodemographic characteristics, KAP Score and UIC, age was significantly associated with iodine status (O.R 0.86, 95% CI 0.61-1.22, p-value 0.01)

Table 15. Multiple logistic regressions of sociodemographic characteristics, KAP Score and UIC[1]

	Unadjusted		Adjusted[1]	
Characteristics	OR (95% CI)	*p-value*	OR (95% CI)	*p-value*
School Name				
Mtama (Ref)				
Mahiwa	0.49(0.08-2.81)	0.42	.09 (0.11-11.03)	0.94
Madangwa	0.08(0.02-0.36)	0.00	0.04(0.04-0.41)	0.07
Age	0.86(0.61-1.22)	0.40	0.42(0.22-0.80)	0.01
Religion				
Muslim (Ref)				
Christian	1.37(0.47-4.04)	0.56		
Stay with				
Family (Ref)				
Relatives	0.74(0.24-2.26)	0.60		
Head of household				
Father (Ref)				
Mother	0.84(0.29-2.49)	0.76		
Others	1.27(0.37-4.29)	0.70		
Sex of head of HH				
Male (Ref)				
Female	1.52(0.58-4.02)	0.40	2.60(0.46-14.59)	0.28
Occupation of HHH				
Peasant (Ref)				
Employed	3.07(0.66-14.28)	0.15	1.21(0.15-9.59)	0.85
Marital status of HHH				
Married (Ref)				
Single	3.76(0.46-30.54)	0.21	1.65(0.14-19.01)	0.68
Separated/Divorced/Widowed	0.52(0.19-1.42)	0.20	0.55(0.08-3.66)	0.53
Education level of HHH				
Primary (Ref)				
No formal education	0.47(0.12-1.85)	0.28	1.14 (0.17-7.31)	0.89
Secondary and above	2.93(0.91-9.47)	0.07	3.29(0.51-21.14)	0.21
Number of HH members				
3 – 5 (Ref)				
6 – Above	0.58(0.15-2.23)	0.43	4.81(0.68-34.22)	0.12

[1]Variable with p-value of ≤0.05 were included in the multivatiate logistic regressions.
[2]UIC level (<100 vs ≥100)

Table 15 (cont'd)

Number of under 18				
0 – 3 (Ref)				
4 – 10	1.40(0.95-2.05)	0.08	4.12 (0.35-48.65)	0.26
Dietary diversity score	1.50(0.90-2.49)	0.11	0.35(0.22-1.84)	0.22
Knowledge	1.02(0.95-1.09)	0.51		
Attitude	0.99(0.94-1.06)	0.93		
Practice	1.20 (0.88 -1.63)	0.25	0.96 (0.42 -1.12)	0.14

[1]Adjusted for School name, age, education level, number of under 18, and dietary diversity score

Chapter 5. Discussion

A low level of knowledge is one of the obstacles hindering successful elimination of iodine deficiency (Abuye and Berhane, 2007). Lack of nutritional knowledge is parallel to individuals' dietary iodine insufficiency (Nazeri et al., 2015). The study shows there was variation in distribution of knowledge (K) and attitude (A) scores but not practice (P), variance was quite different though the means were similar among the schools. This indicates knowledge on iodine and its related information was unevenly distributed among the schools with Mahiwa having the least scores in all the attributes. Despite universal/national salt iodization programme, this community was unaware of the benefits of I-salt, and most of the households used non-I-salt in their food preparation. Ministry of Health Tanzania has extensively engaged religious leaders as advocacy strategy to increase household consumption of I-salt to the global recommendations (TFNC Unpublished report, 2015). Supported by the study findings, the mean score of knowledge was significantly associated with religion (Mean diff 3.43 95%CI 0.15-0.71, p value 0.04). As evidence suggests that the three most common indicators of socio-economic status are education, income and occupation(Nazeri et al., 2015). In the study context, practice involved use of I-salt and reading labels before purchasing the salt to ensure it is iodized. This study found that practice was associated with occupation level of the head of household (Mean diff 3.43 95%CI 0.15-0.71, p value 0.04).

Different factors other than knowledge, attitude and practices (P) have an impact on iodine nutrition status. As seen in a French study conducted on an adult population, dietary iodine intake is influenced by age, education, energy intake and smoking (Valeix et al., 2009). In the current study no association was found between adolescent girls' knowledge and iodine nutrition

status. This may be attributable to the impact of different factors on knowledge, i.e. age, socioeconomic status, occupation and education. Moreover, high nutritional knowledge and positive attitude do not necessarily lead to behavioral outcome and dietary changes, as indicated in the study which assessed contribution of knowledge and attitude to suboptimal dietary iodine status (Nazeri et al., 2015).

I-salt used during cooking and as table salt, is the main dietary iodine source providing almost all the iodine intake in Tanzania, where due to the low iodine content of its soil, many locally grown plants and animal foods have iodine concentrations too low to serve as constant contributors to the dietary iodine supply (Assey et al., 2006). Furthermore, the production and distribution of less expensive or inadequately iodized brands of salt observed in Lindi and other parts of the country is another major destabilizing factor in sufficient dietary iodine intake. Our findings that 45.5% of the salt samples brought by subjects contained inadequate iodine content and 12.9% contained no iodine at all indicate that significant number of the subjects in the study area consumed salt with inadequate iodine content. However, the difference in the level of iodine in salt and iodine status among the schools was significant (Pearson Chi^2 25.7, p value 0.00). Other studies have also revealed a lack of association between self-reported I- salt use and UIC (Chen et al., 2015), which may be due to consumption of meals outside of the home and processed foods that have not been prepared with I-salt. In two locations (Mtama and Mahiwa), although salt iodization was low in 40-50% of the samples brought from home, 80-90% of the girls had adequate iodine status. This can be explained by the fact that the schools had school feeding program (SFP) which provides one nutritionally adequate meal (lunch) for all the students which may include iodine rich foods. On the other hand, Madangwa school was located in close proximity to salt farms which can explain the 58.1% of the brought salt having

inadequate iodine. In such regard, issues regarding adequate iodization by local producers and appropriate storage also need to be urgently addressed at production level.

Intake of a diverse variety of foods has been a recommendation for achieving adequate nutrient intake and the recommendation appears in the dietary guidelines of many countries (Kennedy et al., 2007). However, the precise number of foods or food groups that one should strive to consume over any given period is not commonly mentioned in most dietary guidelines. The use of dietary diversity as an indicator of adequate nutrient intake remains under evaluation, particularly in developing countries including Tanzania. In assessment of the importance of dietary diversity to adequate nutrient intake, researchers have used different food group classification systems, as well as diverse reference periods, cut-off points, and age groups. In this study, nine food groups were used to calculate DDS and in the multiple logistic regression testing for an association between sociodemographic characteristics and DDS, occupation level was significantly associated with the outcome (O.R 0.30, 95% CI 0.12-0.90, p value 0.03). Preliminary evaluation of the local diet (not reported here) revealed that the diet is low in natural sources of iodine. Fish was rarely consumed, eggs, meat and milk not consumed at all, thus iodine deficiency is clearly a serious cause for concern in this community and is likely to have a long-term impact on the growth and cognitive development of the children living here.

In addition, no associations were observed between consumption of I-salt and adolescents' knowledge, attitude and practices regarding iodine and I- salt, which can be explained by the fact that salt intake is strongly determined by environmental, social and economic issues such as cultural factors, availability and perceived palatability. In other studies, price rather than health aspects is a major contributor of salt consumption (Lowe et al., 2015).

5.1 Conclusion and Recommendations

Our study findings underscore the importance of continuous public education regarding iodine nutrition and enforcing USI program in the areas where sale of non-I-salt is still common. Knowledge, attitude, and practice of using I-salt plus consumption of I-salt fortified at the recommended levels are important in achieving iodine sufficiency. In the southern region in Tanzania where salts that are not fortified or fortified below the recommended level of concentrations, nutrition education strategies in adolescents and other age groups should focus on purchase and consumption of I-salt that has been fortified adequately. The amount of iodine added to salt during the fortification process needs to account for the loss of iodine during transport and storage and should be regularly monitored by government agencies.

5.2 Study Limitations

The present study has a few potential limitations that need to be considered. First, we could not measure the dietary iodine intake through iodine content of foodstuff, but I-salt is the main source of dietary iodine in Tanzania. Second, iodine concentration in a 24-hr urine sample is considered a gold standard for determination of dietary iodine intake. Yet, a single spot urine sample is an inappropriate indicator of habitual iodine intake, because of variation in daily dietary iodine intakes. Third, causality relationships cannot be established due to the cross-sectional design of the study.

APPENDICES

Appendix A: Briefing script

Title: Knowledge Attitude and Practices in efforts to eliminate iodine deficiency among adolescent girls in rural Tanzania

Hello. My name is Elizabeth Ndaba, I am working with Dr. Song at Michigan State University who collaborates with Dr. Mamiro from Sokoine University of Agriculture. We are here to study maternal nutrition and child health, focusing on awareness of iodine nutrition among teenage girls. This school has been selected to participate, participant's views and feelings towards this topic will be put together in assessing the outcomes (dietary intake, use of iodized salt, and iodine status) from this study, participants will know their iodine nutrition status.

All information participants will provide in the interview will be kept confidential and used for the purposes of this study only and will in no way affect the participants' relationship with their parents/ school administrator. The interview will take between 30 to 35 minutes of one's time.

The objective is to obtain information that will assist in facilitate eliminating IDD in Tanzania by empowering consumers' understanding of the importance of using iodized salt. Participation will be voluntary, and one can decline to participate without any consequences of any kind, participant will be asked to kindly indicate if they are willing to proceed with the interview and at the same time, a participant will be free not to answer the question she is not will to respond to and the interviewer will go on to the next question.

As a participant, we are going to provide you with a consent forms that you will fill in and another one for the head of schools as guardians, explaining that this study is to know the nutrition status of adolescent girls in the district and your school was randomly chosen to be among the participating school.

After the consent is signed by you / head of school, please return this form to your class teacher because on the day we will be conducting the study, these forms will be needed. Also, please remember that we will provide small pouches and which you will provide us with 1 table spoonful of the kitchen salt, this salt will also be presented on the data collection day, furthermore, we will give you small container which will need 20mL of urine early in the morning during the survey day.

Do you have any question? (Session for question and answers)

We are going to have a small exercise in class. We will randomly select our participants, and these will consent with us so as we give them the consent forms

Thank you very much

Appendix B: Head of schools informed consent form

Title: Knowledge Attitude and Practices in efforts to eliminate iodine deficiency among adolescent girls in rural Tanzania.

Purpose: Your school is invited to participate in this research project which will assess the knowledge, attitude and practices of adolescent girls on iodine nutrition as efforts to eliminate IDD in this district. Iodine is important for all age groups but for adolescents because of their development peak which requires high nutrient intake if not taken care, nutritional deficiencies hinder their potential to study, performance in class, production in and outside schools and their reproduction later in life.

The information obtained from this study would help increase knowledge on iodine nutrition and further be used in designing interventions for eliminating iodine deficiency among adolescent girls in Tanzania. This study is being conducted by Michigan State University, USA in collaboration with Sokoine University of Agriculture, Morogoro. It is sponsored by USAID/ Innovative Agricultural Research Initiative (iAGRI).

Procedure: upon obtaining your consent, the students will be randomly selected to be included in the study and asked to bring 2 teaspoonfuls of salt for iodine testing on the day of study. During the study they'll be asked about (1) socio demographics, and their knowledge attitude and practices (KAP) on iodine (2) Will also be asked to provide a 10mL urine sample to measure their iodine status. This urine sample will be coded and tested at the Tanzanian Food and Nutrition Laboratory. Finally, they will be requested to recall the foods they ate in the previous 24 hours prior to study date. The session will take a minimum of 30 minutes in a separate classroom during break time to avoid interference with class hours.

Risks/Discomforts There is absolutely no pain using the designed tools, no health complications and providing the requested biological sample is not associated with any kind of risk.

Benefits: You will be provided with aggregate data which shows iodine status of the students. The researchers hope that in the future adolescent girls will be among prioritized beneficiary of public health interventions. Subjects will be given a pen and diary after collecting samples as a token for participation.

Confidentiality: Results will be kept strictly confidential and will not be shared with anyone except members of our survey team. Information about your students will be kept confidential to the maximum extent allowable by law. You'll be provided with aggregate data on their iodine status. Data will be coded to increase privacy Records will be kept for three years at Sokoine University of Agriculture, Michigan State University and Urine samples analyzed for research will be kept for at least three years at Tanzanian Food and Nutrition Laboratory. Your data will be accessible only by members of the study team, Michigan State University and/or authorized institutional representatives.

Your Rights to not participate in the study: Participation of your school will be completely voluntary. Refusal to participate or discontinued participation at any time will result no penalty or loss of benefits to which you're otherwise entitled. If you have concerns or questions about this study, such as scientific issues, or to report an injury, please contact the researchers named below:

If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish.

Professor Peter Mamiro
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P.O. Box 3006, Morogoro
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Won O Song, PhD, MPH, RD

Dept. of Food Science and Human Nutrition, 469 Wilson RD, 35A Trout Michigan State University,East Lansing, MI 48824
Phone: +1 5173558474
Email: song@msu.edu

By signing this sheet, you certify that you have read/understood explanation of this consent form and have received answers to all your questions/concerns.

My signature below indicates I voluntarily agree for my school to participate in this study.

Name …… Signature or thumb print……. Date

Contact information for Institutional Review Boards

If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish

Sokoine University of Agriculture,
P.O.Box 3000, Chuo Kikuu Morogoro, Tanzania.
E-mail: sua@suanet.ac.tz

National Health Research Ethics Review Committee
National Institute for Medical Research
2448 Ocean Road, P.O. Box 9653

Michigan State University's Human Research Protection Program
Telephone: +1 517 355 2180, E-mail: irb@msu.edu or Regular mail: 408 West Circle Drive, Olds Hall Room 207, MSU, East Lansing, MI 48824

This study will begin Jan 2017. *Please indicate the date that best suits for the study at your school ……*

Appendix C: Class teacher informed consent form for girls aged 14 - 17 years

Title: Knowledge Attitude and Practices in efforts to eliminate iodine deficiency among adolescent girls in rural Tanzania.

Purpose: Your student is invited to participate in this research project which will assess the knowledge, attitude and practices of adolescent girls on iodine nutrition as efforts to eliminate IDD in this district. Iodine is important for all age groups but for adolescents because of their development peak which requires high nutrient intake if not taken care, nutritional deficiencies hinder their potential to study, performance in class, production in and outside schools and their reproduction later in life.

The information obtained from this study would help increase knowledge on iodine nutrition and further be used in designing interventions for eliminating iodine deficiency among adolescent girls in Tanzania. This study is being conducted by Michigan State University, USA in collaboration with Sokoine University of Agriculture, Morogoro. It is sponsored by USAID/ Innovative Agricultural Research Initiative (iAGRI)

Procedure: Upon obtaining your consent, the student will be included in the study, and asked to bring 2 teaspoonfuls of salt for iodine testing on the day of study. During the study she will be asked about (1) socio demographics, and her knowledge attitude and practices (KAP) on iodine (2) Will also be asked to provide a 10mL urine sample to measure her iodine status. This urine sample will be coded and tested at the Tanzanian Food and Nutrition Laboratory. Finally, she will be requested to recall the foods she ate in the previous 24-hr prior to study date. The session will take a minimum of 30 minutes in a separate classroom during break time to avoid interference with class hours.

Risks /Discomforts: There is absolutely no pain using the designed tools, no health complications and providing the requested biological sample is not associated with any kind of risk.

Benefits: She will know her iodine nutrition status. The researchers hope that in the future adolescent girls will be among prioritized beneficiary of public health interventions. She will also be given a pen and diary after collecting samples as a token for participation.

Confidentiality: No names will be attached thus results will be coded to increase privacy. The result will be kept strictly confidential and will not be shared with anyone except her and members of our survey team. Information about her will be kept confidential to the maximum extent allowable by law. Records will be kept for three years at Sokoine University of Agriculture, Michigan State University and Urine samples analyzed for research will be kept for at least three years at Tanzanian Food and Nutrition Laboratory. Your data will be accessible only by members of the study team, Michigan State University and/or authorized institutional representatives.

Your Rights to not participate in the study: Participation of your student will be completely voluntary. Refusal to participate or discontinued participation at any time will result no penalty or loss of benefits to which she's otherwise entitled. If you have concerns or questions about this study, such as scientific issues, or to report an injury, please contact the researchers named below:

Won O Song, PhD, MPH, RD
Dept. of Food Science and Human Nutrition, 469 Wilson RD, 35A Trout
Michigan State University, East Lansing, MI 48824
Phone: 5173558474
Email: song@msu.edu

Professor Peter Mamiro
Sokoine University of Agriculture, Depart of Food Science &Technology, P.O. Box 3006, Morogoro.
Phone*:* + 255754462006 E-mail:petermamiro@yahoo.com

Contact information for Institutional Review Boards

If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish

National Health Research Ethics Review Committee

National Institute for Medical Research

2448 Ocean Road, P.O. Box 9653

Michigan State University's Human Research Protection Program
Telephone: +1 517 355 2180, E-mail: irb@msu.edu or Regular mail: 408 West Circle Drive, Olds Hall Room 207, MSU, East Lansing, MI 48824

Sokoine University of Agriculture,
P.O.Box 3000, Chuo Kikuu Morogoro, Tanzania.
E-mail: sua@suanet.ac.tz

By signing this sheet, you certify that you have read explanation of this consent form and have received answers to all your questions/concerns. Both of your signature below indicates voluntarily participation in this study.

Teachers name …… Signature/thumb print……

Date ……

Student name ……. Signature/thumb print…….

Date…….

Appendix D: Informed consent form for girls above 18 years of age

Title: Knowledge, attitude and practices in efforts to eliminate iodine deficiency among adolescent girls in rural Tanzania

Purpose: You are invited to participate in this research project as per your willingness and that of your school to allow their students to participate. This study will assess the knowledge, attitude and practices of adolescents towards elimination of IDD in this district. Iodine is important for all age groups but for adolescents because of their development peak which requires high nutrient intake if not taken care, nutritional deficiencies hinder your potential to study, performance in class, production in and outside schools and your reproduction later in life.

The information obtained from this study would help increase knowledge on iodine nutrition and further be used in designing interventions for eliminating iodine deficiency among adolescent girls in Tanzania. This study is being conducted by Michigan State University, USA in collaboration with Sokoine University of Agriculture, Morogoro. The study is sponsored by USAID/ Innovative Agricultural Research Initiative (iAGRI).

Procedure: You have been selected by chance from the rest of your classmate and after you consent to participate, you will be asked about (1) socio demographics, and your knowledge attitude and practices (KAP) on iodine (2) you'll be requested to provide 2 teaspoon of salt to measure iodine content (3) Will also be asked to provide a 10mL urine sample to measure your iodine status; this urine sample will be coded and tested at the Tanzanian Food and Nutrition Laboratory. Finally, will request you to recall the foods you ate in the previous 24 hours prior to study date. The session will take a minimum of 30 minutes in a separate classroom for privacy and minimal interference.

Risks/Discomforts There is absolutely no pain using the designed tools, no health complications and providing the requested biological sample is not associated with any kind of risk.

Benefits: You will know your iodine nutrition status. The researchers hope that in the future adolescent girls will be among prioritized beneficiary of public health interventions. You will also be given a pen and diary after collecting samples as a token for participation.

Confidentiality: No names will be attached thus results will be coded to increase privacy. The result will be kept strictly confidential and will not be shared with anyone except you and members of our survey team. Information about you will be kept confidential to the maximum extent allowable by law. Records will be kept for three years at Sokoine University of Agriculture, Michigan State University and Urine samples analyzed for research will be kept for at least three years at Tanzanian Food and Nutrition Laboratory. Your data will be accessible only by members of the study team, Michigan State University and/or authorized institutional representatives.

Rights to not participate in the study: Your participation will be completely voluntary. Refusal to participate or discontinued participation at any time will result no penalty or loss of benefits to which you're otherwise entitled. If you have concerns or questions about this study, such as scientific issues, or to report an injury, please contact the researchers named below:

Won O Song, PhD, MPH, RD Dept. of Food Science and Human Nutrition, 469 Wilson RD, 35A Trout Michigan State University,East Lansing, MI 48824
Phone: 5173558474, Email: song@msu.edu

Professor Peter Mamiro
Sokoine University of Agriculture, Depart of Food Science &Technology,
P.O. Box 3006, Morogoro
Phone:+255 754 462 006
E-mail:petermamiro@yahoo.com

Contact information for Institutional Review Boards

If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish

Michigan State University's Human Research Protection Program
Telephone: +1 517 355 2180, E-mail: irb@msu.edu or Regular mail: 408 West Circle Drive, Olds Hall Room 207, MSU, East Lansing, MI 48824

National Health Research Ethics Review Committee
National Institute for Medical Research
2448 Ocean Road, P.O. Box 9653

By signing this sheet, you certify that you have read explanation of this consent form and have received answers to all your questions/concerns. Your signature below indicates that you voluntarily agree to participate in this study.

Subject's code…… Signature and /or thumb print…… Date ……

Appendix E: Introduction to students before survey

Good day, my name is _____. I am a master student at Michigan State University collaborating with Dr. Song of Michigan State University and Dr. Peter Mamiro from Sokoine University of Agriculture. We would like to invite you to participate in a study that aims to assess levels of knowledge, attitudes and practices on iodine nutrition together with factors associated with low iodine consumptions in adolescent girls. This school has been selected to participate in this study. All your views and feelings towards this topic will be put together in assessing the outcomes - iodine status and use of iodized salt. All information you give in this interview will be kept confidential and used for the purposes of this study only and will in no way affect your relationship with your class teacher and school administrator. This interview will take between 20 to 25 minutes of your time. Please note that you are not taking a test. We are trying to obtain information that will assist in designing an intervention program to help adolescent girls in rural Tanzania. This is a voluntary participation and you can decline to participate without any consequences of any kind. Kindly indicate if we can proceed with the interview. If I ask you any question you don't want to answer, just let me know and I will go on to the next question or you can stop the interview at any time.

Are there any questions before we get started? ☐ Yes ☐ No

Signature of interviewer: ……Date……. /……. /…….

Appendix F: Ethical clearance certificates

THE UNITED REPUBLIC OF TANZANIA

National Institute for Medical Research
3 Barack Obama Drive
P.O. Box 9653
11101 Dar es Salaam
Tel: 255 22 2121400
Fax: 255 22 2121360
E-mail: headquarters@nimr.or.tz

Ministry of Health, Community Development Gender, Elderly & Children
6 Samora Machel Avenue
P.O. Box 9083
11478 Dar es Salaam
Tel: 255 22 2120262-7
Fax: 255 22 2110986

NIMR/HQ/R.8a/Vol. IX/2355

25th November 2016

Elizabethproscovia Z. Ndaba
C/O Dr. Peter S Mamiro
Department of Food Technology Nutrition and Consumer Sciences.
Sokoine University of Agriculture,
P.O.Box 3006
MOROGORO

CLEARANCE CERTIFICATE FOR CONDUCTING MEDICAL RESEARCH IN TANZANIA

This is to certify that the research entitled: Knowledge, Attitude and Practices in efforts to Eliminate Iodine Deficiency among Adolescent Girls in Rural Tanzania (Ndaba E *et al*) whose Co Supervisor is Dr. Peter S Mamiro of the Department of Food Technology Nutrition and Consumer Sciences, SUA, Morogoro has been granted ethical clearance to be conducted in Tanzania.

The Principal Investigator of the study must ensure that the following conditions are fulfilled:

1. Progress report is submitted to the Ministry of Health, Community Development, Gender, Elderly & Children and the National Institute for Medical Research, Regional and District Medical Officers after every six months.
2. Permission to publish the results is obtained from National Institute for Medical Research.
3. Copies of final publications are made available to the Ministry of Health, Community Development, Gender, Elderly & Children and the National Institute for Medical Research.
4. Any researcher, who contravenes or fails to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine. NIMR Act No. 23 of 1979, PART III Section 10(2).
5. Site: Lindi District Council.

Approval is for one year: 25th November 2016 to 24th November 2017.

Name: Dr Mwelecele N Malecela

Signature
CHAIRPERSON
MEDICAL RESEARCH
COORDINATING COMMITTEE

Name: Prof. Muhammad Bakari Kambi

Signature
CHIEF MEDICAL OFFICER
MINISTRY OF HEALTH, COMMUNITY DEVELOPMENT, GENDER, ELDERLY &CHILDREN

MICHIGAN STATE
UNIVERSITY

Initial IRB Application Approval

July 29, 2016

To: Won Song
139 GM Trout Building

Re: **IRB#** 16-838 Category: EXPEDITED 3,7
Approval Date: July 13, 2016
Expiration Date: July 12, 2017

Title: Knowledge, attitude and practices in elimination of iodine deficiency among Tanzanian women of reproductive age

The Institutional Review Board has completed their review of your project. I am pleased to advise you that **your project has been approved.**

Please send the National Health Research Ethics Review Committees' approval letter and approved consent forms to the MSU IRB upon receipt. Note if the consent forms approved by the MSU IRB are revised by the National Health Research Ethics Review Committee, the revised forms must be submitted to the MSU IRB via a revision before implementation.

The committee has found that your research project is appropriate in design, protects the rights and welfare of human subjects, and meets the requirements of MSU's Federal Wide Assurance and the Federal Guidelines (45 CFR 46 and 21 CFR Part 50). The protection of human subjects in research is a partnership between the IRB and the investigators. We look forward to working with you as we both fulfill our responsibilities.

Renewals: IRB approval is valid until the expiration date listed above. If you are continuing your project, you must submit an ***Application for Renewal*** application at least one month before expiration. If the project is completed, please submit an ***Application for Permanent Closure***.

Revisions: The IRB must review any changes in the project, prior to initiation of the change. Please submit an ***Application for Revision*** to have your changes reviewed. If changes are made at the time of renewal, please include an ***Application for Revision*** with the renewal application.

Problems: If issues should arise during the conduct of the research, such as unanticipated problems, adverse events, or any problem that may increase the risk to the human subjects, notify the IRB office promptly. Forms are available to report these issues.

Please use the IRB number listed above on any forms submitted which relate to this project, or on any correspondence with the IRB office.

Good luck in your research. If we can be of further assistance, please contact us at 517-355-2180 or via email at IRB@msu.edu. Thank you for your cooperation.

Sincerely,

Ashir Kumar, M.D.
BIRB Chair

c: Won Song, Elizabeth-Proscovia Ndaba

Office of Regulatory Affairs
Human Research Protection Programs

Biomedical & Health Institutional Review Board (BIRB)

Community Research Institutional Review Board (CRIRB)

Social Science Behavioral/Education Institutional Review Board (SIRB)

Olds Hall
408 West Circle Drive, #207
East Lansing, MI 48824
(517) 355-2180
Fax: (517) 432-4503
Email: irb@msu.edu
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MSU is an affirmative-action, equal-opportunity employer.

Appendix G: Questionnaire (English version)

Knowledge, attitude and practices in efforts to eliminate iodine deficiency among adolescent girls in rural Tanzania (January – March 2017)

IDENTIFICATION

Code		District		Village		Ward		School name	

Urine provided: ① Yes ② No

Salt provided: ① Yes ② No

Test for the presence and amount of iodine in the salt sample presented

①Present below 15 ppm (<15 ppm) ② Present above 15ppm (≥15 ppm) ③ Not present

Section I: Sociodemographic information

The following questions will be asked so that we get a snapshot about you and your household. Please check the answer that applies to you.

1. How old are you?

① 14 ② 15 ③ 16 ④ 17 ⑤ 18 ⑥ 19

2. What is your religion?

① Christian ② Muslim ③ Others (specify:)

3. Which village do you live in? ()

4. During school days who do you stay with?

① Independent ② Family ③ Relatives ④ Others (specify:)

5. What is the sex of the head of the household? ① Male ② Female

6. What is your household's head relationship to you?

① Mother ② Father ③ Grandmother

④ Uncle ⑤ Aunt ⑥ Others (specify:)

7. What is the occupation of your household's head?

① Peasant ② Salt farmer ③ Employed

④ Businessman ⑤ Others (specify)

8. Currently what is the marital status of your household's head?

① Married ② Single ③ Separated ④ Divorced ⑤ Widowed

9. What is the highest level of education completed by your household's head?

① No school ② Primary ③ Secondary O-level

④ Secondary A-level ⑤ University ⑥ Others (specify)

10. How many people are currently living in your household, including yourself?

① 2 ② 3-5 ③ 6-10 ④ more than 10

11. How many people including you are under 18yrs? ()

① 3 ② 4 -6 ③ 7-10 ④ More than 10 ④ Less than 2 ④ None

12. How many children in the household are under five years old? ()

① None ② 1-3 ③ 4-5 ④ More than 5

13. Where do you obtain salt used at home?

① Retail shop② Market ③ Salt farm ④ Others (specify:

Section II: Knowledge, Attitude, Practice (KAP) questions

Now I would like to ask you questions about iodine. Please check the answer that applies to you.

Knowledge

1. Can you please tell me what iodine is?

① Vitamin ② Micronutrient ③ Something in the food we eat

④ Don't know ⑤ Others (specify:)

2. What is the main source of dietary iodine in the Tanzanian diet?

① Iodized salt ② Vegetables ③ Meat

④ Don't know ⑤ Others (specify:)

(*If you answered* Don't know *for question 1&2 then skip additional questions related to iodine knowledge*)

3. Do you know which part of the body needs iodine for its functioning?

① Yes ② No ③ Don't know

3-1. If yes, could you tell me which part it is?

4. Do you know the cause of iodine deficiency?

① Yes ② No ③ Don't know

4-1 If yes, could you tell me what it is?

5. Do you know the consequence of iodine deficiency?

① Yes ② No ③ Don't know

5-1 If yes, could you tell me what it is?

6. Do you know what is goiter?

① Yes ② No ③ Don't know

6-1 If yes, could you tell me what it is?

7. Do you know what iodized salt is?

① Yes ② No ③ Don't know

7-1 If yes, could you tell me what is iodized salt?

8. Do you know what sickness can iodized salt prevent?

① Yes ② No ③ Don't know

8-1 If yes, what is it?

Attitude/Perception

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
1. Adequate iodine intake is advantageous to maintain health.	①	②	③	④	⑤
2. A lack of iodine in the body leads to serious health problems	①	②	③	④	⑤
3. Using iodized salt is vital for body health.	①	②	③	④	⑤
4. Iodized salt should be consumed instead of non-iodized salt.	①	②	③	④	⑤
5. The most appropriate salt for consumption is iodized salt.	①	②	③	④	⑤
6. Iodized salt differs from other types of salts.	①	②	③	④	⑤
7. In our country, salt iodization is mandatory.	①	②	③	④	⑤
8. The amount of iodine should be printed on the salt package.	①	②	③	④	⑤

Practice/Behavior

1. What kind of salt do you use at home?

① Common salt ② Rock salt ③ Iodized salt ④ Others (specify)

2. Do you purchase salt? ① Yes ② No

If Yes *continue to next 2 questions*

If No *skip next 2 questions*

3. Do you read labels on the salt package to make sure it is iodized?

① Yes ② No ③ Don't know what iodized salt is ④ Others (specify)

4. Which item do you consider most important when purchasing salt?

① Price ② Packaging ③ Being iodized ④ Others (specify)

5. When do you add salt during cooking process?

① at the beginning ② After few hours/minutes

③ at the end ④ Others (specify)

6. Where do you obtain, salt used for cooking at home?

①at the market ② Salt producers ③ Don't use salt ④ Others (specify:

7. How do you store salt in your home?

Probes: exposed to sunlight, moist environment, covered container

Section III: 24-hr Dietary Recall Form

Now I would like us to go in details of the foods you ate from yesterday morning until now and we will be estimating the amount you had. Feel free to mention both foods and beverages made from even local/ wild sources. Describe in detail. List one food per line.

No.	Quick list of foods and drink items	Time (am/pm)	Method of cooking & individual ingredients	Amount eaten (utensil used)	Eaten at home (Y/N)
01					
02					
03					
04					
05					

Section IV: Food Intake and Dietary Diversity

Now I am going to ask you what you ate and drank yesterday

Please describe the foods (meals and snacks) that you ate or drank yesterday during the day and night, whether at home or outside the home. Start with the First food or drink of the morning. *Write down all foods and drinks mentioned. When composite dishes are mentioned, ask for the list of ingredients when the respondent has finished, probe for meals and snacks not mentioned.*

List of foods the respondent ate yesterday

QN	Food group	Example	Yes	No
01	CEREALS	corn/maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, noodles, porridge or other grain products) + e.*g. ugali, porridge or paste*	… …	.....
02	WHITE ROOTS AND TUBERS	white potatoes, white yam, white cassava, or other foods made from roots e.g. *chips*	… …	….
03	VITAMIN A RICH VEGETABLES AND TUBERS	Pumpkin, carrot, squash, or sweet potato that are orange inside + *other locally available vitamin A rich vegetables (e.g. red sweet pepper)*	… …	….
04	DARK GREEN LEAFY VEGETABLES	dark green leafy vegetables, including wild forms + *locally available vitamin A rich leaves such as amaranth, cassava leaves, bean leaves, pumpkin leaves, okra, kale spinach*	… …	.....
05	OTHER VEGETABLES	other vegetables (e.g. tomato, onion, eggplant) + *other locally available vegetables*		….
06	VITAMIN A RICH FRUITS	ripe mango, cantaloupe, apricot (fresh or dried), ripe papaya, dried peach, and 100% fruit juice made from these + watermelon, pineapple *other locally available vitamin A rich fruit Azam juice*	… …	….
07	OTHER FRUITS	Other fruits, including wild fruits and 100% fruit juice made from these.	… …	…
08	ORGAN MEAT	liver, kidney, heart or other organ meats or blood-based foods	… …	…. .
09	FLESH MEATS	beef, pork, lamb, goat, rabbit, game, chicken, duck, other birds, insects	….	…
10	EGGS	eggs from chicken, duck, guinea fowl or any other egg, milk and milk products like yoghurt, cheese	… …	…
11	FISH &SEAFOOD	fresh or dried fish or shellfish	… …	…
12	DAIRY	Milk and milk products example, milk, cheese, yoghurt		
13	Legumes, nuts and pulses	Beans, peanut, sunflower seeds, pigeon peas and the local dishes from this.	…..	…
14	Fungi	Chanterelle, mushroom and local dishes from this and related edible species	… …	….

Thank you for your cooperation!!!

Appendix H: Swahili version of the documents

UELEWA, MTAZAMO NA TABIA ZINAZOPELEKEA ATHARI ZITOKANAZO NA UKOSEFU WA MADINI JOTO KWA VIJANA BALEHE WA KIKE TANZANIA

Code		Wilaya	LINDI	Kijiji		Kata		Shule	

1. Mkojo umetolewa ①Ndiyo ②Hapana
2. Chumvi imetolewa ①Ndiyo ②Hapana
3. Kiasi cha madini joto kwenye chumvi iliyotolewa

①Zaidi ya 15ppm ②Chini ya 15ppm ③Hakuna

Sehemu I: Taarifa za mhojiwa

Maswali yafuatayo yataulizwa ili tupate ufahamu wa kuhusu wewe na kaya yako (weka tiki panapohusika)

1. Una miaka mingapi?

① 14 ② 15 ③ 16 ④ 17 ⑤ 18 ⑥ 19

2. Dini yako?

①Mkristo ②Muislamu ③Nyingine (taja)

3. Jina la kijiji unachoishi (_____)

4. Wakati huu ambapo upo shule, unaishi na nani?

①Pekeyangu ②Familia ③Ndugu ④ Mwingine (taja)

5. Jinsia ya mkuu wa kaya?

①Kike ② Kiume

6. Una uhusiano gani na mkuu wa kaya?

① Mama ② Baba ③Bibi ④ Mjomba ⑤ Shangazi ⑥ Nyingine (taja)

7. Kazi aifanyayo mkuu wa kaya

① Mkulima ② Mkulima wa chumvi ③ Mwajiriwa ④ Mfanyabiashara ⑤ Nyingine (taja)

8. Hali yake ya ndoa

①Ameoa/Ameolewa ② hajaoa/hajaolewa ③Ametengana ④Mtalaka ⑤ Mjane

9. Kiwango chake cha juu cha elimu

①Hakusoma ②Shule ya msingi ③ Kidato cha nne ④Kidato cha sita ⑤ Chuo kikuu ⑥ Nyingine (taja)

10. Kaya yako ina jumla ya watu wangapi ukijumuisha na wewe

① 2 ② 3-5 ③ 6-10 ④ Zaidi ya 10

11. Idadi ya wanakaya wenye umri chini ya miaka 18 ukijumuisha na wewe

① 3 ② 4 -6 ③ 7-10 ④ Zaidi ya 10

12. Idadi ya watoto wenye umri chini ya miaka mitano katika kaya yako

①Hakuna ② 1-3 ③4-5 ④ Zaidi ya 5

13. Chumvi itumikayo nyumbani mnaipata wapi?

①Dukani ② Sokoni ③Shamba la chumvi ④Nyingine (taja)

Sehemu II: Uelewa, tabia na mtazamo kuhusu madini joto

Maswali yafuatayo yatauliza uelewa, tabia na mtazamo wako kuhusu madini joto

Uelewa

1. Madini joto ni nini?

① Vitamini ②Kiini lishe ③Kitu kinacholiwa ④Sijui ⑤ Nyingine (taja:_____)

2. Nini chanzo kikuu cha madini joto kwenye chakula?

①Chumvi yenye madini joto ②Mboga ③Nyama ④Maziwa ⑤ Nyingine (taja)

(*Kama umejibu* Sijui *kwa swali namba 1&2, ruka maswali yote yanayohusiana na uelewa wa madini joto*)

3. Je unajua sehemu ya mwili inayohitaji madini joto ili kufanya kazi?

①Ndio ②Hapana ③Sijui

3-1 Kama ndiyo, itaje _____

4. Je, unajua nini kinasababisha upungufu wa madini joto?

①Ndio ②Hapana ③Sijui

4-1 Kama ndio, elezea _____

5. Je unajua madhara yatokanayo na upungufu wa madini joto?

①Ndio ②Hapana ③Sijui

5-1 Kama ndio, elezea _____

6. Unajua goita ni nini?

① Ndio ②Hapana ③ Sijui

6-1 Kama ndio, elezea _____

7. Je unaijua chumvi yenye madini joto?

①Ndio ②Hapana ③Sijui

7-1 Kama ndio, elezea _____

8. Je unaujua ugonjwa ambao unazuilika kwa kula chumvi yenye madini joto?

① Ndio ② Hapana ③ Sijui

8-1 Kama ndio, taja ugonjwa huo _____

Mtazamo

	Sikubali kabisa	Sikubali	Sikubali wala sikatai	Nakubali	Nakubali kabisa
9. Kula madini joto ya kutosha kuna faida kiafya	①	②	③	④	⑤
10. Ukosefu wa madini joto una athari kubwa sana mwilini	①	②	③	④	⑤
11. Matumizi ya chumvi yenye madini joto ni muhimu kwa afya	①	②	③	④	⑤
12. Ni bora kutumia chumvi yenye madini joto kuliko isiyo na madini joto	①	②	③	④	⑤
13. Utumiaji wa chumvi yenye madini joto ni muhimu kwa afya	①	②	③	④	⑤
14. Chumvi yenye madini joto iko tofauti kabisa na chumvi nyingine	①	②	③	④	⑤
15. Hapa nchini, uongezwaji wa madini joto kwenye chumvi ni lazima	①	②	③	④	⑤
16. Kiasi cha madini joto kilichopo kwenye chumvi kiandikwe juu ya pakiti ya chumvi	①	②	③	④	⑤

Tabia

1. Chumvi gani inatumika kupikia chakula nyumbani?

①Ya mawe ② Ya kawaida ③ Yenye madini joto ④ Nyingine (taja)_____

2. Je, unanunua chumvi? ① Ndio ② Hapana

Kama Ndio *endeleana maswali mawili yanayofuata*

Kama Hapana *ruka maswali mawaili yanayofuata*

3. Je, hua unasoma nembo iliyopo kwenye pakiti ya chumvi kuhakikisha ina madini joto?

①Ndio ②Hapana ③ Sijui nembo ya madini joto ④ Nyingine (elezea: ____)

4. Ni vitu gani unazingatia kabla ya kununua chumvi?

①Bei ② Ufungaji ③ Uwepo wa madini joto ④ Nyingine (Taja:)

5. Ni wakati gani naongeza chumvi wakati wa kupika?

① Mwanzoni ② Muda mfupi baada ya kuanza kupika ③ Mwishoni ④ Nyingine (Taja:)

6. Chumvi mnayotumia nyumbani kwajili ya chakula mnaipata wapi?

① Sokoni ② Wazalisha chumvi ③ Hatutumii chumvi ④ Nyingine (taja: ___)

7. Unahifadhi vipi chumvi nyumbani?

①Mfuko wa chumvi ②Chombo chenye mfuniko

③Mfuko wa nailoni ④ Nyingine (taja:)

Sehemu III: Taarifa ya mlo kwa masaa 24

Tungependelea kujua kwa undani aina ya vyakula ulivyokula kuanzia jana asubuhi mpaka hivi sasa. Na hapa tutakadiria kiwango ulichokula. Jisikie huru kutaja vyakula pamoja vinywaji hata kama ni vya kiasilia. Elezea kwa undani na taja chakula kimoja kwa kila mstari.

Orordha ya vyakula na vinywaji	Muda Am/pm	Njia ya upikaji & aina ya vyakula ulivyopika	Kiwango ulichokula	Ulikula nyumbani (N/H)

Sehemu IV: Sasa ntakuuliza nini ulichokula na kunywa jana

Tafadhali elezea vyakula (milo and vitafunio) ambavyo umekula au kunywa jana asubuhi na usiku, ikiwa ni nje au nyumbani. Anza na chakula cha kwanza au kinywaji cha asubuhi. Andika vyakula na vinywaji ulivyotajwa. *Mkama ametaja milo iloandaliwa ataje vitu jumuishi katika mlo huo pale mhojiwa takapomaliza kutaja milo na vitafunio.*

Orodha ya vyakula alivyokula mhojiwa jana

Swali	Kundi la chakula	Mfano	Ndiyo	Hapana
01	CEREALS	Mahindi, wali, ngano, mtama, ulezi au aina yoyote ya nafaka au chakula kilichotengenezwa na aina hii ya nafaka (mf: mkate, tambi, uji au chakula cha nafaka) + mf: *ugali, uji au tambi*	……	.....
02	MIZIZI MYEUPE NA MIZIZI	Viazi mviringo, viazi vikuu, mihogo au aina ya chakula chengine kitokacho na miziz mf: chipsi	……	….
03	MBOGA ZA MAJANI ZENYE VITAMINI NA MIZIZI	Boga, karoti, viazi vitamu ambavyo ndani vina rangi ya chungwa +mboga zenye vitamin A *(mf pilipili hoho nyekundu)*	……	….
04	MBOGA ZA MAJANI ZENYE KIJANI ILIYOKOZA.	Mboga za majani zenyre kijani iliyokoza, pamoja zile pori + majani yenye vitamin A kama mchicha, majani ya muhogo, majani ya maharage, majani ya boga, bamia, sukuma wiki.	……	.....
05	MBOGA NYENGINEZO	Mboga nyenginezo (mf. Nyanya, vitunguu, biringanya) + mboga pori nyenginezo	……	….
06	MATUNDA YENYE VITAMINI A	Embe bivu, tikiti maji, papai, na juisi iliyotengenezwa na matunda haya + nanasi na matunda pori mengine yenye vitamin A	……	….
07	MATUNDA MENGINE	Matunda mengine, pamoja na matunda na juisi iliyotengenezwa na matunda haya kwa 100%. *Mitooo,*	……	…
08	NYAMA YA MIFUGO YA KIENYEJI	Ini, figo,moyo au nyama nyengineyo ya mfugo wa kienyeji au vyakula vyenye asili ya damu.	……	…..
09	NYAMA ZA MINOFU	Nyama ya ng'ombe, nguruwe, kondoo, mbuzi, sungura, kuku, bata, aina nyenyineyo ya ndege,wadudu	….	…
10	MAYAI	Mayai ya kuku, bata, kanga au mayai mengineyo.	……	…

11	SAMAKI NA VYAKULA VYA BAHARINI	Samaki wabichi au kukausha au wa kwnyw maganda	……	…
12	MAZIWA NA VYENYE ASILI YA MAZIWA	Maziwa, mtindi, jibini, maziwa ya unga, vyakula vyenye maziwa ndani kama samli.		

Asante kwa kushiriki.

UTAMBULISHO

Uelewa, Mtazamo Na Tabia Zinazopelekea Athari Zitokanazo Na Ukosefu Wa Madini Joto Kwa Vijana Balehe Wa Kike Mkoa Wa Lindi.

Jina langu ni Elizabeth Ndaba ninafanya kazi na Dr. Song katika Chuo kikuu cha Jimbo la Michigan (**Michigan State University)** ambaye anashirikiana na Dr. Mamiro kutoka Chuo kikuu cha Kilimo Sokoine (**Sokoine University of Agriculture)**. Tunatafiti kuhusu uelewa, mtazamo na tabia zinazopelekea athari zitokanazo na ukosefu wa madini joto kwa vijana balehe wa kike. Shule hii imechaguliwa kushiriki kwa kutoa washiriki amabapo mawazo na hisia zao kuhusiana na mada hii vitawekwa pamoja na kujua matokeo (ukosefu wa madini joto, matumizi ya chumvi yenye madini joto na ulaji wa vyakula vyenye madini joto).

Maelezo yote utakayotoa kama mshiriki yatakuwa ni siri na kutumiwa kwa ajili ya utafiti huu tu, na hayataathiri uhusiano uliopo kati yako na walimu au utawala wa shule. Mahojiano yetu yatachukua kati ya dakika 20 mpaka 30.

Lengo la utafiti huu ni kupata taarifa ambazo zitasaidia kuondoa athari zinazosababishwa na ukosefu wa madini joto nchini na kuwawezesha walaji kutambua umuhimu wa kutumia chumvi iliyoongezwa madini joto.

Kama mshiriki, utapatiwa fomu ya ridhaa uijaze/ijazwe na mlezi/mwalimu inayoelezea dhumuni la utafiti huu na kwamba shule yako imechaguliwa kushiriki katika zoezi hili. Wasilisha fomu iliyojazwa kwa mwalimu wako wa darasa siku ya utafiti kwani itahitajika. Pia tutahitaji uje na kijiko kimoja cha chumvi siku hiyo. Siku ya utafiti, utapatiwa kikopo ambacho utatakiwa kujaza si chini ya mililita 20 za mkojo.

Kumbuka kushiriki kwako ni kwa hiyari na unaweza kukataa kushiriki bila shinikizo lolote.

Wakati wa mahojiano, uko huru kuacha kujibu swali lolote ambalo hutokua tayari kulijibu na naomba unioneshe ishara ya kuendelea na mahojiano kwa kuuliza maswali mengine.

Una swali lolote? 1. Ndio 2. Hapana

Naweza kuanza mahojiano .....

Saini ya msaili: ……Tarehe ……. /……. /…….

Ahsante Sana!

FOMU YA RIDHAA YA MWALIMU WA DARASA KWA MSICHANA WA MIAKA CHINI YA 18

Uelewa, mtazamo na mazoea katika juhudi za kuondoa athari zitokanazo na ukosefu wa madini joto miongoni mwa vijana balehe wa kike katika mkoa wa lindi.

Lengo: Mwanafunzi wako (1) anaalikwa kushiriki katika utafiti huu kwa ridhaa yake na ridhaa ya shule kumruhusu kushiriki. (2) Utafiti huu unahusu maarifa na mtazamo juu ya athari zitokanazo na ukosefu wa madini joto na mazoea yanayoweza kupelekea matatizo haya kwenye jamii. Upungufu wa madini joto na lishe duni ni jambo la kawaida hasa kwa wasichana walio balehe kwani mahitaji yao huongezeka kipindi hiki. Upungufu huu unaathiri uwezo wasichana hawa kujisomea, kufanya vizuri darasani, afya na uzazi na maisha bora kuanzia nyumbani, shuleni mpaka hapo baadaye katika maisha.

Taarifa zitakazopatikana katika utafiti huu zitasaidia kuongeza maarifa kuhusu upungufu wa lishe na kuweza kutumika katika kuandaa mkakati kwa wasichana walio balehe nchini. Utafiti huu unaendeshwa na Chuo kikuu cha Jimbo la Michigan, Marekani kwa kushrikiana na Chuo kikuu cha kilimo Sokoine, Morogoro kwa udhamini wa USAID/ Innovative Agricultural Research Initiative (iAGRI).

Taratibu: Kwa ridhaa yako, binti huyu atashiriki kwenye utafiti na atahitajika kuleta kijiko kimoja cha chumvi siku ya utafiti. Ataulizwa kuhusu (1) umri wake, mahali anapoishi, idadi ya watu na kipato katika kaya anayotoka, uelewa na mtazamo wake kuhusu madini joto na ataroodhesha aina mbali mbali ya vyakula alivyokula masaa 24 yaliyopita (3) Pia ataombwa kuleta mkojo kiasi cha 20ml ili kupima kiwango cha madini joto mwilini. Mkojo huu utapimwa katika maabara ya tasisi ya Chakula na lishe Tanzania.

Tatizo/Usumbufu Hakuna kabisa maumivu katika matumizi ya vifaa vitakavyotumika, wala matatizo yoyote ya kiafya na vipimo vilivyotakiwa havihusiani na kuwa na tatizo lolote.

Faida: Atanufaika kwa kujua hali yake ya lishe na kiwango cha madini joto mwilini. Watafiti wanategemea wasichana walio balehe watapata faida kupitia mkakati wa afya ya uma hapo baadaye. Atapatiwa kalamu ya wino na shajara (diary) kama ishara ya kushiriki.

Usiri: Majina hayatabandikwa kwenye vipimo vitakavyochukuliwa na majibu ni siri ya mshiriki hivyo hayatatolewa kwako au kwa yeyote bali yatahifadhiwa kwa usiri wa hali ya juu. Majibu hayataonyeshwa kwa mtu yoyote ispokuwa wajumbe katika jopo la watafiti na taarifa hizi zitahifadhiwa kwa usiri na kwa mujibu wa sheria. Takwimu zitawekewa namba za siri ili kuongeza usiri. Kwa miaka mitatu kumbukumbu ya taarifa hizi zitawekwa katika Chuo kikuu cha kilimo Sokoine, Chuo kikuu cha Jimbo la Michigan na vipimo vya mkojo vitakavyotumika kwaajili ya utafiti, vitawekwa kwa miaka mitatu katika maabara ya taasisi ya chakula na lishe Tanzania. na wezo wa kupata taarifa za utafiti utakuwa ni wa wajumbe wa timu ya utafiti, kitengo cha utafiti chuo kikuu cha Michigan na/au wawakilishi walioidhinishwa na taasisi.

Haki za kutoshiriki katika utafiti huu: Ushiriki wa Mtoto wako utakuwa ni wa hiyari. Kukataa kushiriki au kukatisha ushiriki mda wowote hautakuwa na adhabu yoyote. Kama una tatizo lolote au swali kuhusu utafiti huu, kama vile maswala ya kisayansi au kutoa taarifa ya hatari. Tafadhali wasiliana na watafiti wafuatao:

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Mawasiliano kwa Bodi ya Mapitio ya Kitaasisi

Kama una swali lolote kuhusiana na jukumu au haki zako kama mshiriki wa utafiti, kupata taarifa au kutoa taarifa au kutoa malalamiko kuhusiana na utafiti huu. Unaweza kuwasiliana na umtakaye.

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Kwa kusaini karatasi hii, umekubali kuwa umesoma/kuelewa maelezo ya mkataba huu wa kuridhia na kupata majibu ya maswali yote. Saini yangu hapo chini inaashiria, nimekubali kwa hiyari yangu ushiriki wa mwanafunzi wangu katika utafiti huu.

1. Jina la mwalimu …… Saini au dole gumba…… Tarehe ……

2. Namba ya utambulisho/ mtoto ……..…Saini au dole gumba……Tarehe……

FOMU YA RIDHAA YA MSICHANA WA MIAKA 18 AU ZAIDI

Uelewa, mtazamo na tabia zinazopelekea athari zitokanazo na ukosefu wa madini joto miongoni mwa vijana balehe wa kike mkoa wa Lindi.

Lengo: (1) Unaalikwa kushiriki katika utafiti huu kwa ridhaa yako na ridhaa ya shule kuruhusu kushiriki. (2) Utafiti huu unahusu maarifa na mtazamo juu ya athari zitokanazo na ukosefu wa madini joto na mazoea yanayoweza kupelekea matatizo haya kwenye jamii. Upungufu wa madini joto na lishe duni ni jambo la kawaida hasa kwa wasichana walio balehe kwani mahitaji yao huongezeka kipindi hiki. Upungufu huu unaathiri uwezo wasichana hawa kujisomea, kufanya vizuri darasani, afya na uzazi na maisha bora kuanzia nyumbani, shuleni mpaka hapo baadaye katika maisha.

Taarifa zitakazopatikana katika utafiti huu zitasaidia kuongeza maarifa kuhusu upungufu wa lishe na kuweza kutumika katika kuandaa mkakati kwa wasichana walio balehe nchini. Utafiti huu unaendeshwa na Chuo kikuu cha Jimbo la Michigan, Marekani kwa kushrikiana na Chuo kikuu cha kilimo Sokoine, Morogoro kwa udhamini wa USAID/ Innovative Agricultural Research Initiative (iAGRI).

Taratibu: Umechaguliwa kinasibu miongoni mwa wanafunzi wenzio kushiriki. Kama, utaridhia, utahitajika kuleta kijiko kimoja cha chumvi siku ya utafiti na kutakiwa kujibu maswali yahusuyo (1) umri, mahali unapoishi, idadi ya watu na kipato katika kaya unayotoka, uelewa na mtazamo wako kuhusu madini joto na kuorodhesha aina mbali mbali ya chakula ulichokula kwa masaa 24 yaliyopita (2) Pia utaombwa kuleta mkojo kiasi cha 20ml ili kupima kiwango cha madini joto mwilini. Mkojo huu utapimwa katika maabara ya tasisi ya chakula na lishe Tanzania**.**

Tatizo/Usumbufu Hakuna kabisa maumivu katika matumizi ya vifaa vitakavyotumika, wala matatizo yoyote ya kiafya na vipimo vilivyotakiwa havihusiani na kuwa na tatizo lolote.

Faida: Utanufaika kwa kujua hali yako ya lishe na kiwango cha madini joto mwilini. Watafiti wanategemea wasichana walio balehe watapata faida kupitia mkakati wa afya ya uma hapo baadaye. Utapatiwa kalamu ya wino na shajara (diary) kama ishara ya kushiriki.

Usiri: Majina hayatabandikwa kwenye vipimo vitakavyochukuliwa na majibu ni siri ya mshiriki hivyo hayatatolewa kwako au kwa yeyote bali yatahifadhiwa kwa usiri wa hali ya juu. Majibu hayataonyeshwa kwa mtu yoyote ispokuwa wajumbe katika jopo la watafiti na taarifa hizi zitahifadhiwa kwa usiri na kwa mujibu wa sheria. Takwimu zitawekewa namba za siri ili kuongeza usiri. Kwa miaka mitatu kumbukumbu ya taarifa hizi zitawekwa katika Chuo kikuu cha kilimo Sokoine, Chuo kikuu cha Jimbo la Michigan na vipimo vya mkojo vitakavyotumika kwaajili ya utafiti, vitawekwa kwa miaka mitatu katika maabara ya taasisi ya chakula na lishe Tanzania. Uwezo wa kupata taarifa za utafiti utakuwa ni wa wajumbe wa timu ya utafiti, kitengo cha utafiti chuo kikuu cha Michigan, na/au wawakilishi walioidhinishwa na taasisi.

Haki za kutoshiriki katika utafiti huu: Ushiriki wako utakuwa ni wa hiyari. Kukataa kushiriki au kukatisha ushiriki mda wowote hautakuwa na adhabu yoyote. Kama una tatizo lolote au swali kuhusu utafiti huu, kama vile maswala ya kisayansi au kutoa taarifa ya hatari. Tafadhali wasiliana na watafiti wafuatao:

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Kama una swali lolote kuhusiana na jukumu au haki zako kama mshiriki wa utafiti, kupata taarifa au kutoa taarifa au kutoa malalamiko kuhusiana na utafiti huu.

Unaweza kuwasiliana na umtakaye.

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Kwa kusaini karatasi hii, umekubali kuwa umesoma/kuelewa maelezo ya mkataba huu wa kuridhia na kupata majibu ya maswali yote. Saini yangu hapo chini inaashiria, nimekubali kwa hiyari yangu ushiriki wangu katika utafiti huu.

Namba ya utamblisho …… Saini/dole gumba…….Tarehe……

FOMU YA RIDHAA YA MKUU WA SHULE

Uelewa, mtazamo na mazoea katika juhudi za kuondoa athari zitokanazo na ukosefu wa madini joto miongoni mwa vijana balehe wa kike katika mkoa wa Lindi.

Lengo: Shule yako imechaguliwa kushiriki katika utafiti unaohusu uelewa, maarifa na mtazamo juu ya athari zitokanazo na ukosefu wa madini joto na tabia zinazoweza kupelekea athari hizo haya kwa wasichana waliobalehe. Upungufu wa madini joto na lishe duni ni jambo la kawaida hasa kwa wasichana walio balehe kwani mahitaji yao huongezeka kipindi hiki. Upungufu huu unaathiri uwezo wasichana hawa kujisomea, kufanya vizuri darasani, afya na uzazi na maisha bora kuanzia nyumbani, shuleni mpaka hapo baadaye katika maisha.

Taarifa zitakazopatikana katika utafiti huu zitasaidia kuongeza maarifa kuhusu upungufu wa lishe na kuweza kutumika katika kuandaa mkakati kwa wasichana walio balehe nchini. Utafiti huu unaendeshwa na Chuo kikuu cha Jimbo la Michigan, Marekani kwa kushrikiana na Chuo kikuu cha kilimo Sokoine Morogoro kwa udhamini wa USAID/ Innovative Agricultural Research Initiative (iAGRI)

Taratibu: Kama ukiridhia, wanafunzi walioko shuleni kwako watachaguliwa kinasibu (randomly) kushiriki kwenye utafiti huu na kutakiwa kuletakuleta kijiko kimoja cha chumvi kwajili ya kupima kiwango cha madini joto siku ya utafiti. Pia watatakiwa kujibu maswali yahusuyo (1) umri, makazi, idadi ya watu na kipato katika kaya wanayotoka, uelewa na mtazamo yao kuhusu madini joto na kuorodhesha aina mbali mbali ya vyakula walivyokula masaa 24 yaliyopita. (2) Pia wataombwa kuleta mkojo kiasi cha 20ml ili kupima kiwango cha madini joto mwilini. Mkojo huu utapimwa katika maabara ya tasisi ya Chakula na lishe Tanzania.

Tatizo/Usumbufu**:** Hakuna kabisa maumivu katika matumizi ya vifaa vitakavyotumika, wala matatizo yoyote ya kiafya na vipimo vinavyotakiwa havihusiani na kuwa na tatizo lolote.

Faida: Utapatiwa taarifa za makadirio ya hali ya lishe ya wanafunzi wako na kiwango cha madini joto. Watafiti wanategemea wasichana walio balehe watapata faida kupitia mkakati wa afya ya uma hapo baadaye. Washiriki watapatiwa kalamu ya wino na shajara (diary) kama ishara ya kushiriki kwao.

Usiri: Majina hayatabandikwa kwenye vipimo vitakavyochukuliwa na majibu ni siri ya mshiriki hivyo yatahifadhiwa kwa usiri wa hali ya juu. Majibu hayataonyeshwa kwa mtu yoyote ispokuwa wajumbe katika jopo la watafiti na taarifa hizi zitahifadhiwa kwa usiri na kwa mujibu wa sheria. Takwimu zitawekewa namba za siri ili kuongeza usiri. Kwa miaka mitatu kumbukumbu ya taarifa hizi zitawekwa katika Chuo kikuu cha kilimo Sokoine, Chuo kikuu cha Jimbo la Michigan na vipimo vya mkojo vitakavyotumika kwaajili ya utafiti, vitawekwa kwa miaka mitatu katika maabara ya taasisi ya chakula na lishe Tanzania. Uwezo wa kupata taarifa za utafiti utakuwa ni wa wajumbe wa timu ya utafiti, kitengo cha utafiti chuo kikuu cha Michigan, na/au wawakilishi walioidhinishwa na taasisi.

Haki za kutoshiriki katika utafiti huu: Ushiriki wako utakuwa ni wa hiyari. Kukataa kushiriki au kukatisha ushiriki mda wowote hautakuwa na adhabu yoyote. Kama una tatizo lolote au swali kuhusu utafiti huu, kama vile maswala ya kisayansi au kutoa taarifa ya hatari. Tafadhali wasiliana na watafiti wafuatao:

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Kwa kusaini karatasi hii, umekubali kuwa umesoma/kuelewa maelezo ya mkataba huu wa kuridhia na kupata majibu ya maswali yote. Saini yangu hapo chini inaashiria, nimekubali kwa hiyari yangu ushiriki wangu katika utafiti huu Jina …… Saini /dole gumba……. Tarehe……

Utafiti utaanza mwezi Oktoba 2016. Tafadhali onyesha tarehe ambayo utakua tayari utafiti kufanyika shuleni kwako …….

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