NUTRITIONAL STATUS AND RISK FACTORS ASSOCIATED WITH WOMEN PRACTICING GEOPHAGIA IN QWAQWA, SOUTH AFRICA

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Nutritional status and risk factors associated with women practising geophagia in QwaQwa, South Africa

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DECLARATION

"I hereby declare that this thesis for the qualification PhD in Dietetics at the University of the Free State is my own work and was not handed in for another qualification at another institution. I furthermore waive copyright of the thesis in favour of the University of the Free State"

Annette van Onselen

20 May 2014

Date

Dedicated to

my husband Charl, my daughter Charné, my mother Stella, my sister Corrette, my father in law Sam, my mother in law Rita and my father Kalie, for their encouragement and support.

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LIST OF ABBREVIATIONS

BBC	British Broadcasting Corporation
BC	Before Christ
BMI	Body Mass Index
CI	Confidence Interval
cm	Centimeters
CRD	C-reactive Protein
CUT	Central University of Technology
DRI	Dietary Reference Intake
DALYs	Disability Adjusted Life Year
DHS	Demographic and Health Survey
EAR	Estimated Average Requirements
EDTA	Ethylenediaminetetra-acetic Acid
EER	Estimated Energy Requirement
ESR	Estimated Sedimentation Rate
FAO	Food and Agriculture Organisation
FBC	Full Blood Counts
FBDG	Food Based Dietary Guidelines
FFQ	Food Frequency Questionnaire
g	Grams
GBD	Global Burden of Disease
GLP	Good Laboratory Practice
ICSH	International Council for Standardization in Haematology
ITHBC	Integrated Theory of Health Behaviour Change
kg/m^2	Kilograms per Meter Squared
kJ	Kilojoules
m	Meter
MCV	Mean Corpuscular Volume
mg	Milligram
mg/L	Milligram per Liter
ml	Milliliters
mmol/L	Millimole per Liter
mm	Millimeter
µg/L	Microgram per Liter
µmol/L	Micromoles per Liter
MRC	Medical Research Council
N	Number of Subjects
ND	Not Determined
NHLS	National Health Laboratory Services
PAL	Physical Activity Level
PDPAR	Previous Day Physical Activity Recall
pH	Power of Hydrogen (Reference: Carlsberg Laboratory)
pmol/L	Picomole per Liter
RDW	Red Blood Cell Distribution Width
RLS	Restless Leg Syndrome
SADHS	South African Demographic and Health Survey
SANAS	South African National Accreditation System

SAFBDG	South African Food Based Dietary Guidelines
SANHANES-1	South African National Health and Nutrition Examination Survey
STATS SA	Statistics South Africa
THUSA	Transition, Health and Urbanisation in South Africa
UCSF	University of California, San Francisco
UFS	University of the Free State
USA	United States of America
WHO	World Health Organization
WHR	Waist to Hip Ratio
Zn	Zinc

CHAPTER 1

INTRODUCTION

1.1 PROBLEM STATEMENT

1.1.1 Geophagia

Geophagia is the practice of eating earthy soil-like substances such as clay (Erick, 2012: 363) which can be red, white or gray (Ekosse & Junbam, 2010), and chalk or coals (Walker *et al*., 1985). In humans who practice geophagia, the daily intake is around 40-50 g/day (Geissler *et al*., 1999; Sheppard, 1998). Geophagia is closely related to pica, a classified eating disorder characterized by abnormal cravings for nonfood items (Young *et al*., 2008; Erick, 2012: 363). As early as 1821, soil eating was associated with an attempt to correct chlorosis, or "green sickness" which is a form of anemia that affects adolescent girls (Woywodt & Kiss, 2002). Geophagia among children and pregnant women was first described medically in a book in 1563 (Rose *et al*., 2000). Since that time a limited amount of literature on the topic has been published and few recent studies are available, most of which are associated with poor socioeconomic background, which is common in developing countries (Simon, 1998). The practice is more common in women than in men (Rose *et al*., 2000).

Geophagia has been related to nutritional, psychological, cultural, medical (Danford, 1982), social, taste (Geissler *et al.*, 1999), spiritual, religious, ritual (Sudilovsky, 2007; Hunter & de Kleine, 1984) and physiological needs (Katz, 2008; Vermeer, 1966). Culture and beliefs also play a role in the practice of geophagia (Hooda & Henry, 2009; Abrahams & Parsons, 1996). It has been reported that women eat soil to draw attention during and after pregnancy (Izugbara, 2003). In addition, clays are eaten by pregnant and lactating women as a calcium source. These clays are believed by some to be invaluable, especially where individuals are lactose intolerant (Hunter,

1973) or have an iron deficiency (Woywodt & Kiss, 2002; Louw *et al*., 2007). In Turkey geophagia was a common finding among Turkish children and women in villages associated with severe iron deficiency anemia in addition to zinc depletion (Cavdar *et al*., 1983). Young (2010) found that pica is a consequence of micronutrient deficiency, but not necessarily an attempt to remedy it.

Clays have been used to reduce abdominal pain caused by hookworms, to reduce or ease hunger pangs, to soothe heartburn and nausea and to satisfy cravings since soils are supposed to taste good (Hunter & de Kleine, 1984). There is also evidence that supports the usefulness of the flora found in soil. Some researchers have even suggested that it is useful in the establishment of healthy bacteria within the digestive tract, claiming that it can improve the symptoms experienced during Crohn's Disease and Leaky Gut Syndrome (Dominy *et al*., 2004). A study done in the late 1970s by Vermeer & Frate (1979) showed that geophagia contributed to hypertension but did not correlate with hunger, anaemia or helminthic problems in rural areas in Mississippi. In some parts of the world, for example in Haiti and China, rising food prices have driven many of the nation's poor to consume clay cookies on a regular basis to ward off hunger (Wilson, 2003).

Despite the claimed benefits, geophagia may also be harmful to humans in terms of microbiological and environmental health aspects. Geophagia has been criticised as unhygienic, exposing consumers to toxic constituents such as heavy metals and parasites (Reilly & Henry, 2000), and has been reported to contribute to the helminth load when soils with infective stages of parasites are consumed (Harvey *et al*., 2000; Geissler *et al.*, 1999). Saathoff *et al*. (2002) showed that geohelminth infections were a major health problem of children from rural areas in developing countries and that, in addition to high prevalence rates, there were high re-infection rates.

Significant differences in hookworm intensity have been observed between geophagous and non-geophagous women (Luoba *et al.,* 2005). Women who ate termite mound earth were more often and more intensely infected with hookworms at delivery than those eating other kinds of earth. (Luoba *et al*., 2004). In South Africa, Saathoff *et al*. (2002) demonstrated that *Ascaris lumbricoides* was more prevalent in children who regularly ate soil from termite mounds (28%) compared to non-geophagous children (19%) and it was less common in groups that preferred tree termite soil (13%) compared to soil from other sources (8%). Young *et al.* (2007) found that geophagia is not a source of Trichuris or hookworm infection among pregnant women in Pemba (insufficient power to evaluate the effect of Ascaris), which is in contrast to other reported findings of helminth infection and geophagia. Geophagia could also cause constipation (Dickins & Ford, 1942) as well as bowel impaction, dental injury and inadequate nutrient intake (Gonyea, 2007).

In contrast to the reported negative consequences of soil consumption, soil plays a pivotal role in both human and animal nutrition in many cultures as a means of supplying essential mineral nutrients through the soil-plant-human and soil-plant-animal food chains. Soil may contain large quantities of both macro- and micro mineral nutrients that could possibly be important in human nutrition in some populations. In this regard, Abrahams & Parsons (1997) have suggested that geophagia could be a source of supplementing nutrients.

Contrary to this, a study by Hooda *et al*., (2004) showed that instead of releasing mineral nutrients for supplementation, the soils generally removed nutrients that were already bio-available in the solution. A study by López *et al*., (2007b) also indicated that the daily intake of iron and zinc in pregnant women with pica was lower than in pregnant women without pica.

Wilson (2003) and Young *et al*. (2008) have suggested that research into geophagia requires a strong interdisciplinary approach. Despite the possible advantages and disadvantages of geophagia and taking into account that this practice occurs commonly, limited research has been undertaken in this regard. Although a couple of studies have focused on geophagia related to enzootic aspects, there are no documented studies addressing the mineralogy, geochemistry, chemistry, microbiology, ecology and environmental health of geophagic soils in South Africa.

1.1.2 Iron deficiency

Approximately one third of the world population (2 billion) suffer from iron deficiency (Nojilana *et al*., 2007). Iron deficiency can be caused by a number of pathways, of which one is insufficient dietary intakes of iron, protein, folate and vitamin C (World Health Organization (WHO), 2004). Approximately two-thirds of total body iron is found in haemoglobin of red blood cells and the remaining body iron is stored as ferritin. Haemoglobin and ferritin levels are documented to be the most significant diagnostic indicators of iron deficiency anaemia (Ioannou *et al*., 2002). Anaemia is the final indicator of chronic long term iron deficiency and many symptoms are reflected in several physiological abnormalities. Examples hereof include poor muscle function which leads to a decreased in productivity and muscle function and abnormal cognitive development even before anaemia is present in children (Stopler & Weiner, 2012: 727). Restless leg syndrome (RLS) is also associated with iron deficiency (Spencer *et al*., 2013). Progressive untreated anaemia leads to cardiovascular and respiratory changes which can cause cardiac failure, which demonstrated the importance of treating iron deficiency in individuals who are at risk of cardiovascular disease (Pereira & Sarnak, 2003).

Globally, 10% of maternal deaths are caused by iron deficiency anaemia (Nojilana *et al*., 2007). In South Africa 4.9% of maternal deaths were attributed to iron deficiency anaemia in 2000 (Nojilana *et al*., 2007). In 2012, 9.7% of South African women between the ages of 16 -35 years had iron deficiency and 12.2% of men and 22% of women were anaemic (South African National Health and Nutrition Examination Survey, (SANHANES-1), 2013).

Iron deficiency anaemia has been shown to be the cause of significant health and economic loss (Saeed *et al*., 2013). Iron deficiency anaemia causes 1.3% of global total Disability Adjusted Life Year (DALYs), with South-East Asia contributing 40% and the Africa region about 25% towards the burden of the disease (WHO, 2006). Stephenson *et al*. (2000) have reported that the total cost per annum of productivity loss in South Asia due to iron deficiency was $5 billion dollars. In the year 2000 an estimated 1.3% of all DALY’s in South Africa were due to iron deficiency anaemia (Nojilana *et al*., 2007).

1.2 AIM OF THE STUDY

The main aim of this study was to determine the nutritional status and risk factors associated with women practising geophagia in QwaQwa, South Africa and to subsequently develop a nutrition education intervention in order to address the nutritional and health implications of the practice of geophagia.

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1.2.1 OBJECTIVES

Objectives of this study were to determine:

- The nutritional status of a group of participants that practiced geophagia and a control group that did not practice geophagia:
  - ➢ Nutrient intake.
  - ➢ Anthropometric status.
  - ➢ Physical activity.
  - ➢ Blood parameters.
- Associations between the practice of geophagia and nutrient intake, anthropometric status and blood parameters.
- The factors (odds ratios) that have an influence on parameters of nutritional status of women practicing geophagia and not practicing geophagia (including nutrient intake, anthropometric status, physical activity and blood parameters).
- To develop a nutrition education intervention to address the nutritional and health implications of the practice of geophagia.
- To determine the impact of the intervention on the practice of geophagia.

1.3 STRUCTURE OF THE THESIS

The first chapter of the thesis includes the problem statement and motivation for the study and outlines the main aim and objectives of the study. In Chapter 2 a literature review related to the practice of geophagia is given. The methodology applied in the study is discussed in Chapter 3, while the intervention is described in Chapter 4. The results are reported in Chapter 5. The results are discussed in Chapter 6, followed by conclusions and recommendations in Chapter 7. The summary of the study is bound at the back of the thesis.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

According to Young *et al*. (2010a), pica is defined as "the craving and purposive consumption of substances that the consumer does not define as food." As early as 1930 the occurrence of pica was documented by Laufer (1930) when he reported on geophagia in his Anthropological Series. Pica has been described in almost every culture (Halsted, 1968; Reid, 1992). Geophagia is the most common type of pica described in the literature and refers to the "deliberate eating of soil" (Young *et al.*, 2010a; Njiru *et al*., 2011). This practice is said to be related to poverty and famine but can also be observed in the absence of hunger. Although the practice is more common under pregnant women, lactating women, schoolchildren and people with psychiatric disorders (Bisi-Johnson *et al*., 2010) there are groups in which the practice is common in the whole community.

According to González-Turmo (2009: 43) "food is what people eat and non-food is that which people do not or should not eat." The understanding of what constitutes food can differ from one culture to another and thus this statement is a subjective one. The concept of food and non-food items is cross-cultural and biased (González *et al*., 2004) and is explained by González –Turmo (2009: 43) as "each person asserts his/her taste in food with an unquestionable right to do this, and the assertion inevitably contains a categorization of what is and what is not food"

Food practices and habits are distinguished by the terms "not edible" or "inedible" and "edible". As mentioned, these terms are also interpreted differently in different cultures (MacClancy *et al*., 2009: 3). The human being chooses foods based on sensory, psychological and nutritional properties (Messer, 2009: 54).

Chagga women in Tanzania use the term *Tamaa* to describe feelings of why they consume clay. The smell of the soil arouses *Tamaa* (which means the desire for rare things). *Starehe* is linked to personal taste, satisfaction, ego and fantasy. These terms have been used to describe the practice of consuming non-foods such as soil eaten by women on the slopes of Mount Kilimanjaro (Knudsen, 2004). Allport (2002) has suggested that a craving for salt can also be considered a form of geophagia.

In the Southwest of America, Indians mix geophageous clays with acorn-based dough, and then bake it as a food item (Sing & Sing, 2010). In Sardinia and northern California traditional breads are made of acorn flour, water and clay (Hunter, 2004, p. 72).

Food is consumed because of human nature and cultural requirements and influences. According to MacClancy and Macbeth (2004: 5-6), food is divided into the two sub-categories of "substance" and "symbol" and therefore contributes to the body's physical and social well-being.

Medical Geology is the study of the impact of geologic materials and processes on human health. This is a new emerging field which interacts with different disciplines such as geoscience, biomedical science and nutrition (Bunell *et al.*, 2007). Geophagia is an area of concern in medical geology.

In the following section a discussion of pica in general, followed by a more detailed overview of the practice of geophagia, will be given.

2.2 PICA

The word "pica" originates from the magpie bird named Pica Pica (Latin) by Linnaeus due to their vigorous appetite. Pica is characterized by the deliberate consumption of non-food items for more than one month (Young, 2009: 17; American Psychiatric Association, 2000). Consumption of non-food items during pregnancy often involves geophagia or amylophagia (Erick, 2012: 363).

2.2.1 Classification of pica

According to Uher & Rutter (2012), pica is classified as a form of eating disorder which may include the deliberate intake of large quantities of plastics (plasticophagia), faeces (coprophagia), lead (plumbophagia), starch or dough (amylophagia) and clay or soil (geophagia). Other forms of pica include amylophagy (eating of raw starches) and pagophagy (eating large quantities of ice) (Danford, 1982).

Pagophagia is seen as an unusual manifestation of pica which appeared predominantly in the USA (Sayetta, 1986). The practice of pagophagia was first described by a French royal doctor, in women and young girls suffering from chlorosis (Parry-Jones, 1992). Although very limited data about this practice is available, craving for ice has been associated with iron deficiency in a case series (n=3) of Caucasian women and men as well as a Hispanic woman (Khan & Tisman, 2010).

Plasticophagia is the frequent nibbling and sucking of plastics (Tayie, 2004), while plumbophagia is the consumption of lead (Mensah *et al*., 2010) often eaten in the form of lead paint chips (Lacey, 1990). Coprophagia is reportedly practiced for cultural reasons. Miller (1998) reports that the Zunis (an Indian population in South America), eat human faeces as part of their rituals. Cultures in West Africa also believe that this behavior is an act of trust and dependence (Cantarero, 2009). Amylophagy is one of the more frequently types of pica practiced (Young *et al*., 2010b) and refers to the consumption of uncooked rice (Young *et al.*, 2010a), laundry starch (Rainville, 1998) and corn starch (Corbett *et al*., 2003).

During pregnancy, pica can include different kinds of materials that are craved. These can include starch (Young, 2010; Tayie & Lartey, 1999; Taylor, 1979; Snowdon, 1977; Keith *et al*., 1968; O'Rourke *et al*., 1967; Sage, 1962; Gladfelter *et al*., 1960; Posner *et al*., 1957), ice (Corbett *et al*., 2003; Simpson *et al*., 2000; Rainville, 1998; Coles *et al*., 1995; Schwab & Axelson, 1984), ash (Nyaruhucha, 2009;) chalk (Walker *et al*., 1985) and paper (Mikkelsen *et al*., 2006; Al-kanhal & Bani, 1995; Edwards *et al*., 1954).

2.2.2 Aetiology of pica

The aetiology of pica is unclear, but factors involved in the development of pica may include hunger, micronutrient deficiencies, gastrointestinal distress, and protection from pathogens and toxins (Young *et al*., 2008; Gonyea, 2007). Psychosocial and biochemical related causes are also suggested to contribute to pica behaviour (Ellis & Pataki, 2012). Psychological, cultural, medical, social, spiritual, religious, and ritual needs have also been related to the practice of geophagia (Geissler *et al*., 1999; Hunter & De Kleine, 1984; Danford, 1982). According to Young *et al*. (2010c), the three main causes of pica include hunger, micronutrient deficiency and protection from toxins and pathogens.

2.2.2.1 Hunger

Pica is often practiced where poverty and famine are prevalent to decrease appetite and fill the empty stomach (Hawass *et al*., 1987). Young explains this hypothesis "that hunger motivates pica" in her book, "Craving Earth" (Young, 2011: 92) and suggests that there are four possible explanations for this practice:

* People who practice pica do not have enough food available;
* People who practice pica do so to fill their stomachs in an attempt to stave off feelings of hunger;
* Non-food substances would not be craved if other food was available;
* People practicing pica would then not choose specific non-food substances, but would eat any available non-food substances.

Literature as far back as the eighteen centuries has shown that a small percentage of people practice pica due to hunger (Von Humboldt *et al*., 1814). The Indians in Otamac only eat clay for two months of the year when food is not available, but not for the rest of the year when food is more plentiful. This finding contradicts the findings of Young *et al*. (2010a), who state that pregnant and non-pregnant women do not eat soil because of hunger. Early reports of pica do not indicate the amount of non-food substances consumed (Maupetit, 1911; Morel-Fatio & Tobler, 1896), but only used terms such as "small quantities" and "size of a nut." Young (2011: 95) state that "if hunger motivated pica, people would not expect the substances to be strongly desired, but rather eaten as a desperate remedy for hunger." Some authors have also indicated that pica is associated with terms such as "a devouring passion" (Galt, 1872) and "I went wild over it" (Spencer, 2002). In Pemba, Zanzibar, people choose their pica substances very carefully (Young *et al.*, 2010b) and are thus particular about the type of non-food substance that they choose to eat.

2.2.2.2 Micronutrient deficiency

Malnutrition has also been suggested as a reason for practicing pica (Sugita, 2001). Pregnant women and children are at the greatest risk for developing micronutrient deficiencies such as iron, zinc and calcium. According to Young (2011: 58; 2010) pagophagy may occur during iron deficiency and pica is also related to zinc and calcium deficiencies. The authors estimate that "there are twenty case reports of anaemia associated with pica for every one report of any other negative health outcome." A cross-sectional study undertaken in Kenya found that 56% of pregnant women that practiced pica had low iron status (Geissler *et al*., 1998).

Individuals who had zinc and iron deficiencies have been reported to abstain from the practice of pica after receiving iron and zinc supplements (Moore & Sears, 1994; Nicoletti, 2003). In contrast, Young (2011: 108) reports that there is no evidence that micronutrient supplementation affects pica behaviour.

(i) Association between pica and iron deficiency

As mentioned, a number of studies have shown an association between the practice of pica and iron deficiency (Kettaneh *et al*., 2005; Khan & Tisman, 2010). Bushara *et al*. (2010) identified pica as a risk factor for anaemia in pregnant women in a cross-sectional study in Central Sudan. In addition, Poy *et al*. (2012) reported that 39% of pregnant women (n=42) consuming non-food items, showed lower blood levels for iron than pregnant women not practicing pica (n=69) attending the Florito Hospital in Argentina. In contrast, Barton *et al*. (2010) did not find any difference in iron deficiency or iron deficiency anaemia between women with pica and without pica in their study undertaken among 262 non-pregnant adult outpatients. Ellis & Schnoes (2006) found that pica is linked with significantly lower maternal haemoglobin levels at birth.

(ii) Association between pica and zinc deficiency

A few studies have shown an association between pica and zinc deficiency. A cross-sectional study in Chandigarh, Northern India showed that children between 18 and 48 months with pica had lower mean plasma levels of Zn (Singhi *et al*., 2003).

(iii) Association between pica and calcium deficiency

In a study amongst urban African American pregnant women, those who engaged in pica had a lower calcium intake than those who did not (75% vs. 60.3% respectively) (Edwards *et al*., 1994). However, the calcium intake was measured indirectly. Wiley & Katz (1998) have indicated that the consumption of dairy products is inversely related to geophagia during pregnancy.

(iv) Pica in populations with high micronutrient requirements

On the one hand, it is speculated that pica is an adaptive reaction to micronutrient deficiency, while on the other hand the practice of pica may cause micronutrient deficiencies. According to Young (2011: 113) the practice of pica does not contribute to micronutrient deficiencies. Johns and Duquette (1991a) speculate that pica is the cause of micronutrient deficiency, because the micronutrients bind with the ingested substance and thus make them less likely to be absorbed.

2.2.2.3 Protection from toxins and pathogens

The detoxification and protection hypothesis that is described by Young *et al*. (2010a), attributes protection from pathogens or plant chemicals by either binding with them directly or by binding with the mucin layer (thereby preventing their passage into the bloodstream) to the practice of pica.

The Pomo Indians in California and native Sardinians in Italy make bread of acorn flour (Johns and Duquette, 1991a; 1991b). Acorn is dangerous because of the high tannin content. These communities use clay to neutralize the tannin level which apparently makes consumption safer and tastier. Indians of the American Southwest and Mexico used clay with wild potatoes, while some communities in Peru and Bolivia still neutralize solanine in wild potatoes with soil to prevent absorption thereof

(Johns, 1986; Johns 1996). In contrast, Young (2011: 129) explain that the abovementioned form of using soil is not a craving, but is part of a recipe.

2.2.3 Prevalence of pica

The practice of pica is more common amongst persons with mental disorders, during pregnancy, and amongst certain cultural groups (Sugita, 2001; Ellis & Pataki, 2012). Pica has been shown to occur between 5.7% and 25.8% of persons with mental disabilities (Ashworth *et al*., 2009; Danford *et al*., 1982) and is more likely to be prevalent in persons diagnosed with autism (Kinell, 1985).

Cravings for non-food items are not exclusive to one geographic area, race, sex, culture or social status; and are also not limited to pregnancy (Erick, 2012: 363). Other risk factors for pica include epilepsy, mental retardation and brain damage (Ellis & Pataki, 2012). The actual prevalence of pica is not known, because it is often a practice that occurs in secret and is not reported (Ellis & Pataki, 2012).

2.2.3.1 Worldwide

In rural areas of Southern America some women crave non-food items such as clay and laundry starch while British women are more likely to crave coal during pregnancy (Trupin, 2012). Golden *et al*. (2012) have reported that the practices of geophagia and amylophagy were very common amongst men and women from the Malagasy population. Women attending antenatal clinics on Pemba Island, Tanzania (n=2361) showed a 40.1% prevalence of any pica substances (Young, 2010). This was also found in Southern California and Ensenada, Mexico (n=225); Texas, USA (n=281); Denmark (n=70,000); Argentina (n=327) and Norway (n=84) (López *et al.*, 2007a; Mikkelsen *et al*., 2006; Corbett *et al*., 2003; López *et al*., 2001; Simpson *et al*., 2000; Rainville, 1998; Mansfield, 1977; Khanum & Umapathy, 1976). In 1958 the British Broadcast Coorporation (BBC) reported the intake of non-food items in 187 listeners that sent letters related to the topic (Harries & Hughes, 1958). A study done in Saudi Arabia showed that 8.8% of pregnant women attending health centres (n=321) practice pica (Al-kanhal & Bani, 1995) and 13.6% of pregnant women (n=416) in Sudan craved non-food items (Osman, 1985). A high percentage of pregnant women in Iran (60.9%) were reported to practice pagophagia (Mortazavi & Mohamadi, 2010).

2.2.3.2 Africa

In a study undertaken in Tanzania by Nyaruhucha (2009), 63.7% of pregnant women experienced pica, eating soil, ice and ash. A study by Koryo-Dabrah *et a*l. (2012) reported that more than fifty percent of pregnant women in Ghana practiced pica in the first trimester of pregnancy, 42.3% in the second trimester and 42.1% in the last trimester.

2.2.3.3 South Africa

In a small descriptive study undertaken in Bloemfontein, South Africa, by Louw *et al*. (2007), the authors reported a higher prevalence of pica in black people compared to other races in their study amongst non-pregnant women younger than 18 years with low ferritin levels (less than 40 mg/L). In another study undertaken by Walker *et al*., (1985), twenty four percent of women (n=1771) from 5 different racial groups with infants younger than one year, reported practicing pica.

2.2.4 Conditions associated with pica

Conditions and factors associated with pica include iron deficiency anaemia, psychiatric conditions, epilepsy, pregnancy and social- and cultural orientation.

2.2.4.1 Iron deficiency anemia

Iron deficiency affects one-third of the world's population and is often associated with pica (Yadav & Chandra, 2011). A number of cross-sectional studies have reported that iron deficiency and/or anaemia are associated with pica (Young, 2011: 161). In 109 pregnant women attending the Fiorito Hospital, Argentina, 38% were practicing pica and showed lower iron and zinc levels compared to the other pregnant women without pica (Poy *et al.*, 2012). Similarly, women in Argentina with pica (n=327) had a higher incidence of iron deficiency-anaemia than their control group (López *et al*., 2007b; López *et al*., 2001).

A study by Dickinson *et al*. (2009) also showed that iron deficiency in pregnant women was higher in the Chikwaya district than the Chiradzulu district in Malawi, possibly due to differences in the soil samples that are eaten (Dickinson *et al*., 2009). Similarly, an association between pica and low haemoglobin levels was found in women in Tanzania (n=2361) (Young *et al*., 2010a). Anaemia was also present in 37% of women consuming clay in a cross-sectional study conducted in an east Anatolian Province in Turkey (Karaoglu *et al*., 2010).

In contrast, other studies could find no relationship between pica and haemoglobin levels. Randomly selected postnatal inpatients from urban and rural areas of Georgia, USA showed no difference in haemoglobin levels between pica and non-pica groups (O'Rourke *et al*., 1967). Similarly, women in North Carolina attending antenatal clinics (n=128) did not show a difference in haemoglobin levels due to the practice of pica (Corbett *et al*., 2003).

There is controversy about the practice of geophagia and its relationship with iron deficiency. On the one hand some researchers report that geophagia results in iron deficiency, while others feel that iron deficiency triggers geophagia (Hooda & Henry, 2009: 90). Pregnant women in Malawi who suffer from iron deficiency believe that the soil will provide a valuable source of iron (Lakudzala & Khonje, 2011). Some studies have also illustrated that iron supplementation helps geophagists to improve their iron status and to stop the practice of geophagia (Arbiter & Black, 1991). In contrast, Nchito *et al*. (2004) found that where geophagia was practiced among Zambian schoolchildren in Lusaka, iron supplementation did not impact on the practice of geophagia.

2.2.4.2 Psychiatric conditions

In adults, pica is often associated with mental retardation and psychosis (Bhatia & Gupta, 2009). The American Dietetic Association considers pica, and specifically geophagia, as a psychobehavioural disorder (Hunter, 2004: 70). Literature has demonstrated that people with intellectual disability and other developmental disabilities are more prone to developing behavioural problems (McIntyre *et al*., 2006). A population-based survey conducted in the rural area of Bangladesh showed that behavioural impairments, which included nocturnal enuresis and pica, occurred more commonly amongst children between the ages of two and nine (n=4003). These behavioural impairments were significantly linked to cognitive and motor disabilities (Khan *et al*., 2009).

2.2.4.3 Pregnancy

Pica occurs more commonly amongst pregnant women from low socio-economic communities (Rose *et al*., 2000). In a study undertaken amongst pregnant women in Tanzania, appetite changes that included cravings, aversions and pica were reported (Patil, 2012). Women practicing pica during pregnancy range from 0–68%, depending on the patient population (Smulian *et al*., 1995). Ahmed *et al*. (2012) found a significant correlation between age and family history with the practice of pica under pregnant women in Khartoum, Sudan, with younger women being more likely to practice geophagia than older women.

In countries such as Malawi (Hunter, 1993) and Nigeria (Vermeer, 1966), pica and pregnancy are synonymous with each other. Pregnant women visiting antenatal clinics in North America (Corbett *et al*., 2003; Edwards *et al*., 1994), South America (Simpson *et al*., 2000), Africa (Young *et al*., 2010c; Karimi *et al*., 2002; Tayie & Lartey, 1999) and Europe reported practicing pica.

2.2.4.4 Social and cultural orientation

In a study about pregnant women in Argentine, López *et al*. (2012) reported that nearly half of the women of a sample of 1,014 reported a family history of pica. In another study by Ashworth *et al*. (2009), undertaken in three special institutions in Ontario for people with intellectual disabilities, the authors reported that pica was strongly associated with disrupted parent-child relationships, lack of social contact and low involvement in recreational activities.

According to Geissler *et al*. (1999), some cultures learn pica from their cultural beliefs. Certain occupations such as potters and gardeners have always been reported to be more prone to pica (Hochstein, 1968). In contrast, Cooksey (1995) has reported that African American women who engage in pica feel alone and do not engage in pica due to cultural reasons.

2.3 GEOPHAGIA

As previously mentioned, geophagia is the practice of consuming clay, dirt and other parts of the earth's crust, and is practiced worldwide (Ghorbani, 2008). Geophagia is the most common type of pica practiced in Southern Africa and South Africa (Brand *et al*., 2009) and has been categorized as a medical condition by the World Health Organization (WHO, 1996).

2.3.1 History of geophagia

The earliest documentation related to geophagia was written by Hippocrates (460 – 380 BC) who said that **"**if pregnant women eat earth or charcoal, the child that enters the world will be marked on its head with these substances" (Hippocrates 1839: 487). In his journey reports, Von Humboldt documented that mothers from the Otomac tribe in Peru feed their children large amounts of clay to keep them quiet (Halsted, 1968). A midwife called Trotula of Salerno also reported the practice of eating clay, chalk or coal, and suggested that beans cooked with sugar should be eaten with it (Salerno 2001, p. 96). Reference to geophagia also dates back to the 18th century when people from the Sultan of Turkey were reported to consume a certain type of clay from the island of Lemos. This clay was reportedly considered to be a "healthy food" by Europeans (Starks & Slabach, 2012). Travellers and missionaries in Africa also reported the practice of geophagia during the 18th to the 20th century in countries like Nigeria, Ghana and Sierra-Leone (Hunter, 1993). Hawass *et al*. (1987) documented that miners in Austria made "stone butter" from clay and mountain tallow, which was used instead of butter on bread.

2.3.2 Aetiology of geophagia

The practice of geophagia varies in different cultures according to the local soil types and cultural motivation for the behaviour (Sing & Sing, 2010; Brand *et al*., 2009). The dominant reasons for practicing geophagia are related to medical reasons (Reid, 1992), cultural and religious purposes (Vermeer & Ferrell, 1985) and because of mental illness (Hunter, 1973).

From a survey of historical references, Parry-Jones & Parry-Jones (1992) found that black slave populations in the southern United States were also more likely than other Americans to practice geophagia.

2.3.2.1 Physiological factors

Geophagia is reported to be a reaction to a physiological need and is associated by some with growth periods such as pregnancy and childhood (Cavdar *et al*., 1983). According to Zedlitz (2010), the craving for clay usually occurs when the demand for nutrients is higher, such as during pregnancy and childhood. As far back as 1959, Lanzkowsky suggested that iron deficiency causes geophagia, but the evidence is not conclusive. Young *et al*. (2010a) found that iron deficiency-anaemia occurred significantly more often in pregnant amylophagists in Tanzania. Geophagia is also a risk factor for diarrhea in Kenyan children (Shivoga & Moturi, 2009) and anaemic pregnant women in the community of eastern Sudan (Adam *et al*., 2005). In Uganda soils are ingested for medical purposes to absorb harmful substances such as tannin and to reduce the bitterness of certain foods (Abrahams, 1997).

2.3.2.2 Psychological factors

As previously mentioned in the section on pica, the compulsive ingestion of soil is linked to numerous psychological abnormalities (Callahan, 2003). Young urban geophagic women that practice geophagia in South Africa believe that clay improves ones natural beauty (Songca *et al*., 2010) and pregnant women in Nairobi, Kenya, choose soft stone because they believe it is safer and makes the baby and mother stronger during labour (Ngozi, 2008).

2.3.2.3 Environmental factors

Geophagia is often practiced in populations where poverty is severe and famine is present (Ghorbani, 2008) as well in traditional societies where cultural change or transitions in lifestyle are common (such as in sub-Saharan Africa). Although geophagia is sometimes practiced as a treatment for diarrhoea, geophagia is also a risk factor for developing diarrhoea as a result of poor sanitation (Shivoga & Moturi, 2009). This finding was confirmed in a study undertaken in Kenya amongst children under five years of age who were exposed to environmental health risks in the home environment such as animal waste in the yard (Shivoga & Moturi, 2009).

2.3.3 Prevalence of geophagia

2.3.3.1 Worldwide

An in-depth study undertaken in villages around Shiraz city in the Fars province of Iran, showed that children and pregnant women were more likely to practice geophagia than other members of the community (Karimi *et al*., 2002). The Aboriginal people in Australia also eat white clay for medicinal reasons (Bateson & Lebroy, 1978). In Mexico, eating deep red dirt of Chimayo, "an old adobe-brick and stucco structure", is practiced daily since it is believed that the clay is sacred (Callahan, 2003). In the United States of America, a significant percentage of pregnant women (31.1% of 225) in Southern California, and Ensenada in Mexico, practiced geophagia (Simpson *et al*., 2000), while 23% - 44% of the Latin-American population practice geophagia (López *et al*., 2004). The percentage of women in urban areas of Washington DC that practiced geophagia was found to be low (8%) (Edwards *et al*., 1994), while women in Texas reported a high incidence (76%) of consuming clay (Rainville, 1998). In urban and rural areas of Augusta, Georgia, 32.5% of postnatal inpatients practiced geophagia (Sage, 1962) and in women (n=211) attending antenatal clinics in Georgia, 21% consumed soil during pregnancy (Edwards *et al*., 1954). Pregnant and lactating women (n=204) attending two health facilities in Dar es Salaam, Tanzania, showed a 60% incidence of eating soil (Nyaruhucha, 2009). Pagophagy occurs more often than geophagy in Brazil (Kim & Nelson, 2012) and in New Jersey 53% of pregnant women (n=1334) between 13-24 years of age consumed ice (Coles *et al*., 1995). Geophagia is also prevalent where 4.8% of 125 women in private and public antenatal clinics in Kingston, Jamaica reported consuming soil (Landman & Hall, 1992). In another Jamaican study, children who practiced soil eating were more prone to malnutrition (Shivoga & Moturi, 2009). Several studies have also reported that children of school-going age practice geophagia. These include children from Lusaka, Zambia (74.4%) (Nchito *et al*., 2004), Senegal (58.7%) (Diouf *et al*., 2000) and Mississippi in the USA (26%) (Ferguson & Keton, 1950).

2.3.3.2 Africa

African countries have the highest incidence of practicing geophagia (Ngozi, 2008) ranging from 56% in Kenya under pregnant women (n=275) to 73% of schoolchildren (n=285) in western Kenya (Geissler *et al*., 1998). Clay eating has been reported to be common in five African countries, namely Malawi, Zambia, Zimbabwe, Swaziland and South Africa (Walker *et al*., 1997). In Malawi, pregnant women commonly practice geophagia, but women who are not pregnant do not practice geophagia because they believe that it is a sign of pregnancy (Hunter, 1993). Geophagia has also been reported to be high amongst scholars in Nigeria where hookworm infection was identified in 58% of primary schoolchildren in Anambra State (Chumkwuma *et al*., 2009). The Chagga women of Tanzania believe that geophagia is sacred to women and defines their femininity (Knudsen, 2004). HIV-infected women in Dar es Salaam, Tanzania enrolled in a Vitamin A trial (n=327), reported a 29% prevalence of geophagia (Kawai *et al*., 2009). In Swaziland the majority of geophagists were women in the Hhoho and Manzini areas (Peter, 2011). In a literature review by Njiru *et al*. (2011), the prevalence of geophagia in pregnancy was found to be as high as 84% under women in Uganda. In Kinshasa, Zaire a high prevalence of soil eating (71.3%) was reported at antenatal and postpartum clinics at university hospitals (Tandu-Umba & Paluku, 1988). Women (n=171) attending antenatal clinics in the eastern Caprivi region of Namibia also consumed soil and 41.5% of the women were found to be anaemic (haemoglobin <11 g/dl) (Thomson, 1997).

2.3.3.3 South Africa

In South Africa ingestion of clay is mainly practiced by pregnant women. In a study undertaken by Walker *et al*. (1997) amongst South African women, the prevalence of geophagia was found to be 38.3% in urban women and 44.0% in rural women. In Indian, Coloured and White women the prevalence was much lower at 2.2%, 4.4% and 1.6% respectively (Walker *et al*., 1997). Studies undertaken in the rural area of QwaQwa in the Free State region (Mogongoa *et al*., 2011) and in Limpopo region (Songca *et al*., 2010) have shown that the practice of geophagia is still prevalent under persons from rural areas in Southern Africa. Saathoff *et al*. (2004) also reported the prevalence of soil eating under rural schoolchildren from the Northern parts of KwaZulu-Natal. In a survey conducted under 240 people in the Oliver Tambo district of the Eastern Cape, 75% reported practicing geophagia (George & Ndip, 2011).

2.3.4 Composition of geophagic soil

In the following section the texture and minerology of geophagic soil will be discussed briefly.

2.3.4.1 Texture of soil

Soil consists of air, water, minerals, organic matter and biota that cover the terrestrial earth in layers above the underlying bedrock (Skinner, 2007). Soils collected by geophagists are most commonly collected from banks of rivers or adjacent to freshwater seeps and springs (Sing & Sing, 2010). The soil profile is determined by the depth from the surface, which is divided into soil layers or horizons (Figure 2.1) described generally as A, B and C (Fey, 2010).

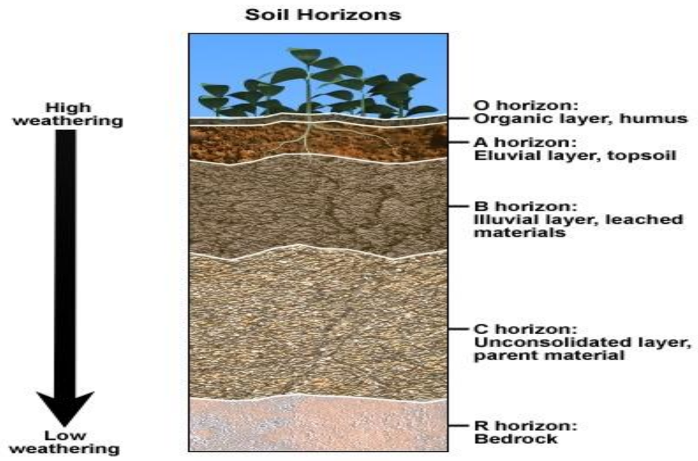

FIGURE 2.1. DIAGRAM SHOWING THE SOIL LAYERS
(University Corporation for Atmospheric Research)

Horizon C refers to bedrock and is the origin of the minerogenic material in all layers of a developed soil. Horizon A is commonly known as the topsoil and horizon B the layer below horizon A. Layer A consists mostly of a mixture of biota, organic materials and broken-down minerogenic particles (Fey, 2010).

2.3.4.2 Mineralogy of soil

Clay is largely made up of clay minerals, but quartz, feldspar, carbonates, ferruginous material and other non-clay material can also be present and are in the highest concentrations in the B horizon. Types of clay includes Ball clay, Fire clay, Flint clay and Kaolin (which largely consist of kaolinite); Bentonite and Bleaching earth (consisting mainly of montmorillonite). Common clays consist of a combination of layers of illite/smectite and montmorillonite (Bergaya & Lagaly, 2006).

Geophagic clayey soil properties such as colour, texture, smell and taste all play a role in the type of clay that geophagists choose to eat (Reilly & Henry, 2000; Wilson, 2003; Nchito *et al*., 2004; Young *et al*., 2007; Ekosse & Junbam, 2010; Ngole *et al*., 2010; Young *et al*., 2010d). Bentonite clay is available worldwide as a digestive aid, while kaolin is also widely used as a digestive aid and as the base for some medicines. Attapulgite is an active ingredient in many anti-diarrheal medicines (Ziegler, 1997). In Tanzania geophagic soil samples consist of 56% sand and 33% clay. Kaolinite is the main component of the clay called pemba, with minor components of illite, goethite and hematite (Yanai *et al*., 2009). Ekosse & Junbam (2010) have reported that clays from Swaziland used for geophagia purposes were dominantly greyish to reddish and had a pH value of 6.33. Rural women in Zambia and Zimbabwe preferred soils from large termite mounds (Diamond, 1998), while pregnant and lactating women in western Kenya prefer to ingest soft stone known as "odowa" and earth from termite mounds (Luoba *et al*., 2004).

South African geophagists usually prefer clayey soils consisting of clay and sand have a soft, smooth and powdery consistency (Ekosse & Junbam, 2010). Clayey soil from the Free State Province is silky, whilst those from Limpopo Province are gritty and powdery (Ekosse & Junbam, 2010). The geophagic clays in QwaQwa contain mostly quartz and kaolinite (Ekosse *et al*., 2008). A study undertaken among rural black women in QwaQwa showed that these women preferred white clay, while some ate yellowish geophagic clays (Ekosse & Junbam, 2010). This is also seen in other provinces such as the Limpopo Province (Ekosse & Junbam, 2010).

2.4 GEOPHAGIA AND HUMAN HEALTH

Many geophagists consume soil because they believe in the beneficial qualities of clayey soil, which include reported relief of gastro-intestinal distress (Wilson, 2003), detoxification (Walker et *al*., 1997), anti-microbial treatment and immune-booster properties (Callahan, 2003), and mineral supplementation (e.g. calcium) (Hooda *et al*., 2004). Some studies have also suggested that calcium in the soil reduces the risk of pregnancy-induced hypertension (Wiley & Katz, 1998).

2.4.1 Advantages to human health

Advantages of soil consumption to human health have been reported and include mineral supplementation, creating a barrier to toxins and relief from gastro-intestinal distress.

2.4.1.1 Mineral supplementation

It has been suggested that soil consumption may increase the mineral content of the diet. Some people believe that zinc and iron are acquired from the eating of clay. Many soil samples contain iron and zinc, but bioavailability studies of iron and zinc have, however, indicated that the clay does not actually provide additional zinc and iron but in fact binds with the iron in foods ingested at the same time, reducing the total amount of available dietary iron (Hooda *et al*., 2004; Hooda & Henry, 2009: 94). Red soil may have properties that might prevent iron deficiency-anaemia, but may also affect the bioavailability of the non-haem component and thus restrict iron bioavailability (Dreyer *et al*., 2004). An *in vitro* study undertaken by Hooda *et al*. (2004) showed that soils from Uganda, Tanzania, Turkey and India removed minerals from the soil which is already bioavailable in the soil before consumption. In an old study amongst 348 adult Black patients from the "Outpatient Department of the Johannesburg" Non-European Hospital in South Africa, mean iron absorption decreased by 12.4% after consuming soil with meals (Sayers *et al*., 1974).

Clays contain high levels of calcium and the bioavailability thereof has also been claimded to be high, which makes it possible that calcium intake, can be increased through soil consumption (Hooda *et al*., 2004). The continuous practice of geophagia may thus be a way of calcium supplementation (Lakudzala & Khonje, 2011). Clays also have a high citation exchange capacity which might have the beneficial properties of binding with chemical toxins that plants produce, such as tannins and glycoalkoloids (Dominy *et al*., 2004; Johns, 1996). This binding property of clay may explain why people consume soil during periods of famine to counteract the toxins in the plants and roots that they eat to survive (Hooda and Henry, 2009: 68). The cation exchange capacity also has an effect on microbes. Clays such as attapulgite, kaolin-pectin, diatomaceous earth, bentonite, and termite earth may reduce the harmful effect of fungi, bacteria and viruses (Young, 2009: 71).

Smith *et al*. (2000) have reported that a number of studies have illustrated that soil eating is considered good for health, because it "strengthens the blood and promotes growth and physical strength." These authors have also suggested that pregnant women consuming soil improve their immunity due to antigens that are produced in response to the live organisms that are ingested.

2.4.1.2 Create a barrier

According to Hooda & Henry (2009: 69), geophagia may also create a barrier for the invasion of toxins in three ways. Firstly, it may help the intestinal mucosa separate ingested food from the rest of the body until it is suitable to be absorbed in the bloodstream; secondly, it may slow down the movement of food through the gut and lastly, increase the time of waste excretion. An example is smectite which is a large component of soil (Mahaney *et al*., 2000) that binds with mucous in the gut to increase the barrier effect (Leonard *et al*., 1994).

2.4.1.3 Relieving gastro-intestinal distress

Geophagia is also well known for its reported beneficial properties in relieving gastro-intestinal distress (Wilson, 2003). Koalin and smectite (which is commonly found in clay) has the potential to reduce nausea and gastro-intestinal upset (Hooda & Henry, 2009, p. 70). Clinical trials have shown that smectite reduces the severity and duration of diarrhoea (Guarino *et al*., 2001; Narkeviciute *et al*., 2002). The pH of clays is higher than hydrochloric acid in the stomach and because of the alkaline properties of the clays, it could play a role in reducing heartburn (Nyaruhucha, 2009).

In Third World countries clay is reported to be consumed to line the stomach before eating yam or fish which may be poisonous (Ghorbani, 2008).

2.4.2 Disadvantages to human health

2.4.2.1 Binding with minerals and toxic reactions

Some clay contains excessive and harmful amounts of minerals such as potassium and zinc (Garg *et al*., 2004). The type of soil a geophagist chooses to consume determines the possibility of nutrient-release in the gastro-intestinal tract (Figure 2.2) (Aufreiter *et al*., 1997). Adsorptive clays are more likely to cause iron or zinc deficiency (Simon, 1998). Abrahams (2012) has shown that soil containing mostly kaolinite and micas (illite and muscovite) enter the stomach with a pH of 7-10. Nutrient-ions retention is increased which can result in a higher incidence of nutrient deficiency.

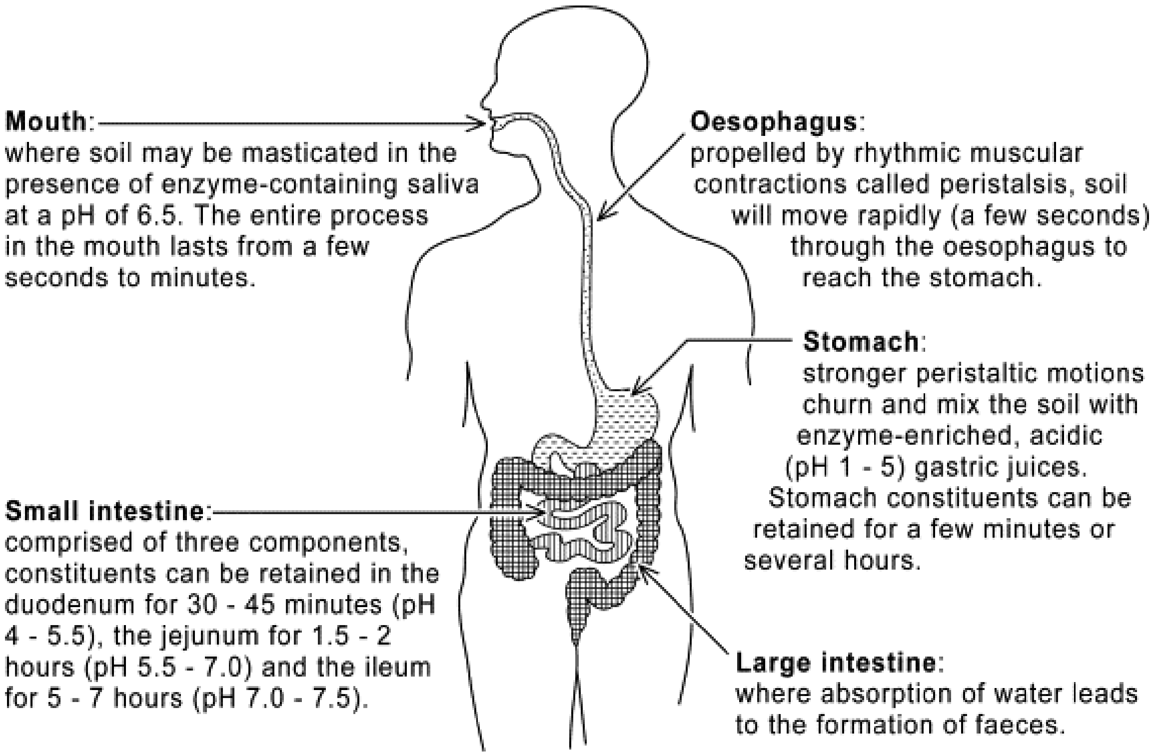

FIGURE 2.2: ILLUSTRATION OF THE PATH OF SOIL INGESTED BY HUMANS
(Aufreiter *et al*., 1997)

As far back as 1961, a syndrome occurring in males in Iran was observed with severe iron deficiency anaemia, Zn-deficiency, hypogonadism, hepatosplenomegaly and dwarfism related to the geophagia syndrome (Arcasoy *et al*., 1978; Prasad *et al*., 1961).

The first description of zinc deficiency associated with geophagia was made by Prasad *et al*. (1961) in adolescent boys in Iran who had been clay eaters since childhood. The phosphate in clay binds with Zinc, which explains why it is not absorbed (Elmes, 2002). Geophagia was practiced by these males, but the relationship between the syndrome and geophagia is unclear (Prasad, 2001). The World Health Organization (WHO, 1996) suggested that the zinc deficiency was due to "calcareous soil-type and leached arenaceous soils of low Zn content that may lead to irregularities in human food chains."

Other health hazards include the toxic reactions to soils contaminated by lead or with pollutants. Lead environmental pollution is common worldwide and pica has been identified as a cause of lead poisoning (Khan *et al*., 2011). Soils may contain high levels of lead, which can be absorbed into the bloodstream. High levels of exposure to lead may contribute to lower intelligence quotient of children and be detrimental to the foetus in pregnant women (Lakudzala & Khonje, 2011). As early as 1975 Hussey reported that geophagists eating soil high in potassium may develop hyperkalaemia (Ghorbani, 2008).

2.4.2.2 Gastro-intestinal problems

Mechanical bowel problems, constipation, ulcerations and intestinal obstruction, and perforation and maternal death have been reported in cases where clay consumption was common (Ellis & Pataki, 2012; Key *et al*., 1982). In addition, it can also be life-threatening in patients with renal failure (Gelfand *et al*., 1975). Some geophagists have experienced severe constipation (Woywodt & Kiss, 1999) and even intestinal obstruction (Ye *et al*., 2004). Abdominal pain and diarrhoea occur more often in pregnant Pemba women in which amylophagy and geophagy is a common practice than in those without (Young *et al*., 2010a).

2.4.2.3 Organisms in soil

Geophagia is also associated with geohelminth infection. Geohelminth infections affect 3.8 million people worldwide, and cause an estimated 135,000 deaths each year (WHO, 2012). Eating soil may increase infection with endoparasitic organisms such as geohelminths and Clostridium tetnai (Bethony *et al*., 2006; Flohr, 2003; Abrahams, 2002). Worldwide, geohelminth infection is a health risk with approximately two billion people infected, two million clinical cases and 60,000 deaths occurring every year (Glickman *et al*., 1999). In a study undertaken by Sumbele *et al*. (2011), geophagists from the Mdantsane district in the Eastern Cape also showed high incidence of geohelminth infection. Epidemiological and biological studies have, however, shown that hookworm is not transmitted by geophagia (Geissler *et al*., 1998; Saathoff *et al*., 2002). In contrast to other studies, Van Eijk *et al.* (2009) could not find a correlation between geohelminth infections and soil eating in a cross-sectional study among pregnant women in Tanzania.

Fungi, protozoa, viruses, prions and the archaebacteria are also commonly found in soil and contribute to the musty smell of freshly turned soil. Microalgae are photosynthetic and are mostly found in topsoil (Bisi-Johnson *et al*., 2010). Soil microorganisms can be beneficial or harmful to mankind depending on their functions and their impact on soil quality.

2.4.2.4 Dental damage

Geophagists can be identified by dentists by the wear on their teeth (Young, 2011: 64). Case reports showed evidence of tooth abrasion, cracks and erosion (Johnson *et al*., 2007; Djemal *et al*., 1998), tooth decay (Abbey & Lombard, 1973) and a rare pattern of damage to the tooth surface (Barker, 2005).

2.5 CONCLUSION

Pica is characterized by the deliberate consumption of non-food items for more than one month (Young, 2009: 17; American Psychiatric Association, 2000). The aetiology of pica is unclear, but factors involved in pica may include hunger, micronutrient deficiencies, gastro-intestinal distress, and protection from pathogens and toxins (Young *et al*., 2008; Gonyea, 2007).

Cravings for non-food items are not exclusive to one geographic area, race, sex, culture or social status; and are also not limited to pregnancy (Erick, 2012: 363).

Other risk factors for pica include epilepsy, mental retardation and brain damage (Ellis & Pataki, 2012). The actual prevalence of pica is not known, because it is often a practice that occurs in secret and is not reported (Ellis & Pataki, 2012).

Geophagia is the most common type of pica described in the literature and refers to the deliberate eating of soil (Young *et al.,* 2010; Njiru *et al.,* 2011). Geophagia has been reported to be more likely to occur in a population that is at greater risk for iron deficiency, for instance malnourished pregnant women (Izugbara, 2003; Hooda & Henry, 2009: 90) and populations which rely on the intake of heavily toxin plants. Geophagia often leads to mineral deficiencies such as iron, zinc or potassium (Reid, 1992). Iron deficiency is the most prevalent single deficiency documented worldwide and is present in all populations which include rich and poor countries (WHO, 2008). Anaemia is an indicator of iron deficiency, which can lead to behavioural and cognitive dysfunctions (Yadav & Chandra, 2011).

Many geophagists consume soil because they believe in the beneficial qualities of clayey soil, which include reported relief of gastro-intestinal distress (Wilson, 2003), detoxification (Walker et *al*., 1997), anti-microbial treatment and immune-booster properties (Callahan, 2003), and mineral supplementation such as calcium (Hooda *et al*., 2004). The reported positive effects of geophagia on human health include mineral supplementation, creating a barrier to toxins and relief of gastro-intestinal distress. Disadvantages of geophagia include dental caries, binding of soil with minerals which are important to human health and gastro-intestinal problems such as diarrhoea. Geophagia is also associated with geohelminth infection.

CHAPTER 3

METHODS AND TECHNIQUES

3.1 INTRODUCTION

This study formed part of a larger study which investigated the practice of geophagia in Africa. The larger study was divided into two phases. In phase one of the larger study, mineralogy, geochemistry, ecology and environmental health factors of geophagic soils were investigated. Specifically this part of the study (phase 2) was related to determining the health and nutritional implications associated with the practice of geophagia in women in QwaQwa and to develop an intervention to address any adverse findings associated with the practice of geophagia.

During phase one, information about the attitudes, knowledge and beliefs of individuals (practicing geophagia and not) regarding the practice of geophagia were obtained using questionnaires. Furthermore, information regarding the geochemistry and mineralogy of the soils that are utilised for geophagia was gathered.

The current study comprised phase 2 in which the health and nutritional implications of geophagia were evaluated. A blood sample of geophagic individuals (40) as well as 40 subjects who did not practice geophagia (control group) identified during phase one of the larger study, were included in phase 2. Questionnaires were administered to determine dietary intake, anthropometric measurements and blood samples were obtained from both groups of individuals (Figure 3.1).

The intervention study followed in which a nutrition education intervention was developed and implemented after the nutritional risk factors that needed to be addressed had been identified. This intervention was offered to all those who participated in phase 2 of the study as well as other members of the community who were interested in receiving the intervention. After the three month intervention period, a questionnaire related to geophagic practices was repeated in both the geophagia and control groups to evaluate the impact of the intervention.

3.2 STUDY DESIGN

The study design comprised of an observational epidemiological study which included an exposed (geophagia) and non-exposed (non-geophagia) group followed by an intervention phase. An assessment of the impact of the intervention was also conducted.

3.2.1 Sample selection

3.2.1.1 Population

According to the mid-year population estimate of the Free State Province, the total amount of women between the ages of 15 and 44 were 740 983 for 2008. The population of Thabo Mofutsanyane (Phuthaditjaba) consisted of 352 847 people between the ages of 15 and 44, and this town had the highest non-urban population (59.8%), in 2001. The Maluti, a Phofung population, consisted of 193 409 women in 2001 and showed equal proportions of males and females in the age groups up to age 19, after which there were higher proportions of females up to the age of 85 and above. According to STATS SA, there was only a 2.4% change in the population for the period 2001 to 2008. Due to the fact that the practice of geophagia had not been studied widely and the incidence of the practice was largely unknown, the population included the broad population of women in QwaQwa, South Africa.

3.2.1.2 Sample

A random sample of 300 women in South-Africa was interviewed in phase 1 (Table 3.1) of the study which has already been completed but has not been reported in this thesis (research not published yet).

For the larger study (from which the current study (phase 2) followed), random samples of streets (starting at a fixed point) were selected by the biostatistician specifically by using maps of the QwaQwa area. From each of the selected points, the closest street was identified. In each of those streets all women that met the inclusion criteria were approached and all women that gave informed consent were included. If no women were available in that street, the street to the left of the starting point was chosen.

It was hoped that if an initial sample of 40 experimental and 40 control participants was used, the number of participants that eventually completed the current study would statistically be sufficient in terms of power. From the list of geophagic respondents identified in phase 1, participants for the experimental group were randomly selected and approached to participate in phase 2 of the study, until a sample of 40 individuals had been obtained. The individuals from phase 1 not practising geophagia were then stratified according to the demographic distribution of the geophagic sample and participants were randomly selected and approached for consent to participate in phase 2 of this study until a sample of 40 individuals were obtained, in order for the two groups to be compared.

Table 3.1 Distribution of respondents among participants in South Africa (Free State, North West and Gauteng regions) for phase 1 and QwaQwa for phase 2

RESPONDENT GROUP	GEOPHAGIA GROUP	CONTROL GROUP	TOTAL
Participants (phase 1)	300 (geophagic and non-geophagic women)		300
Adult women (phase 2)	40	40	80

Inclusion criteria for geophagia group in phase 2:

- Females that practiced geophagia for at least once per day for a month or more;
- Females who gave consent (Annexure A) that they were willing to participate in the second phase of the project;
- Non-pregnant females 18 – 45 years of age;
- Females who consumed soil or clay;
- Apparently healthy females (reported healthy according to the health questionnaire and with a normal white blood cell count on the full blood count);

Inclusion criteria for control group in phase 2:

- Females who gave consent (Annexure A) that they were willing to participate in the second phase of the project;

- Non-pregnant females 18 – 45 years of age;
- Apparently healthy (reported healthy and normal full blood count).

3.3 MEASUREMENTS

3.3.1 Variables and operational definitions

The variables in phase 1 assisting phase 2 included information regarding the attitude, knowledge and beliefs of individuals (practicing geophagia and not) regarding the practice of geophagia, as well as the geochemistry and mineralogy of the soils that were utilized for geophagia. The variables which were determined to meet the objectives of phase 2 included socio-economic status, anthropometric measurements, dietary intake, physical activity and a selection of relevant blood parameters.

3.3.2 Geophagic status (Annexure B)

The geophagic status (phase 1) was determined using a questionnaire that consisted of sections that addressed geophagic habits; extent and practices; demographic and biological data; and medical history of individuals who practiced geophagia; reasons for geophagic practices; soil/clay type (based on traditional knowledge description); general profile and social and personal history of geophagic individuals (Annexure B) for phase 1. University students from the Central University of Technology (CUT) who spoke the local (indigenous) languages were recruited and trained by the research team working from the CUT at that time. These university students administered the questionnaires under the supervision of the fieldworkers and research team. A total of 300 questionnaires were administered at the following six study sites in four different provinces in South Africa:

- Free State: QwaQwa and Manguang.
- Northern Province: Duiwelskloof, including Burgersfort and Sekhukhune.
- North West: Ga-Rankuwa.
- Gauteng: Soshanguve.

The data regarding their geophagic status collected during phase 1(Annexure B), was used as background information for phase 2 together with socio-demographic status (Annexure C).

3.3.3 Socio-demographic status (Annexure C)

For the purpose of this study (phase 2) socio-demographic information included age, language, pregnancy status, household composition, level of education, employment status, type of dwelling, fuel used for cooking and household supplies.

3.3.4 Anthropometric nutritional status (Annexure D)

For the purpose of this study, anthropometric information included height, weight and waist circumference. These measurements were used to calculate body mass index (BMI) and waist circumference.

BMI refers to current weight in kilograms divided by height in m^2. According to international recommendations, underweight is defined as a BMI of less than 18.5 kg/m^2; normal weight is 18.5 kg/m^2 to 24.9 kg/m^2; overweight is defined as a BMI of 25.0 kg/m^2 - 29.9 kg/m^2 and obesity is defined as a BMI of ≥30 kg/m^2 (Hammond & Litchford, 2012: 166).

When waist circumference was used as an independent predictor of risk for chronic diseases of lifestyle, the cut-off for waist circumference in women is $\geq$80 cm (Alberti *et al*., 2006).

3.3.5 Dietary intake (Annexure E)

Dietary intake for the purpose of this study, referred to nutrient intake determined through amount and frequency of food consumption per day, per week, or per month. The nutrients included energy, macro- and micronutrient intake. Macronutrient intakes were interpreted using the recommended intakes as stipulated by the Institute of Medicine (2002):

- Total energy intake indicated in kilojoules compared to the Estimated Energy Requirement (EER) ranges for women of different ages;
- Total amount of energy from carbohydrates in diet between 45% – 65% of total energy;
- Total amount of energy from protein in the diet between 10% – 35% of total energy; and
- The amount of energy from fat in the diet between 25% – 35% of total energy.

The micronutrient intake was interpreted as follows:

The term Dietary Reference Intake (DRI) is a collective name and refers to a set of at least four nutrient-based reference values, each with a specific application. In the case of groups, the Estimated Average Requirements (EAR) was used as cut-off points to determine the adequacy of intakes for each nutrient (Murray *et al*., 2012: 275). Intakes below 100% of the EAR were used to indicate an inadequate intake.

3.3.6 Physical activity (Annexure F)

For the purpose of this study, physical activity was defined as any form of muscular activity or metabolic equivalents that resulted in the expenditure of energy (Ireton-Jones, 2012: 26). The amount of time spent on sport and leisure activities were established using the previous day physical activity recall (PDPAR) (Annexure F) as validated by Weston *et al*. (1997). Patients were asked to list all the activities they performed during a weekday. From this information the researcher calculated physical activity level (PAL) for each patient as follows: the PAL value for the various activities performed throughout the day was determined by adding the PAL for each activity.

PAL refers to those activities structured around the household, as well as extramural activities. PAL values are categorised as follows (Ireton-Jones, 2012: 26):

- Sedentary: 1 - 1.4 PAL
- Low activity: 1.4 - <1.6 PAL
- Active: 1.6 - <1.9 PAL
- Very active: 1.9 - 2.5 PAL

3.4 BLOOD PARAMETERS (PATHOLOGY)

The following blood parameters and international cut-off points were used to evaluate or compare the results against (Lewis, 2006: 14):

VARIABLE	NORMAL VALUES
Haematology	
Red blood cell count	3.8-4.8x10^{12}/l
Haemoglobin	12-15g/dl
Packed cell volume (haematocrit)	0.41 ± 0.05 (l/l)
Mean cell volume	83-101fl
Mean cell haemoglobin	29.5 ± 2.5 pg
Platelet count	150-410 x 10^9/l
White blood cell count	4.0 – 11.0 x 10^9/l
ESR	03 – 12 mm/h
Clinical pathology	
S-Total Protein	60 - 78 g/L
Albumin	35 – 52 g/l
Urea	2.6 – 7.6 mmol/l
Serum iron	10 - 30 µmol/l
Ferritin	10 – 291 µg/l
Calcium	2.15 – 2.50 mmol/l
Magnesium	2.3 – 2.6 mmol/l
Potassium	3.5 – 5.1 mmol/l
Phosphorus	0.8 – 1.45 mmol/l
Chloride	98 – 107 mmol/L
Sodium	136 – 145 mmol/L
C - reactive protein	<10 mg/L
S-Cholesterol	<5.0 mmol/L
S-ALT	10 – 40 IU/L
S-AST	13 – 35 IU/L

3.5 TECHNIQUES

3.5.1 Questionnaires

Questionnaires (socio-demographic status (Annexure C), dietary intake (Annexure E) and physical activity (Annexure F) were used to collect information from participants during individual interviews with the researcher. The geophagic status questionnaire (Annexure B), however was completed by trained fieldworkers during phase 1 and not by the researcher. Appointments were made with participants beforehand and interviews took place at the participant's home. Where participants could not understand English, trained interpreters assisted the researcher.

Dietary intake was determined using a validated Food Frequency Questionnaire (FFQ) (Annexure E) and completed by the researcher with each participant.). The FFQ was validated for the Transition, Health and Urbanisation in South Africa (THUSA) study by comparing the FFQ against a seven-day weighed record completed by 74 respondents (MacIntyre *et al*., 2001a;2001b). Standardised food models were used to estimate portion sizes. Food intake reported in household measures was converted to weight in grams using the MRC (Medical Research Council) Food Quantities Manual (Langenhoven *et al*., 1991a). Each FFQ was summarised by the researcher (specific food code and weight in grams per day). Intakes of macro- and micronutrients were determined using the Food Finder Programme which included the MRC Food Composition Tables (Langenhoven *et al*., 1991b).

3.5.2 Anthropometry

Anthropometric measurements (Annexure D) involve assessing the physical measurements of an individual and relating these measurements to standards that reflect health and nutritional status (Hammond & Litchford, 2012: 165). All measurements were taken by the researcher.

Body weight was measured according to standard methods described by Hammond & Litchford (2012: 166) with a calibrated Seca digital electronic scale to the nearest 0.1 kg. Participants wore light clothing and no shoes and stood in the middle of the scale without touching anything, with their body evenly distributed on both feet. The electronic scale was zeroed before weighing a participant and calibrated after every 20th participant measured by the researcher using a known weight.

Standing height of subjects were measured wearing light clothing and no shoes and was measured to the nearest 0.5 cm using a stadiometer as recommended by Hammond & Litchford (2012: 165). Participants stood with heels together, arms to the side, legs straight, and shoulders relaxed, and the head in the Frankfort horizontal plane (looking straight ahead) as described by Hammond & Litchford (2012: 165). Participants placed their heels, buttocks, scapulae and the back of the head against the vertical board of the stadiometer. Participants were asked to take a deep breath and hold their breath just before the measurement was taken. This ensured that an erect posture was maintained, while the headboard was lowered with pressure to compress the hair on the highest point of the head. The researcher was trained and the technique were standardized which contributed to the reliability of the research result.

Waist circumferences were measured in duplicate, around the smallest part of the waist to the nearest 0.1 cm, using a tape measure. The measurements in centimetres (cm) were taken at the narrowest area below the rib cage and above the umbilicus as viewed from the front. The measurements were taken at the end of a normal expiration. These techniques were standardized which contributed to consistency and reliability of the calculated waist circumference values (Hammond & Litchford, 2012: 169).

3.5.3 Laboratory Analyses

Peripheral venous blood from the cubital vein (15 ml blood) was drawn for pathological analyses. Blood was drawn by registered Biomedical Technologists with training in phlebotomy. The following blood samples were drawn: 1 x 5 ml EDTA plasma-specimens and 1 x 10 ml clotted serum-specimens. Blood samples for the pilot study were analysed using standard laboratory techniques by Van Rensburg Laboratory and data was sent electronically to the Department of Biostatistics at Central University of the Free State. Five millilitres of blood from each participant was collected into ethylenediaminetetra-acetic acid (EDTA) tubes for full blood counts (FBC), sedimentation rate (ESR) and reticulocyte counts while ten millilitres of clotted blood samples were used for parameters of iron status (total serum-iron and ferritin). The SEDIPLAST® was used to measure the ESR which is a closed system based on the Westergren method. The Westergren method is considered the gold standard and is recommended by the International Council for Standardization in Haematology (ICSH). Haematology specimens were done at the temporary laboratory at the hotel and the rest at Central University of Technology (CUT) and blood samples for chemical profile analyses for phase 2 (the current main study) were analysed by the National Health Laboratory Services (NHLS), Universitas Hospital, Bloemfontein, accredited with SANAS. Special authorization was given by the hotel management in QwaQwa to run the temporary laboratory at their facilities because some of the laboratory analysis needed to be done within four hours after blood collection. The South African National Accreditation System (SANAS) is recognised by the South African Government as the single National Accreditation Body that gives formal recognition that Laboratories, Certification Bodies, Inspection Bodies, Proficiency Testing Scheme Providers and Good Laboratory Practice (GLP) test facilities are competent to carry out specific tasks in terms of the Accreditation for Conformity Assessment, Calibration and Good Laboratory Practice Act (Act 19 of 2006). All tests were performed using commercially available reagents, standards and controls for both normal and abnormal physiological concentrations. Serum iron and transferrin were done on the Beckman Coulter CX9 and the transferrin saturation automatically calculated. The Siemens Advia Centaur was used to determine ferritin by using the method described by the UCSF Clinical Labs-Chemistry.

3.5.4 Validity and reliability

All issues addressed by the questionnaires were directly related to the aim and objectives of the study. All data was collected by the researcher except for the questionnaire related to human geophagia (Annexure B), where the trained fieldworkers collected data in phase 1 as well as the collection of blood samples.

3.5.5 Socio-demographic Questionnaire

To ensure validity, the indicators included in the socio-demographic questionnaire were done in accordance with recommended indicators of socio-demographic factors described in scientific literature and assessed in other relevant studies to comply with the aim and objectives of the study.

To ensure reliability, the socio-demographic questionnaire was re-administered by the researcher to 10% of the original sample to determine the reliability of the questionnaire. The reliability interviews took place one month after the main study. None of the questions related to socio-demographic status were found to be unreliable.

3.5.6 Food Frequency Questionnaire (FFQ)

A FFQ validated for black populations, adapted from the THUSA (Transition and Health during Urbanisation of South Africans) study was used (MacIntyre *et al*., 2001a). The frequency of food consumption was categorized as 'consumes it daily', 'weekly' and 'monthly' or 'does not consume it', according to Nelson (2000: 366). The questionnaire concentrated on food items commonly consumed by African people as indicated in the THUSA study. The FFQ was further adapted for the purpose of the research study. By using the already validated questionnaires adopted from the THUSA study, the techniques used in the present study and reliability of results was obtained. To improve reliability, only one person, namely the researcher, interpreted and coded the FFQ.

3.5.7 Anthropometry

All anthropometric measurements were measured according to standard methods as recommended by Hammond & Litchford (2012: 165). The researcher was trained in methods and techniques were standardized to determine accurate anthropometry.

Scales were zeroed before each measurement and the weight recorded by the scale compared with a known weight, a 2.5kg packet of flour was used to ensure that the reading on the scale reflected the same reading when measuring the standard weight after every 20th subject measured by the researcher.

3.5.8 Physical activity

The amount of time spent on sport and leisure activities was established using the previous day physical activity recall (PDPAR) (Appendix F) as validated by Weston *et al.* (1997). The activity recall was conducted by the trained researcher and a standardised activity recall was used. All activities were recorded for every half hour of the day and the physical activity level was calculated accordingly.

3.5.9 Blood samples

Full blood counts were performed using the ABX PENTRA 60 which uses current impedance changes, spectrophotometry, and double hydrodynamic sequential system coupled with cytochemistry and measuring of transmitted light, to measure the different parameters of the full blood count (Nakamine, 2004). The iron studies were performed on the serum specimens. The total serum-iron and transferrin were analysed on the Beckman Coulter CX9 and the transferrin saturation automatically calculated. The ferritin values were calculated by the Siemens Advia Centaur using a method as described by UCSF Clinical Labs-Chemistry (UCSF Clinical Labs-Chemistry, 2010). The FBC were performed using the ABX PENTRA 60 which uses current impedance changes, spectrophotometry; double hydrodynamic sequential system coupled with cytochemistry and measuring transmitted light to measure the different parameters of FBC. The reliability of these tests was scrutinised using commercially available standards and controls, as well as the recommended tubes and needles for each test.

3.5.10 Methodological limitations

Regular meetings were held with the research team to ensure that methodology faults were limited, e.g. the planning and execution of the study as well as how the supervision in the field was conducted. The planning and execution of follow-up visits to the different sites within QwaQwa were co-ordinated with the research team.

Important information such as the responsibilities of each member of the research team was also discussed with the fieldworkers.

The community in QwaQwa was regularly visited by the fieldworker during phase 1 and phase 2 to ensure participation of participants and to answer any questions regarding the study. The fieldworker explained the importance of the study and their involvement in the study to ensure participation during the intervention period and to limit drop-outs.

3.6 The role of the researcher

The researcher was responsible for the following:

Compilation and adaption of questionnaires used in phase 2 of the study (the FFQ was adapted from the validated questionnaire compiled for the THUSA study);

- Collection of all nutritional data (socio-demographic questionnaire, dietary intake, anthropometry) from all participants from January 2009 to December 2009;
- Determination of associations between the practice of geophagia and nutrient intake, anthropometric status and blood parameters (with the assistance of a biostatistician);
- Determination of the risk of the practice of geophagia on parameters of nutritional status including nutrient intake, anthropometric status and blood parameters (with the assistance of a biostatistician);
- Design, implementation and evaluation of the nutrition intervention.
- Design and composition of brochure in English (Annexure G) and Sotho (Annexure H).

3.7 Training of fieldworkers

The fieldworkers were trained regarding the completion of questionnaires used in the study as indicated in the instruction manual for the fieldworkers (Annexure K).

3.8 PILOT STUDY

A pilot study for phase 2 (questionnaires and anthropometric measurements) was undertaken by the researcher on a sample of 20 persons (in QwaQwa) who were similar to the target group before the main survey in order to determine whether questionnaires would be easily understood and to determine the amount of time needed to complete each questionnaire and to perform the anthropometric measurements. The two fieldworkers assisted the researcher in completing the questionnaires. Since no changes were made to any questionnaires, similar blood samples were collected and specific laboratory tests were done as in the main study, the results of the participants in the pilot study were included in the main study.

3.9 STUDY PROCEDURE

The process that was followed in carrying out the study is summarized in Figure 3.1 below.

Before commencement of the study, the protocol was submitted for evaluation to an Evaluation Committee at the School of Allied Health Professions, Faculty of Health Sciences, University of the Free State (UFS), and approved. The main study was approved by the Ethics Committee at the Faculty of Health Sciences (ETOVS no. 104/08). The protocol specifically related to this part of the study was re-submitted as an amendment and also approved.

The study was conducted after the pilot study as mentioned in paragraph 3.5.3. The procedures for the pilot and the main study were as follows:

- Transport and accommodation arrangements were made to visit the different areas and permission was obtained in setting up a temporary laboratory;
- A list of females from phase 1 (bigger study) who regularly practised geophagia and had completed a consent form (Annexure A), was compiled. A separate list of women who did not practice geophagia was compiled. From these lists, a random sample of participants was selected to participate in phase 2 (n=40 for geophagic group and n=40 for control group);

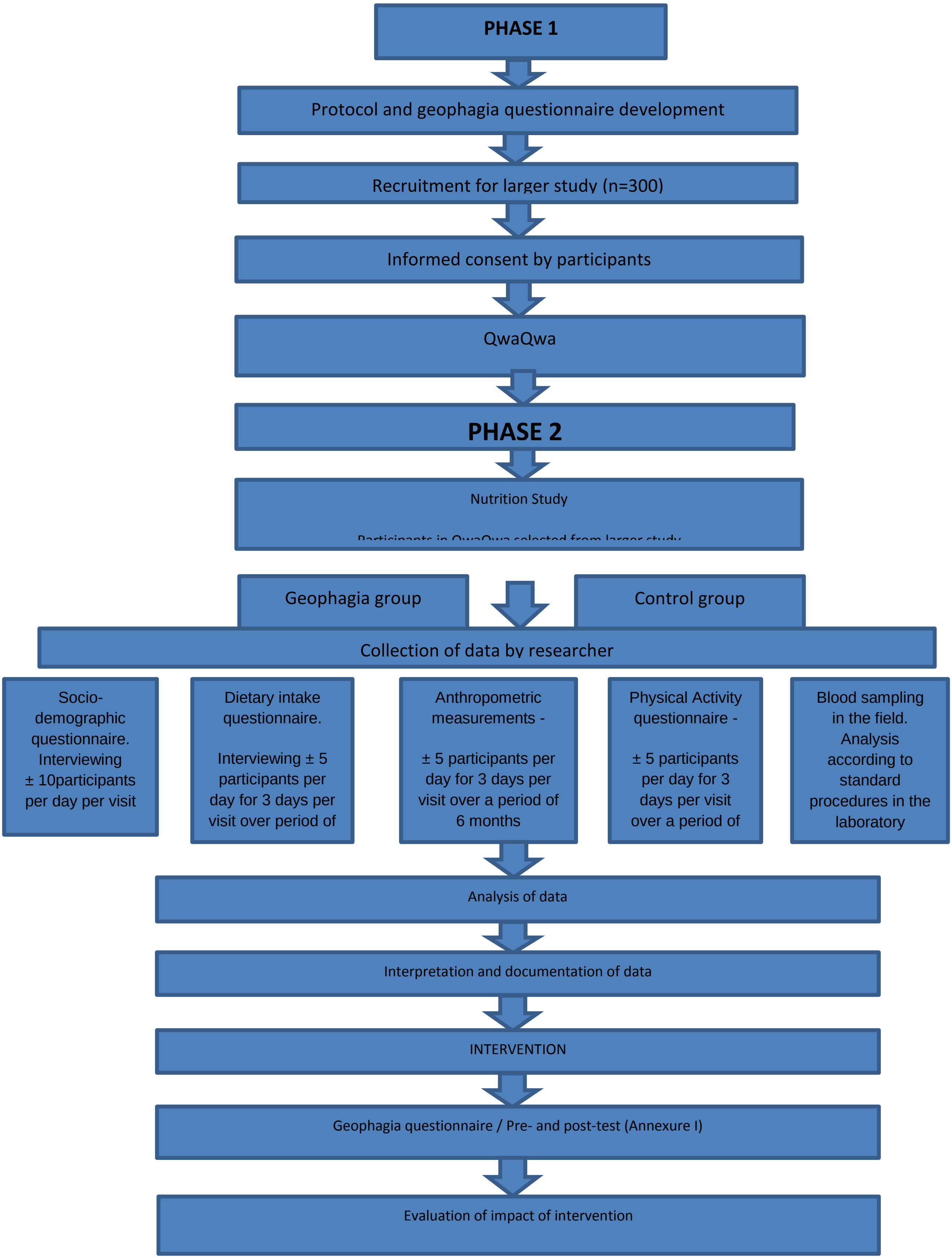

Figure 3.1: Study procedures

- Collection of data (questionnaires, anthropometric measurements and blood sampling) was undertaken at the participant's home by the researcher and all blood analyses were completed in the laboratory by trained laboratory personnel at CUT;
- Reliability interviews were done within a month of the main study;
- Data of phase 2 was analysed statistically by Prof F.J. Veldman, Department of Dietetics and Human Nutrition, University of KwaZulu-Natal;
- Intervention was designed and implemented by the researcher and fieldworkers. A brochure was developed to educate the participants and a questionnaire was designed to determine their geophagic knowledge and habits as well as compliance to the food based dietary guidelines before and after the intervention;
- Drop-outs and withdrawals were noted by the researcher for each group as well as the reasons for each drop-out or withdrawal.

3.10 STATISTICAL ANALYSIS

Ten percent of social demographic questionnaires were repeated to determine the reliability of data. Where answers to questions differed with more than 20%, the question was considered unreliable and the results not reported.

Descriptive statistics, namely frequencies and percentages for categorical data and means, standard deviations or medians, and percentiles for continuous data were calculated. Comparisons between groups for continuous data were assessed using independent t-tests. For categorical data, the Chi-square test was used. Comparison within groups, between baseline and end of intervention results, were measured using the paired t-test. A logistical regression analysis was performed in order to identify those factors measured in this study that can be used to predict whether a person would be more likely to practice geophagia or not in this specific target population. In all instances, a p-level of ≤ 0.05 was considered to be significant. All analyses were performed using Statistical Programme Social Sciences 21 by Professor F.J. Veldman at the Department of Dietetics and Human Nutrition of the University of KwaZulu-Natal.

3.11 INTERVENTION

As mentioned above, an intervention was designed by the researcher after risk factors of the practice of geophagia and nutritional status of participants were determined. The intervention aimed to address the problems and risks identified in phase 2. Participants were followed-up to evaluate the impact of the intervention regarding their geophagia practices.

The intervention consists of the following:

- Development of the brochure (Annexure G);
- Implementation of nutrition education to counsel participants and interested members of the community regarding risks and problems identified during the study;

The following procedures were followed during the intervention:

After phase 2 risk factors associated with the practice of geophagia were identified, the researcher visited QwaQwa again to discuss these factors with the participants of both the geophagia and control groups. The participants and members of the community were informed by means of the brochure developed by the researcher. Two follow-up visits (focus groups) were planned and co-ordinated with the participants by the researcher and were confirmed in advance telephonically to ensure that as many participants as possible would be present. Two translators were used to address the participants and members of the community to minimize any communication issues. These translators were also trained by the researcher before the implementation of the intervention.

The first visit to the participants and members of the community after the development of the brochure involved the following:

- To explain to the participants the risk factors involved in the practice of geophagia;
- To explain the relationship between geophagia and nutritional status;
- To discuss the importance of healthy eating habits with reference to geophagia.

After the first visit two follow-up visits to the participants took place where they were assessed in terms of:

- Making informed decisions regarding the practice of geophagia which included:
  - Disadvantages of eating soil.
  - Risk-groups (children and pregnant women) who should not consume soil at all.
- Know the effect of geophagia on their nutritional status with reference to the following:
  - The effect of the different kinds of clay to health.

- Make informed decisions regarding a healthy diet namely:
  - The Food Based Dietary Guidelines.
  - What steps can be taken when soil is eaten to improve their health.

Once the participants had been exposed to the intervention a three month period was allowed to apply these recommendations. Thereafter, the impact of the intervention on their geophagia habits and knowledge was assessed right after the intervention period ended.

3.12 ETHICAL CONSIDERATIONS

Approval of the research has been obtained from the Ethics Committee of the Faculty of Health Sciences at the University of the Free State (ETOVS no. 104/08 (July 2008).

Informed consent (Annexure A) has been obtained from participants in the language of their choice (English, Afrikaans, Sotho) and all the procedures were explained to them in detail.

All subjects received a light snack after the blood samples have been drawn. Results of blood tests were available to participants and the researcher had referred participants for relative management. (Referral letter – Annexure J)

The blood which was not used was destroyed. Participants were informed what will happen to unused blood (Annexure A).

Confidentiality of information was maintained by ensuring that no names were made known or written on questionnaires. Furthermore, codes were used in data analysis and results. Participants were specifically informed that they could withdraw from the study at any time. Participants will have access to the final report. Participants will be informed that the results of the study will be published.

CHAPTER 4

INTERVENTION

4.1 INTRODUCTION

In the baseline survey risk factors associated with geophagia and nutritional status of persons engaging in geophagia were determined. The results obtained during the baseline were used to design a nutrition education intervention to address these factors.

According to Contento (2008) nutrition education is defined as "any combination of educational strategies, accompanied by environmental supports, designed to facilitate voluntary adoption of food choices and other food and nutrition- related behaviours conducive to health and well-being." Behaviour change is the appropriate outcome criteria for evaluating the effectiveness of nutrition education. The Food and Agriculture Organisation (2005) has stated that "in order to be effective, nutrition education should be linked with the means to adapt or adopt new practices." The aim of nutrition education is thus to change nutrition-related habits or behaviours which contribute to poor health (Chapman-Novakofski, 2012: 325; Smith & Smitarisi, 2005).

In the following section, a brief overview of theories of behaviour change and how they apply to the development of the current intervention are given. As described earlier in chapter one, the objectives of the current study included determining the nutritional status of women practicing geophagia and to subsequently develop a nutrition education intervention in order to address the nutritional and health implications of the practice of geophagia.

4.2 BACKGROUND INFORMATION

Baronowski (2006) proposes that interventions change behaviours indirectly through psychosocial, behavioural, environmental and biological factors. Nutrition education is a complex process and should consider factors affecting food choices such as sensory taste, beliefs, culture, perceptions and environmental factors (Contento, 2008). The effective use of educational theory results in assisting people to change their eating practices and environments (Holli *et al*., 2009: 215). A number of researchers (Hawthorne *et al*., 2008; Glazier *et al*., 2006; Ammerman *et al*., 2002) have noted that customising health education to the social, economic and cultural needs of the community increase effectiveness. Nutrition education is more likely to be effective when it is behaviourally focused. Several studies on health and related behaviours have indicated that people make rational decisions about such behaviours when they are aware of, and have some knowledge about the risks associated with particular actions (Redmond & Griffith, 2003; Levy *et al*., 2002). Noordman *et al*. (2012) and Stead *et al*. (2008) have suggested that simple advice is more effective than intensive advice in order to accelerate behaviour change. A study by Harnack *et al*. (1997) showed that the most dominant reason for dietary behaviour change was a health-related problem.

Factors which contribute to the effectiveness of nutrition education include communication and behaviour change. These two factors will briefly be discussed in the following section.

4.2.1 Communication

According to Mitchell & Courtney (2005) communication is the transmission of thoughts and information using different media. Excellent communication can be identified when the desired results are achieved and all parties benefit from it. Communication can be divided into non-verbal, verbal and written communication (Snetselaar, 2009: 38). In intercultural settings, nonverbal communication becomes especially important as successful interaction between communicators from different cultures to steer both the verbal and nonverbal messages in such a way that both communicators understand the message (Okon, 2011).

Communication is most effective if combinations of methods are used to address the different stages of behavioural change (Burgess *et al*., 2009: 165). The advantages and disadvantages of the different communication methods and materials can be seen in Table 4.1.

Health literacy is a person's skill to understand and process primary health information and services required to make relevant health choices (Institute of Medicine, 2004). Poor health literacy may also contribute to poor health status. Literacy is a stronger predictor of a person's health status than income, educational level and racial or ethnic group (Baker *et al*, 1997; Sudore *et al*., 2006; Davis *et al*., 1998). Research also showed that literacy is directly linked to different dietary habits, (Silk *et al*., 2008) with a positive association between healthy eating practices and higher nutrition literacy skills (Lino *et al*., 1998).

Table 4.1 The advantages and disadvantages of different communication methods and materials (Burgess *et al*., 2009, p.165**)**

METHOD / MATERIAL	ADVANTAGES	DISADVANTAGES
1. Face to face methods		
Counselling	Helps a person to make his/her own decision Develops life skills Confidential	Time consuming
Discussions with small groups	Share the same problems	Individuals can dominate
2. Popular media		
Role-playing, stories, pictures	Enjoyable and popular Often wide coverage	Need skilled facilitator
3. Mass media: print		
Pamphlets/brochures, flyers and hand-outs	Provide knowledge Flexible; Well accepted Good local coverage	Short life span Can be expensive

The World Health Organisation (WHO) has stated that literacy is very important in identifying the inequities in health in both rich and poor countries (WHO Commission on the Social Determinants of Health, 2007). Factors contributing to a person's health literacy are the ability to read and write; difficulty of the message to be understood; and the medium of communication used to communicate during the communication process (Weiss, 2009).

In a study undertaken in the Western Cape, South Africa, 580 patients were interviewed concerning the method of communication they preferred when receiving information from health care workers at a primary health care setting. The results showed that the first choice of patients were one on one counselling as method of communication, while booklets were their second choice of receiving information. The reason was that they can take the booklets home to read (Parker *et al.*, 2012).

4.2.2 Behaviour change

Many theories illustrate how and why change in behaviour occurs. Examples of these theories are the following: behavioural learning, humanistic approach, integrated theory of health behaviour change (ITHBC) and the Health Belief Model. In a later section the application of these theories in terms of planning and development of educational material in the current intervention will be discussed.

4.2.2.1 Behaviour learning

Behaviour learning theories are restricted to observable changes in behaviour, where external events on the individual play a major role towards learning (Shaughnessy, 2004). Teaching requires initiating stimulus and response events, which means that traditional training is a teacher centred approach including passive learners in the process (Holli *et al*., 2009: 216). The association between stimuli and subsequent responses or behaviours are strengthened or weakened by the consequences of behaviour. Three kinds of responses can follow behaviour, namely neutral responses, reinforcers and punishers (Mcleod, 2007; Skinner, 1938). Meyer *et al*. (2003: 278) explains that Skinner's theory is also known as programmed instruction, which means that the information needed to be learned is subdivided into different small sections to ease the process of learning. Behavioural approaches are often used in conjunction with cognitive approaches (Corey, 2009: 289).

Since the 1970's Albert Bandura was considered the inventor of the modelling theory. This theory shows that people not only learn from external causes, but also from observing other people and creating mental images; analysing; evaluating and remembering, which in turn influences their decision making and own learning (Holli *et al*., 2009: 218). Social-cognitive theory highlights the significance of factors around people that influence the social environment, which is interpreted differently by each individual. How a person interprets behavioural outcomes determines the ability to achieve these outcomes and to maintain them (Snetselaar, 2009: 13; Margetts, 2004: 126).

The way in which social cognitive learning motivates an individual in interaction with the situation, determines an individual's motivation level and human behaviour. The human behaviour is, therefore, determined by peoples' own specific motives (Meyer *et al*., 2003: 298). There are elements contributing to the social cognitive learning process, namely learning through direct experience, observational learning and learning through self-regulation (Meyer *et a*l., 2003: 303). Information regarding health risks and benefits of behaviour, stimulate the need for change (Bandura, 2004).

Cognitive learning theories focus on internal, unobservable mental processes that individuals use to learn and remember new knowledge or skills (Corey, 2009: 297). The cognitive approach suggests that what the learner knows before learning, invariably influences or affects the scope of what the person will learn, remember and forget in future. Cognitive learning focuses on mental activities such as thinking, remembering and solving problems (Holli *et al*., 2009: 220 - 221).

4.2.2.2 Humanistic approach

Transfer of learning is accomplished when a person can use their own learned knowledge or skills to solve problems. Transfer of learning is not spontaneous. Knowledge transfer inspires a process involving cognitive resources as well as an interpersonal process where the knowledge or information is transferred between individuals or groups (Holli *et al*., 2009: 227; Aita *et al*., 2005).

Health training, and public health programmes, together with modern research and care, has led to changes in morbidity and mortality in some of the adults (Centres for Disease Control and Prevention, 2009a). Nutrition education strategies should thus enhance awareness by using messages and materials that can influence behaviour change. Dodd (2012: 435) states that adults are the perfect target group for health promotion education aimed at preventing nutrition-related diseases through nutrition advice.

4.2.2.3 Integrated Theory of Health Behaviour Change (ITHBC)

The ITHBC is built on the fact that behaviour change is a self-motivating process, which is driven by motivation and the need to change (Ryan, 2009). Person-centred intervention focusses on increasing knowledge and beliefs and improving self-regulating skills and capabilities. Knowledge and beliefs influence the effectiveness of behaviour change and goal settings (Glasgow *et al*., 2002). Knowledge and health beliefs are associated with the desire to change behaviour and with motivation to enhance the ability to change with the support of a knowledgeable person to drive the process in the correct direction (Ryan, 2009).

The outcomes of this theory have a direct and indirect effect on a person. Directly when a specific outcome is associated with a specific health behaviour, and indirectly if the outcome is related to the long-term effect of personal activities on health status (Ryan, 2009).

4.2.2.4 Motivational Interviewing with Acceptance and Commitment Therapy

Motivational Interviewing (Miller & Rollnick, 2012) and Acceptance and Commitment Therapy (Hayes *et al*., 1999) are two theories focussing on commitment which leads to behaviour change by concentrating on a person's values and communicating in his or her relevant language to achieve change (Miller & Rollnick, 2012). Walker *et al*., (2011) also found that client language was a determining factor in the outcomes of their study using motivational interviewing to determine the influence of client behaviour on the outcome of marijuana treatment.

Walitzer *et al*. (1999) suggested that Motivational Interviewing combined with cognitive and behavioural strategies enhance the effectiveness of treatment.

4.2.2.5 The Health belief model

The Health belief model is frequently applied in health education and health promotion (Glanz *et al*., 2002: 47). The Health belief model emphasises the views of individuals regarding the severity of a health problem, as well as the proposed benefits when changing of behaviour. The health problem and the individual's belief and ability to successfully change the action(s) causing certain health problems lead to changes in behaviour (Shikany *et al*., 2009: 21; Champion & Skinner, 2008).

Sharifirad *et al*. (2013), have explained that the health belief model forms part of the intrapersonal health education models and has four characteristics, namely:

- The proposed behaviour holds many benefits for an individual such as social, family, cultural and economy.
- Health educators plan the interventions around the barriers known by them.
- Participants who need to change their behaviour must know the consequences that if they do not change, it will have a negative impact on their health.
- Specific actions are necessary for change, for example educating individuals and educational media (Sharifirad *et al*., 2008; Sharifirad *et al*., 2006; Morowati-Sharifabad *et al*., 2007).

4.3 THE INTERVENTION PHASE

As mentioned earlier, the baseline results were used to structure the intervention phase. The intervention phase for the process of program planning as applied in the development of educational material for the current study is divided into four different phases. The different phases in planning nutrition education interventions are schematically represented in Figure 4.1. These include conceptualization, formulation, implementation and evaluation. Each phase will now be discussed in more detail.

The first step was to develop educational material to use in presenting nutrition education to the participants as well as other members of the community who were interested in receiving the information. Davidson *et al*. (2003) recommends that it is important to be clear on the message used, which medium was used and who conveyed the message to explain the outcomes of behaviour change.

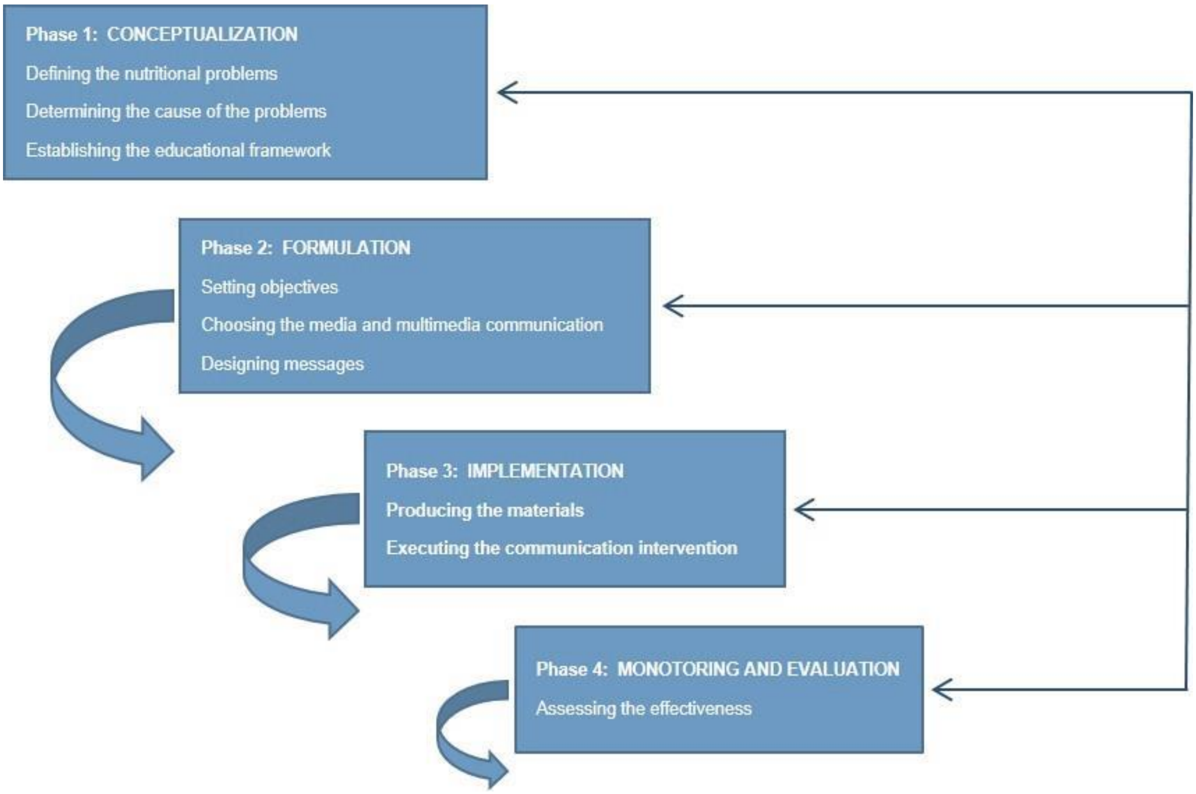

Figure 4.1: A scheme for programme planning, including conceptualization, formulation, implementation and evaluation (International Federation of Red Cross and Red Crescent Societies, 2011; FAO, 1997)

4.3.1 Conceptualization – Phase 1

Conceptualization involves the identification of nutritional problems identified in a community; defining the causes of the problems and establishing the educational framework for the nutrition education process (França *et al*., 2004).

After completion of the baseline phase of the study, nutritional problems and causes from it were identified and the following educational framework was compiled.

- This study showed that the geophagia group had significantly lower serum iron levels than the control group.
- Materials such as harmful bacteria, lead, parasites and worms are found in soil (Sumbele *et al*., 2011; Glickman *et al*., 1999).
- The study also indicated a low physical activity level and a high body mass index (BMI) in both the geophagia and control groups.

4.3.2. Formulation – Phase 2

Formulation includes the setting of objectives, designing of messages, choosing of media and the communication method. Literature emphasises the importance of clear objectives, understandable messages and the selection of particular media as communication channel to the target group (Mitchell & Courtney, 2005; FAO, 1997).

4.3.2.1 Setting of objectives

The objective of the nutrition intervention brochure was to bring about behaviour change in the target group through:

- Informing the participants about the risk factors involved in the practice of geophagia;
- Describing the impact of geophagia on health, and
- Educating the participants about healthy eating habits in general.

An instruction manual (Annexure K) was developed by the researcher which the fieldworkers could use in explaining each objective in a more understandable language, which is important to ensure that the same message is conveyed to the participants throughout the intervention phase. Role play was used to practice the translation of the brochure to ensure that the translators knew the objectives and for the standardization of communication methods used to explain the brochure to the participants.

(i) Objective 1

According to the results obtained in the baseline phase of this study, geophagia may be a risk factor for micronutrient deficiencies (specifically iron deficiency and anaemia). Vulnerable groups include pregnant women and children where micronutrient needs are greater.

In the brochure it was documented as "Soil binds important minerals such as iron, calcium and zinc which are important for the body" and "Pregnant women and children should not eat soil."

The above information was explained and elaborated on by using the instruction manual. The dangers and health consequences of eating soil was explained in easy terms to be understood easily.

(ii) Objective 2

The literature review in Chapter 2 showed that geophagists are very particular about the content and colour of the soil they eat. Some consume clay from termitaria, which is rich in calcium and iron. However, the clays found in South Africa mainly consist of quarts, which could be abrasive to the human intestinal tract. It could also contain heavy metals such as lead. The high content of organic substance in some black clay could host a wide range of microbes, bacteria and geohelminthes, which could be a health risk to geophagists. Soil can also bind with important minerals which lead to micronutrient deficiencies and cause erosion, abrasion and damage to the teeth (Young, 2011: 64).

In the brochure it was documented as: "The soil may contain dangerous items such as: bacteria, parasites, worms and heavy metals such as lead."

The above statement was explained by means of pictures as indicated in the manual. In the pictures they could see what bacteria, parasites and worms look like.

(iii) Objective 3

The South African Department of Health together with other stake holders, have developed the food-based dietary guidelines for healthy eating for adults and children over the age of five years. The food-based dietary guidelines are used to endorse healthy lifestyles and eating practices among all South Africans and to address nutrition challenges (Vorster *et al*., 2013). The SA Food Based Dietary Guidelines (SAFBDG) which were applicable for the period in which the current study was conducted, before the new SA FBDG (2012) were implemented, included the following:

In the brochure the following words were used to attract reader attention by asking "What food is GOOD for you" which was followed by the Food Based Dietary Guidelines:

- Eat a variety of foods;
- Make starchy foods the basis of most meals;
- Chicken, fish, meat, milk or eggs could be eaten daily;
- Eat plenty of vegetables and fruit every day;
- Eat dry beans, peas, lentils and soya regularly;
- Use salt sparingly;
- Use fats sparingly;
- Drink lots of clean, safe water;
- If you drink alcohol, drink it sensibly;
- Use food and drinks containing sugar sparingly and not between meals;
- Be active.

These guidelines were used to educate the participants on healthy eating practices and to be active (Annexures G & H).

4.3.2.2 Choosing media and multimedia communication

As mentioned earlier in this chapter, the communication media plays a vital role in the outcome of nutrition education messages. The communication method for this study was chosen to be interpersonal communication which was strengthened by the use of a brochure that could be taken home. Parker *et al*. (2012) recommends that educational material such as posters, pamphlets and booklets should be used in conjunction with counselling or during support group sessions. The consumer information processing theory states that people have a restricted ability to process, store and retrieve information at any point of time. Therefore information presented should be organized, limited and on the comprehension level of the individual (Holli *et al*., 2009: 222). The successful memorising of information depends on the level of interest shown by the individual regarding the particular topic. Therefore the communication media should be colourful, while questions can be asked to keep the reader's attention (Holli *et al*., 2009: 223).

4.3.2.3 Designing messages

The brochure was chosen as medium of communication and was developed into a tri-fold brochure based on the literature reviews and data collected during the baseline phase of the current study. The interests and needs of the readers of brochures is a fundamental element in the process of construction of this educational material.

The quality of the brochure as well as adequacy of language and illustrations are relevant (Wilkinson & Miller, 2007). According to Wuzowski *et al*. (2008: 100) "A high quality educative material requires reliable information and the use of clear vocabulary in order to permit an easy understanding of its contents." Scientific data is imperative in constructing the brochure content to ensure credibility. Furthermore, key points should be identified and clearly showed in the brochure (Margetts, 2004: 120). The design and layout of a brochure plays a vital role in helping the reader to understand the key message, and thus contributes to the readability level (Kools *et al*., 2006; Houts *et al*., 2006). The National Literacy Work Group on Literacy and Health (1998) suggested that all low-literacy health education material be written at or below a 6^{th} grade reading level. According to Bastable (2008: 108) "Brochures that are conversational and easy to read increase the comfort level of women." The use of ordinary language and cautious use of medical vocabulary increases the readability of the health material. In addition, using short sentences and words increase the readability decrease the reading level and improve understanding. The ability (or lack thereof) of the reader to understand the language as set out in the brochure, can cause a significant barrier in communicating health information. This can lead to readers obtaining confusing and inaccurate health messages (Kreps & Spark, 2008). There are no specific rules to font size and colour of the brochure, but clearly understandable messages should be easily readable (Haute Autorité de sante, 2008). Bastable (2008: 269) has suggested that a simple type style and headers should be used and both capital letters and small letters should be used to increase word recognition.

Literature showed that low literacy education should take place at a grade 6 literacy level (Canadian Public Health Association, 2008). Although the educational level of the participants was between grade 10 and 12, the message was written at a lower literacy level to ensure that the message could not only be understood by the participants but also the rest of the community which could have a lower educational level than the participants. The body mass index of above the normal range of 18.5 kg/m^2 – 24 kg/m^2 indicated an unbalanced intake of nutrients and energy expenditure which was addressed by including the Food Based Dietary Guidelines.

4.3.3 Implementation – Phase 3

The implementation phase comprised the development of the brochure.

The brochure was developed by the researcher in collaboration with academics of the Universities of the Free State and KwaZulu-Natal (information and layout). A graphic designer was also consulted to assist in the layout of the brochure. Factors to be considered in planning nutrition education messages include nutrition-related health concerns, socio-economic status, lifestyle and cultural eating habits, and the ability to understand and apply the information in the education material (Love, 2002). The results of the baseline phase of the intervention information which included socio-economic statuses, level of education, the food frequency questionnaire (Annexure E) as well as blood results, were taken into account while designing the messages for the brochure (Table 4.2). Although the macronutrient intake was sufficient in terms of percentages of total energy intake in the geophagia group, the micronutrient intakes were of concern because of the strong association between pica and micronutrient deficiencies. Foods rich in calcium and iron were specifically specified in the brochure in order to educate the reader about the importance thereof, specifically when practicing geophagia.

After the development of the brochure, the literacy level of the content was tested by using the Coleman Liau Index, which indicated the content of the brochure to accomplish a grade 6 level (Wilson & Wauson, 2010: 123).

The brochure was colour printed and in two languages, namely English and Sotho to ensure that everyone could understand the information in the brochure. Plain text, different fonts, and pictures were used to enhance the desire to read the brochure and to make the brochure easy to understand. The fieldworkers and a Sotho-speaking lecturer at the University of the Free State were consulted during the translation process of the brochure from English to Sotho, to ensure that information was translated correctly.

Table 4.2 Baseline results used for the development of the brochure

SOURCE	BASELINE RESULTS USED FOR DESIGNING MESSAGES	APPLICATIONS AND INFORMATION INCLUDED IN BROCHURE
Socio-demographic questionnaire	Highest level of education: grade 11 - 12	Content of brochure on grade 6 level
	Dominant language: Sotho	Brochure developed in English and Sotho
	More than half of geophagia group did not know that the soil can be harmful	Included the possible dangers of eating soil
Food Frequency Questionnaire	Large number of participants in geophagia group didn't have a refrigerator	Sun-drying of soil included in brochure
	Low calcium intake	Examples of calcium rich food included in brochure
Blood results	Iron deficiency	Examples of iron rich food included in brochure
Activity Questionnaire	Low activity levels	Used food-based dietary guidelines to address inactivity

After the formulation, development and design of the nutrition education brochure was completed, the brochure was ready to be implemented. This included the implementation or application of the brochure, followed by the evaluation and monitoring of it as illustrated in Figure 4.1.

The following steps were taken to implement the brochure during the implementation period:

Step 1

- Preparing visits to QwaQwa with the fieldworkers (translators) and the Central University of Technology. Three planned visits that consisted of three days each to implement the brochure and follow-up visits. Before the implementation phase both translators were tutored by the researcher to clearly explain the aims, objectives and outcomes of the brochure.

Step 2

Visits to participants were confirmed by the fieldworkers who also engaged with them in phase 1. Appointments were made to ensure that every participant was available and to ensure adequate time for the education process. Demographic data such as cell phone number, area in QwaQwa and number of houses were documented by the fieldworker during previous visits to participants. Participants were educated one on one, or in pairs at their homes. A total of 42 participants in the geophagia group and 27 in the control group were educated. Members of the community were also informed regarding the information in the brochure.

Step 3

- After the education process a waiting period of three months allowed participants time to adapt to the recommendations made, before the evaluation took place. Two follow-up visits were also made during this period to ensure that the brochure was fully understood and to address any uncertainties regarding the information in the brochure.
- During this period 1-2 members of the community were also educated during each home visit.

The two fieldworkers were used to address the community to minimize any communication issues. The fieldworkers were fluent in both languages (English and Sotho), as recommended in literature, which is an important contributor to the success of nutrition education. In addition, the translators were also involved in the project during phase 1 (recruitment and pilot study) and phase 2 which included the intervention phase. The one fieldworker was familiar with the community's culture and preferences, which made the implementation process much easier and more effective. The other fieldworker was also involved in the study as one of the researchers. Both fieldworkers were in the same age group as the participants, to ensure effective communication.

A two-way communication process was used, in order for the participants to ask questions at any time to prevent any misperceptions during the explanation process of the brochure. The translators' services proved invaluable in making sure that any communication barriers were eliminated. The information in the brochures was explained in English or Sotho, depending on the language preferred by the participants.

The participants were asked to read through the brochure again during the three month waiting period and to contact the researcher or translator if in need of any further information. The researcher's contact details could be found on the brochure and the fieldworker’s cell phone number was also made available to the participants. During this period one telephonic interview with each participant in the geophagia group was done by the fieldworkers in conjunction with the researcher. The purpose of these telephonic interviews, as indicated in the manual, was to ensure that the participants understood the brochure and to explain any issues which were unclear or not fully understood.

4.3.4 Monitoring and evaluation – Phase 4

Once the participants were informed and educated regarding the information in the brochure, a three month period was given to apply these recommendations. The intervention questionnaire was developed (Annexure I) to see if participants understood the information in the brochure and to determine if the intervention resulted in any changes. A total of 28 participants in the geophagia group and 15 participants in the control group were available to be evaluated. The results of the evaluation of the intervention are presented in the results chapter.

CHAPTER 5

RESULTS

5.1 INTRODUCTION

Descriptive statistics, namely frequencies and percentages for categorical data, and means and standard deviations or medians and percentiles for continuous data, were calculated. Comparisons between groups for continuous data were assessed using independent t-tests. For categorical data, the Chi-square test was used. Comparison within groups between baseline and end of intervention results were measured using the paired t-test. A logistical regression analysis was performed in order to identify those factors measured in this study that can be used to predict whether a person practices geophagia or not in this specific target population. The sample was selected from the population of Thabo Mofutsanyane (Phuthaditjaba) and the Maluti, a Phofung population in the QwaQwa area. Before the intervention, the sample consisted of 69 participants, of whom 42 were in the geophagic group (G) and 27 in the control group (C). After the intervention 28 participants from the geophagia group and 15 participants from the control group were followed up to evaluate the impact of the intervention.

5.2 SOCIO-DEMOGRAPHIC STATUS

The socio-demographic data of both the geophagia and control groups are presented in Table 5.1. The median number of people living in the households was five and four for the geophagia and control group, respectively. The number of adults per household ranged from one to eight in the geophagia group and from one to six in the control group.

The majority of participants in the geophagia group (77.5%) and control group (70.4%) were unmarried. Sotho was the prominent spoken language in both groups (G = 95.2% and C = 92.6%). None of the participants were pregnant (part of

Table 5.1 Socio-demographic information of Geophagia and Control groups

	GEOPHAGIA GROUP		CONTROL GROUP		P-VALUE FOR DIFFERENCES BETWEEN GROUPS
	N (42)	% of total group	N (27)	% of total group	
Mean Age	25	100	26	100	N/A
	42	**100**	**27**	**100**	
Marital Status					
* Unmarried	33	77.5	19	70.4	NS
* Married	8	20.0	5	18.5	NS
* Divorced	0	0.0	0	0.0	N/A
* Widowed	0	0.0	3	11.1	N/A
* Living together	0	0.0	0	0.0	N/A
* Separated	0	0.0	0	0.0	N/A
* Traditional Marriage	1	2.5	0	0.0	N/A
* Other	0	0.0	0	0.0	N/A
	42	**100.00**	**27**	**100**	
Language					
* Sotho	40	95.2	25	92.6	NS
* Tswana	1	2.4	0	0.0	N/A
* English	0	0.0	0	0.0	N/A
* Afrikaans	0	0.0	0	0.0	N/A
* Xhosa	0	0.0	1	3.7	N/A
* Swazi	0	0.0	0	0.0	N/A
* Zulu	0	0.0	1	3.7	N/A
* Other	1	2.4	0	0.0	N/A
	42	**100**	**27**	**100**	
Are you pregnant?					
Yes	0	0	0	0	
No	42	100	27	100	NS
	42	**100**	**27**	**100**	
Are you breastfeeding?					
Yes	0	0	0	0	
No	42	100	27	100	NS
	42	**100**	**27**	**100**	
How many persons live in the house permanently?					
Adults (≥ 18 years)					
1-2	23	55	19	70	NS
3-4	16	38	7	26	NS
5-6	2	5	1	4	NS
7-8	1	2			
9-10	0				
	42	**100**	**27**	**100**	

***** Statistically significant p≤0.05; NS = no significant difference; N/A not applicable

Table 5.1 Socio-demographic information of Geophagia and Control groups (cont.)

	GEOPHAGIA GROUP		CONTROL GROUP		P-VALUE FOR DIFFERENCES BETWEEN GROUPS
	N (42)	% of total group	N (27)	% of total group	
Children (< 18 years)					
0	9	21	4	14	NS
1-2	14	34	10	37	NS
3-4	10	24	8	30	NS
5-6	7	17	3	11	NS
7-8	1	2	2	8	NS
9-10	1	2	0	0	
	42	**100**	**27**	**100**	
What is your highest level of education?					
* None	0	0.0	0	0.0	
* Primary school	2	4.8	3	11.1	NS
* Grade 8 - 10	15	35.7	6	22.2	NS
* Grade 11 - 12	18	42.9	14	51.9	NS
* Tertiary education	7	16.7	4	14.8	
	42	**100**	**27**	**100**	
What is your employment status					
* Housewife by choice	1	2.4	0	0.0	N/ A
* Unemployed	38	90.5	20	74.1	NS
* Self employed	1	2.4	0	0.0	N/A
* Full time wage earner	1	2.4	7	25.9	0.014*
* Other. Specify (part-time, piece job, etc.)	1	2.4	0	0	N/A
	42	**100**	**27**	**100**	
Husband's/partner's primary income employment status					
* Retired by choice	0	0.0	0	0.0	
* Unemployed	8	19.1	3	11.1	NS
* Self employed	2	4.76	1	3.7	NS
* Full time wage earner	9	21.4	13	48.2	NS
* Other. Specify (part-time, piece job, etc.)	23	54.8	10	37.0	N/A
* Not applicable (dead)	0	0.0	0	0.0	NS
	42	**100**	**27**	**100**	
Who is the head of this household?					
* Wife	3	7.1	0	0.0	N/A
* Husband	6	14.3	6	22.2	NS
* Child/children	0	0.0	0	0.0	
* Parent	14	33.3	13	48.2	NS
* Grandparent	5	11.9	2	7.4	NS
* Friend	0	0.0	0	0.0	
* Self	6	14.3	4	14.8	NS
* Other	8	19.1	2	7.4	NS
	42	**100**	**27**	**100**	

***** Statistically significant $p \leq 0.05$; NS = no significant difference; N/A not applicable

Table 5.1 Socio-demographic information of Geophagia and Control groups (cont.)

	GEOPHAGIA GROUP		CONTROL GROUP		P-VALUE FOR DIFFERENCES BETWEEN GROUPS
	N (42)	% of total group	N (27)	% of total group	
Type of dwelling					
* Brick or concrete	36	85.7	26	96.3	NS
* Traditional mud	4	9.5	1	3.7	NS
* Tin	1	2.4	0	0.0	N/A
* Plank, wood	0	0.0	0	0.0	N/A
* Other	1	2.4	0	0	N/A
	42	**100**	**27**	**100.00**	
What fuel is used for cooking?					
* Electric	35	83.3	23	85.2	NS
* Gas	1	2.4	2	7.4	NS
* Paraffin	5	11.9	2	7.4	NS
* Wood, coal	1	2.4	0	0.0	N/A
* Sun	0	0.0	0	0.0	N/A
* Open fire	0	0.0	0	0.0	N/A
	42	**100**	**27**	**100**	
Do you use cast iron pot for cooking?					
* ≤ Once a week	16	38.1	13	48.2	NS
* > Once a week	0	0.0	1	3.7	NS
* Everyday	2	4.8	0	0.0	N/A
* No	24	57.1	13	48.2	NS
	42	**100.00**	**27**	**100**	
Does the home have a working refrigerator and/or freezer?					
* Yes	16	38.1	25	92.6	
* No	26	61.9	2	7.4	0.028*
	42	**100.00**	**27**	**100**	
Does the home have a working stove (gas, coal, electric or hot plate)					
* Yes	36	85.7	25	92.6	NS
* No	6	14.3	2	7.4	NS
	42	**100**	**27**	**100**	
Does the home have a working primus or paraffin stove?					
* Yes	26	61.9	17	63.0	NS
* No	16	38.1	10	37.0	NS
	42	**100.00**	**27**	**100**	
Does the home have a working microwave?					
* Yes	26	61.9	18	66.7	NS
* No	16	38.1	9	33.3	NS
	42	**100.00**	**27**	**100**	

***** Statistically significant p≤0.05; NS = no significant difference; N/A not applicable exclusion criteria) and a large percentage of participants in both groups had as highest level of education grade 11 - 12 (G = 42.9% and C = 51.9%). More than ninety percent (90.5%) of the respondents in the geophagia group and 74.1% of the control group were unemployed. The primary employment status of the husband or partner in the geophagia group (54.8%) was due to part-time or piece jobs while in the control group a full-time wage earner was present in 48.2% of households. In 33.3% of the geophagia group and in 48.2% of the control group a parent of the participant was the head of the household. The number of adults living in a household was predominantly in the group of one or two adults living in the same house for both the geophagia group (55%) and control group (70%). The number of children per household was the highest in the one to two children per house category in the control group (37%), and in the geophagia group (34%). The majority of participants in both groups (G = 85.7% and C = 96.3%) lived in a brick or concrete dwelling.

Electricity was used by both groups as the main source of energy for cooking (G = 83.3% and C = 85.2%), followed by paraffin (G = 11.9% and C = 7.4%). Gas and wood was used by less than 3% of participants in the geophagia group (2.4%) and 7.4% of participants in the control group as source of energy for cooking. Cast iron pots were used less than once a week by the majority of participants in the in the control group (48.2%), while for preparing food. In the geophagia group most households did not have a working refrigerator and/or freezer (61.9%), while the majority in the control group did (92.6%). Most homes did have a working stove (G = 85.7% and C = 92.6%); a working primus or paraffin stove (G = 61.9% and C = 63%) as well as a microwave oven (G = 61.9% and C = 66.7%).

Table 5.2 Final model for socio-demographic factors that were significantly associated with the practice of geophagia

VARIABLE	SCORE	P-VALUE	ODDS RATIO	95% CONFIDENCE INTERVAL (CI)	
				LOWER	UPPER
Full-time wage earners	6.43	0.014	0.14	0.027	0.755
Not having a refrigerator	1.53	0.028	1.54	0.056	0.849

Geophagia was negatively associated with being a full-time wage earner (odds ratio 0.14) and positively associated with not having a refrigerator (odds ratio 1.54) as indicated in Table 5.2. The likelihood of practicing geophagia was thus lower in those participants that were full-time wage earners (odds ratio 0.14) and in those that owned a refrigerator (odds ratio 1.54)

5.3 DIETARY INTAKE

Dietary intake was assessed by determining the amount and frequency of food consumed per day, per week, or per month. From this the energy intake, macro- and micronutrient intake was determined.

5.3.1 Total energy and macronutrient intake

Mean energy, macronutrient and cholesterol intake is shown in Table 5.3. The mean total energy intake for the geophagia group and control group were 10324.3 ± 2755.0 kJ and 10763.9 ± 2556.3 kJ respectively.

The mean total protein intake was almost similar in both groups (G = 74.6 ± 20.1 g; C = 85.6 ± 29.1 g) at 12.5% (geophagia group) and 13.6% (control group) of the total energy intake, which fell into the recommended range of 10 – 35% of total energy intake. The average intake of carbohydrates was 308.5 g and 318.6 g for the geophagia group and control group respectively which is threefold the EAR of 100 g per day. The percentage of total energy from carbohydrate was similar in both groups (G = 54.1%; C = 54.4%), which is within the recommendation of 45 – 65%. The mean total fat intake in the geophagia group was 93.3g and in the control group 94.5g. The percentage total energy intake from fat was 33.1% for the geophagia group and 31.5% for the control group, which was also within the recommended range of 25 – 35%. The mean soluble dietary fibre (G = 3.7g; C = 3.6g) did not different significantly between the groups (p=0.86) as well as the insoluble dietary fibre intake (p=0.89) with a mean intake of 4.6g in the geophagia group and 4.7g in the control group. As seen by the 95% CI for mean differences there were no statistically significant differences between the reported energy and macronutrient intake of the participants in the geophagia and control groups.

Table 5.3 Mean energy, macronutrient and cholesterol intake of Geophagia and Control groups

NUTRIENT INTAKE	N		Mean	STD Deviation	P-value between groups	EAR	Confidence Interval (CI) 95%	
Energy (kJ)	Geophagia group	42	10324.3	2755.0	0.50		879.7	19.0
	Control group	27	10763.9	2556.3				
Total protein (g)	Geophagia group	42	74.6	20.1	0.07	66g	-0.85	22.8
	Control group	27	85.6	29.1				
% of total energy	Geophagia group	42	12.5	2.6	0.125	10 - 35%	-0.32	2.6
	Control group	27	13.6	3.5				
Plant protein (g)	Geophagia group	42	28.7	9.5	0.28		-1.9	6.8
	Control group	27	31.1	8.0				
Animal protein (g)	Geophagia group	42	42.3	15.5	0.06		-0.33	20.08
	Control group	27	52.2	27.1				
Total carbohydrates (CHO) (g)	Geophagia group	42	308.5	91.3	0.63	100g	-31.35	51.7
	Control group	27	318.6	72.1				
% of total energy	Geophagia group	42	54.1	7.4	0.86	45 - 65%	-3.6	4.3
	Control group	27	54.4	9.1				
	Control group	27						
Soluble dietary fibre (g)	Geophagia group	42	3.7	1.5	0.86		-0.70	0.6
	Control group	27	3.6	1.1				
Insoluble dietary fibre (g)	Geophagia group	42	4.6	1.9	0.89		-0.76	0.9
	Control group	27	4.7	1.3				
Total fat (g)	Geophagia group	42	93.3	32.9	0.89	ND	-16.51	18.9
	Control group	27	94.5	40.5				
% of total energy	Geophagia group	42	33.1	6.8	0.39	25 - 35%	-5.31	2.1
	Control group	27	31.5	8.6				
Saturated fat (g)	Geophagia group	42	26.4	9.4	0.68	ND	-4.16	6.3
	Control group	27	27.5	12.3				
Polyunsaturated Fatty Acids (PUFA) (g)	Geophagia group	42	26.6	11.5	0.61	12g	-4.32	7.3
	Control group	27	28.1	12.2				
Mono-unsaturated fatty acids (MUFA) (g)	Geophagia group	42	30.8	11.5	0.62	ND	-4.58	7.7
	Control group	27	32.4	13.9				
Cholesterol (mg)	Geophagia group	42	308.5	91.3	0.45	ND	-44.1	98.5
	Control group	27	318.7	72.1				

ND = not determined

5.3.2 Micronutrient intake

5.3.2.1 Minerals

Table 5.4 shows the mineral and trace element intake of the participants in the two groups at baseline. Both the geophagia group and control group had a calcium intake that was lower than the EAR of 800 mg calcium per day (G = 502.0 mg; C = 589.0 mg). Both groups had intakes that were higher than the EAR for the following minerals: total iron (G = 11.6 mg; C = 13.5 mg); selenium (G = 50.4 mg; C = 54.5 mg); magnesium (G = 287.5 mg; C = 314.7 mg) and phosphorus (G = 1057.1 mg; C = 1209.0 mg). Mean intakes of haem iron (G = 0.7mg; C = 1.2mg) and non-haem iron (G = 4.2; C= 5.3) differed significantly between the two groups (0.005; 0.004 respectively). An EAR for potassium, sodium, haem iron and non-haem iron has not been established. Intakes of sodium (G = 2438.1 mg; C = 2500.9 mg; p = 0.8) and phosphorus (G = 1057.1 mg; 1209.0 mg; p = 0.06) did not differ significantly between the two groups.

5.3.2.2 Vitamin intake of geophagia and control groups

Mean vitamin intakes of the two groups are shown in Table 5.5. Compared to the geophagia group, the control group had a significantly higher intake of vitamin A (p = 0.005). In both groups the intake of vitamin A (G = 1078.8; C = 1731.0) was higher than the EAR of 500 µg per day. Other vitamins that exceeded the RDA in both groups were: thiamine (G = 1.3 mg; C = 1.6 mg); riboflavin (G = 1.5 mg; C = 2.1 mg); niacin (G = 17.3 mg; C = 23.3 mg) and vitamin B6 (G = 1.5 mg; C = 1. 8 mg). For vitamin C the control group had an intake that was higher (81.4 mg) than the RDA of 75 mg; while the intake of vitamin C in the geophagia group was lower than the RDA at 51.1 mg. A significant difference between the two groups was observed as far as niacin (p = 0.002) and riboflavin (p = 0.003) were concerned. In both groups, intakes of vitamin D (G = 5.1 mg; C = 5.8 mg) and folate (G = 233.2 mg; C = 282.6 mg) were lower than the RDA. Intake of vitamin E in the geophagia group (G = 13.9 mg) was more than the EAR of 12mg.

Table 5.4 Mean mineral and trace elements intake of Geophagia and Control groups

NUTRIENT INTAKE	N		Mean	Std Deviation	P-value between groups	EAR	Confidence Interval (CI) 95%	
Calcium (mg)	Geophagia group	42	502.0	216.3	0.13	800	-26.2	200.7
	Control group	27	589.0	250.2				
Chromium (mg)	Geophagia group	42	43.4	24.4	0.864	ND	-10.5	12.4
	Control group	27	44.4	21.4				
Copper (mg)	Geophagia group	42	1.7	0.7	0.039	700 µg	0.03	1.1
	Control group	27	2.2	1.6				
Iron haem (mg)	Geophagia group	42	0.7	0.4	0.005*		0.2	0.9
	Control group	27	1.2	1.1				
Iron non-haem (mg)	Geophagia group	42	4.2	1.1	0.004*		0.4	1.8
	Control group	27	5.3	1.9				
Total iron (mg)	Geophagia group	42	11.6	3.4	0.053*	8.1	-0.02	3.8
	Control group	27	13.5	4.6				
Iodine (mg)	Geophagia group	42	41.2	18.7	0.991	95 µg	-8.5	8.6
	Control group	27	41.3	15.1				
Potassium (mg)	Geophagia group	42	2419.2	700.8	0.051	–	-0.9	718.4
	Control group	27	2777.9	774.8				
Magnesium (mg)	Geophagia group	42	287.5	93.9	0.213	265	-15.9	70.3
	Control group	27	314.7	76.8				
Manganese (mg)	Geophagia group	42	2754	1066.9	0.112	–	-96.0	892.8
	Control group	27	3152.4	896.4				
Sodium (mg)	Geophagia group	42	2438.1	917.5	0.791	-	-408.1	533.5
	Control group	27	2500.9	1014.4				
Phosphorus (mg)	Geophagia group	42	1057.1	320.5	0.062	580	-7.8	311.8
	Control group	27	1209.0	330.9				
Selenium (mg)	Geophagia group	42	50.4	22.9	0.495	45	-7.8	16.0
	Control group	27	54.5	24.9				

***** Statistically significant p≤0.05; ND = not determined

Table 5.5 Mean vitamin intake of Geophagia and Control groups

Nutrient intake	N		Mean	Std. Deviation	P-value between groups	EAR	Confidence Interval (CI) 95%	
							Min	Max
Vitamin A (mg)	Geophagia group Control group	42 27	1078.8 1731.0	539.7 1284.1	0.005*	500 µg/d	206.9	1097.6
Vitamin D (mg)	Geophagia group Control group	42 27	5.1 5.8	2.8 2.9	0.305	10 µg/d	-0.7	2.1
Vitamin E (mg)	Geophagia group Control group	42 27	13.9 15.8	7.8 8.4	0.34	12	-2.1	5.9
Vitamin K (mg)	Geophagia group Control group	42 27	286.4 416.6	288.7 422.7	0.133	ND	-40.6	301.0
Thiamine (mg)	Geophagia group Control group	42 27	1.3 1.6	0.5 0.6	0.022	0.9	0.04	0.6
Riboflavin (mg)	Geophagia group Control group	42 27	1.5 2.1	0.7 1.0	0.003*	0.9	0.2	1.0
Niacin (mg)	Geophagia group Control group	42 27	17.3 23.3	5.9 10.0	0.002*	11	2.2	9.8
Vitamin B6 (mg)	Geophagia group Control group	42 27	1.5 1.8	0.5 0.8	0.083	1.1	-0.03	0.6
Folate (mg)	Geophagia group Control group	42 27	233.2 282.6	72.6 93.1	0.016	32	9.3	89.3
Vitamin B12 (mg)	Geophagia group Control group	42 27	7.3 11.8	5.1 13.5	0.052	2.0	-0.3	9.1
Vitamin C (mg)	Geophagia group Control group	42 27	51.1 81.4	18.5 79.8	0.02	60	4.8	55.8

* Statistically significant p≤0.05

5.4 ANTHROPOMETRIC NUTRITIONAL STATUS

The mean anthropometric results are summarized in Table 5.6 and the categorical body mass index values in Table 5.7. Mean waist circumference of both groups fell under the cutoff point for risk waist circumference in women which is >88 cm (G = 77.5; C = 73.2) (Alberti *et al.*, 2006).

Although the majority of the participants in both the geophagia and control group fell in the normal category for body mass index (BMI) of 18.5 – 24.9 kg/m^2, the mean BMI fell within the overweight category (G = 25.6 kg/m^2; C = 25.1 kg/m^2). Only one participant in the geophagia group fell in the low BMI category.

Table 5.6 Mean anthropometric values of Geophagia and Control groups

Anthropometric measurements	Geophagia group (n=42)			Control group (n=27)			P-value between groups
	Min	Max	Mean	Min	Max	Mean	
Weight (kg)	43.8	120	62.7	43.1	111.3	61.7	0.767
Height (cm)	140	165	156.	140	164.5	156.4	0.095
BMI (kg/m^2)	18	37.0	25.6	19.2	34.1	25.1	0.951
Waist Circumference (cm)	63	126	77.5	62	95	73.2	0.464
Hip Circumference (cm)	85	163	102.6	88	142	101.3	0.742
Waist to hip ratio (WHR)	0.7	1.0	0.8	0.7	0.9	0.7	0.417

Table 5.7 Categorical Body Mass Index (BMI) Values

BMI category	Geophagia group			Control group			P-value between groups
	n	Mean	Std. Deviation	n	Mean	Std. Deviation	
Low <18.5 kg/m^2	1	18					N/A
Normal 18.5 - 24.9 kg/m^2	21	22.4	1.9	16	21.8	1.6	0.302
Overweight 25 – 29.9 kg/m^2	11	28	1.7	5	26.5	1.0	0.051
Obese ≥30 kg/m^2	7	34	4.2	5	34.5	4.2	0.844

Table 5.8 Final model of anthropometric factors associated with geophagia

Variable	Score	P-value	Odds ratio	95% Confidence Interval	
				Lower	Upper
Waist to hip ratio	3.695	0.055	0.353	0.126	0.985

A waist to hip ratio in the android category (>0.8) was negatively associated with geophagia (odds ratio 0.353).

5.5 Activity levels

The mean physical activity level (PAL) for the geophagia group was 1.7 and for the control group it was 1.6, both of which were on the PAL borderline for low active persons which is between 1.4 - <1.6 PAL, whereas active persons are between 1.6 - <1.9 PAL. The differences in mean PAL between the two groups were not significant (p= 0.45).

A large percentage of participants in the geophagia group (n=15) fell into the PAL range for low activity, whilst a large percentage of the participants in the control group (n=12) fell into the active PAL range of 1.6 - <1.9 as demonstrated in Table 5.10.

Table 5.9 Continuous activity level

	Geophagia group (n=42)				Control group (n=27)				P-value between groups
	Min	Max	Mean	Std. Deviation	Min	Max	Mean	Std. Deviation	
Total PAL	1.0	2.2	1.7	0.3	1.2	2.6	1.6	0.2	0.45

Table 5.10 Categorical activity level

PAL category	Geophagia group (n=42)					Control group (n=27)				
	n	Min	Max	Mean	Std Deviation	n	Min	Max	Mean	Std Deviation
Sedentary: 1 - <1.4 PAL	5	1	1.4	1.30	0.1	4	1.2	1.4	1.3	0.1
Low activity: 1.4 - <1.6 PAL	15	1.5	1.6	1.5	0.1	7	1.5	1.6	1.5	0.0
Active: 1.6 - <1.9 PAL	9	1.7	1.9	1.8	0.1	12	1.7	1.9	1.7	0.1
Very active: 1.9 - 2.5 PAL	9	2.0	2.2	2.10	0.2	3	1.99	2.6	2.0	0.0

5.6 BLOOD RESULTS

The mean values for blood results are summarized in Table 5.11.

Participants in both the geophagia and control groups had normal mean blood values for sodium (G = 138.8 mmol/L; C = 137.6 mmol/L), potassium (G = 4.4 mmol/L; C = 4.6 mmol/L) and calcium (G = 2.3 mmol/L; C = 2.3 mmol/L). Both groups had mean serum magnesium values of 0.8 mmol/L and 0.9 mmol/L respectively, which fell below the ideal range of 2.3 - 2.6 mmol/l. The mean serum iron levels of the geophagia group were significantly lower (p = 0.000) than that of the control group (G = 6.9 µmol/L; C = 13.8 µmol/L). There was also a significant difference in the serum

Table 5.11 Mean blood results

	Normal value	Geophagia group (n=42)				Control group (n=27)				95% Confidence Interval (CI) of mean difference	
		Min	Max	Mean	Std. Deviation	Min	Max	Mean	Std. Deviation	Lower	Upper
Na	136 - 147.0 mmol/L	132.5	142.7	138.8	2.3	114.1	143.9	137.6	5.06	-2.9	0.6
Ca	2.15 - 2.50 mmol/l	2.2	2.5	2.3	0.07	2.2	2.4	2.3	0.1	-0.02	0.03
K	3.5 - 5.1 mmol/l	3.4	5.3	4.4	0.5	3.6	5.4	4.6	0.5	-0.01	0.5
BUNm	2.60 - 6.70 mmol/L	.63	4	2.8	0.8	0.8	5.71	3.0	1.15576	-2.7	0.7
Phosm	.80 - 1.46 mmol/L	.65	1.50	1.10	0.20	0.72	1.47	1.1	0.2	-0.1	0.1
TPm	65.0 - 80.0 g/L	.8	102.6	80.4	15.1	68.5	91.4	79.2	5.1843	-7.2	4.81
Albm	35 - 52 g/l	29.2	46.2	38.8	4.1	33.6	44.9	40.4	3.05141	-0.2	3.4
AST	13 - 35 IU/L	16.3	36.6	23.2	4.2	15.7	38.1	22.5	4.3339	-2.8	1.3
ALT	10 - 40 IU/L	7.9	28.6	13.1	3.9	8.9	36.7	14.7	5.3765	-0.5	3.9
CHOL	<5.0 mmol/L	2.3	5.2	3.7	0.8	2.6	6.6	4.0	.9893	-0.1	0.7
Mg	2.3 - 2.6 mmol/l	.69	1.1	0.8*	0.1	0.75	1.06	0.9*	0.1	-0.0	0.1
Fe	10 – 30 µmol/l	2.0	23	6.9	4.0	3	22.0	13.8	5.0	4.0	9.3
Ferritin	10.0 – 291.0 µg/l	2.5	31.9	11.9	7.7	6.3	175.5	42.3	39.8	15.6	41.4
Transferrin	2.5 - 3.8 g/l	2.4	4.5	3.2	0.4	1.9	3.3	2.7	0.42	-0.7	-0.3
Transferrin saturation	20.0 – 55.0%	1.7	24.8	8.1	6.0	5.4	29.8	18.8	7.5	6.7	13.3
CRP	<5 mg/L	1.0	19.8	3.02	4.2	1.0	28.6	4.7	6.9	-1.1	4.31
Hb	12-15g/dl	7.2	14.4	11.2*	1.83	9.9	15.9	13.3*	1.20	1.2	2.8
MCV	83-101fl	63	95	80.2*	11.8	67	95	87.8*	6.47	2.61	12.8
MCH	27.0-322.5 pg	19.5	32.4	27.1*	3.7	22.4	32.9	29.5*	3.00	-49.3	24.2
RBC	$3.8\text{-}4.8 \times 10^{12}$/l	3.7	4.6	4.1*	0.3	4.0	5.2	4.4*	0.3	0.14	0.5
WBC	$4.0 – 11.0 \times 10^{9}$/l	2.9	12.8	5.6	2.0	3.6	10.7	5.9	2.01	-0.8	1.2
Platelets	$150\text{-}410 \times 10^{9}$/l	90	443	286.3	85.4	172	389	273.8	637.0	-52	27.0
ESR	0-12 mm/h	3	126	54.1	41.9	3	127	33.9*	33.52	-39.7	-0.6

***** Means with the same symbol differ significantly between groups (p≤0.05) ferritin levels between the geophagia and control group (G =11.9µg/L; C = 42.3 µg/L; p = 0.00). Serum transferrin and serum transferrin saturation levels also differed significantly between the groups (G = 3.2; 8.1 and C = 2.7; 18.8; p = 0.00).

The mean haemoglobin (G=11.2g/dl; C=13.3g/dl differed significantly while the mean cell haemoglobin (G=27.1pg; C=29.5pg) and the mean cell volume (G=80.2fl; C=87.8fl) were not significantly lower in the geophagia group in comparison to the control group. The platelet count (G = 286.3; C = 273.8) in both groups were within normal reference range ruling out bleeding. The white blood cell count (WBC) (G = 5.6 x 10^9/l; C = 5.9 x 10^9/l) and C-reactive protein (CRD) (G=3.0mg/L; C=4.7mg/L) also fell within normal reference range for the geophagia and control groups, while the erythrocyte sedimentation rate (ESR) (G= 54.1mm/h; 33.9mm/h) was higher than the normal reference range in both groups.

5.7 CORRELATION BETWEEN DIETARY INTAKE AND BLOOD RESULTS OF GEOPHAGIA AND CONTROL GROUPS PRE- AND POST-INTERVENTION

The correlation between the dietary intake and blood results of the geophagia and control groups before the intervention are provided in Table 5.12. In both the geophagia group and control group serum iron correlated with albumin (p = 0.005; p = 0.008) respectively and dietary iron did not correlate with serum iron in either of the groups. Albumin in the geophagia group correlated with calcium (p = 0.000) and phosphate (p = 0.004) and dietary iron intake correlated with energy intake (p = 0.000).

Table 5.12 The correlation between the dietary intake and blood results of the Geophagia and Control group before intervention

Geophagia group (n=42)				Control group (n=27)			
Variable 1	**Variable 2**	**R^2**	**P-value**	**Variable 1**	**Variable 2**	**R^2**	**P-value**
Serum Iron	Albumin	0.337	0.005*	Serum Iron	Albumin	0.315	0.008*
Albumin	Calcium Phosphate	0.762 0.342	0.000* 0.004*				
Dietary iron	Energy	0.710	0.000*	Dietary iron	Sodium Potassium Chloride Calcium Phosphate Selenium Mn Dietary Cholesterol Magnesium Plantprotein Animal protein Haem-iron NonHaem-iron Copper Dietary fat	0.705 0.776 0.504 0.577 0.792 0.498 0.538 0.547 0.737 0.500 0.618 0.565 0.726 0.648 0.511 0.555	0.000* 0.000* 0.000* 0.000* 0.000* 0.000* 0.000* 0.000* 0.000* 0.000* 0.000* 0.000* 0.000* 0.000* 0.000* 0.000*

***** Statistically significant p≤0.05

5.8 IRON STATUS AND GEOPHAGIA

A logistic regression analysis with forward selection was performed in order to establish a typical metabolic profile that could be associated with geophagia. It is envisaged that from the variables included in the equation, one could establish whether a given individual practices geophagia or not. Variables included in the equation are presented in Table 5.13. Risk factors which can be significantly associated with the practice of geophagia included: serum iron ($p = 0.00$), haem-iron ($p = 0.009$), non-haem-iron ($p = 0.004$), ferritin ($p = 0.00$), transferrin ($p = 0.000$), transferrin saturation ($p = 0.000$) and haemoglobin ($p=0.000$) as illustrated in Table 5.8. In addition the waist-to-hip-ratio was also identified as a risk factor with geophagia ($p=0.055$).

A logistic regression analysis of the components of iron status as presented in Table 5.13, delivered the following equation:

$$\mathbf{Y} = \alpha + (-0.184)\text{ Serum iron (Fe)} + (-1.456)\text{ HaemFe} + (-0.008)\text{ NonHaemFe} + (-0.31)\text{ Ferritin} + (0.538)\text{ Transferrin} + (0.026)\text{ Transferrin saturation} + (-0.441)\text{ Haemoglobin} + € \text{ (with € as the error).}$$

It is evident from this analysis that a strong correlation exists between blood iron status variables, and the practice of geophagia.

An additional logistic regression analysis was performed, using a cluster of variables (Iron, Ferritin, Transferrin, Transferrin Saturation, and Haemoglobin) that collectively relate to Iron Status. Each variable was divided into two categories, using the 50^{th} percentile as cut-off (using category 1 as non-desirable, rather than above or below the 50^{th} percentile and category 2 as desirable, rather than above or below the 50^{th} percentile). It is important to acknowledge that the 50^{th} percentile was relative to each group and not based on any standard clinical reference values.

$$\mathbf{Y} = \alpha + (0.431)\text{ Cluster} + € \text{ (with € as the error).}$$

Table 5.13 Final model of blood (pathology) associated with geophagia

VARIABLE	SCORE	P-VALUE	ODDS RATIO	95% CONFIDENCE INTERVAL	
				LOWER	UPPER
Iron (FE)	19.589	0.000*	9.80	2.99	32.11
Ferritin	15.434	0.000*	3.750	1.312	10.721
Transferrin	17.481	0.000*	6.923	2.243	27.929
Haemoglobin	18.425	0.000*	14.50	4.066	51.709
Haem-iron	6.888	0.009*	3.508	1.244	9.893
Non-haem-iron	8.134	0.004*	4.673	1.613	13.538
Transferrin saturation	23.697	0.000*	14.50	4.066	51.709

***** Statistically significant p≤0.05

Based on this analysis, it is shown that the Odd Ratio for someone to practice geophagia and to be classified below the 50th percentile is 27.632 (CI: 3.408 to 224.048; p = 0.000). The implication of this ratio is far-reaching.

5.9 THE GEOPHAGIA KNOWLEDGE AND HABITS PRE- AND POST-INTERVENTION, AS WELL AS THE FOOD-BASED DIETARY GUIDELINES COMPLIANCE POST-INTERVENTION WILL BE PRESENTED IN TABLES.

5.9.1 Geophagia knowledge and habits before intervention

The geophagia knowledge and geophagia habits of the participants were determined during phase 1 when recruitment took place as well as during phase 2 for the geophagia and control group. The geophagia group consisted of 42 people practicing geophagia for at least more than one month.

The geophagia knowledge and habits for the geophagia group before intervention are presented in Table 5.14

5.9.1.1 Knowledge and habits related to geophagia group before intervention

The majority of participants consumed soil more than once a day (42.9%) and 57.1% practiced geophagia once a day. The amount of years that the participants had practiced geophagia ranged from one year to 24 years. Cultural, traditional and spiritual reasons were given as the main reason for consuming soil (65.9%) and the craving for soil was also reported by most of the participants that practiced geophagia (97.6%) and occurred daily (82.9%). The same number of participants reported that craving most likely occurs during the day (n=14) as well as after consuming a meal (n=14). Participants (53.7%) also indicated to crave soil during pregnancy. The smell of the clay also triggered the craving for soil (30%). In a large percentage, family members and friends (65.9%) knew that the participants were consuming soil.

The main substance consumed by the geophagia group was soil (46.3%) and then clay (29.3%), both preferably wet (78%). The most prominent clay used by the geophagists in this study was whitish in colour (65.8%) because of its taste (68.3%). The clay was collected either from a hill or mountain (19.5%) or was bought at a market (12.2%). When the participants had collected the clay, only 26.8% processed the substance before it was eaten, while 20 people indicated that they do use some heat treatment. The geophagists in this study did not think that the substance can be harmful to the human body (53.6%) and 46.3 % did think so. More than half of the participants (58.5%) that answered 'Yes', however did not know the reason for saying so, but did think that the clay or soil may contain harmful elements such as parasites (61%). The majority also didn't know which components could be found in the substances.

Table 5.14 Geophagia knowledge and habits of the Geophagia group pre-intervention

	Geophagia group (n=42)	
	N (42)	**% of group**
Are you presently in the habit of eating soil?		
Yes	42	100%
No	0	0%
Frequency of eating soil:		
Once a day	24.0	57.1
More than once a day	18.0	42.9
How long have you been eating soil? (years)		
1 - 5	19.0	39.1
6 - 10	14.0	34.1
11 - 15	7.0	17.0
16 - 20	1.0	2.4
20 - 24	1.0	2.4
Reasons for eating soil		
No answer	1.0	2.4
Standard practice (cultural, traditional, spiritual)	27.0	65.9
When hungry	1.0	2.4
When pregnant	1.0	2.4
Standard practice and craving	3,0	7.3
Standard practice and when hungry	2,0	4.9
Standard practice and when pregnant	6.0	14.6
Do you ever crave soil?		
Yes	40.0	97.6
No	2.0	4.8
If Yes, how often?		
Regularly - monthly	2.0	4.9
Regularly - weekly	5.0	12.2
Regularly - daily	34.0	82.9
When do you crave soil?	14.6	35.6
Through the day	4.9	12.0
Need some taste	14.6	35.6
After eating	12.2	30.0
Smells it	2.4	5.9
After rain	4.9	4.9
See someone eating soil	5.0	12.0
Pregnant, smells it and after rain	2.4	5.9
Pregnant and away from home	4.9	12.0
Pregnant and after eating	2.4	5.9
Pregnant and smells it	4.9	12.0
Pregnant and see someone eating soil	2.4	5.9
Pregnant and before eating	2.4	12.0
Need some taste, and after rain	4.9	12.0
After eating, and after rain	2.4	5.9
Anytime	7.3	18.0
Smells it, and after rain		

Table 5.14 Geophagia knowledge and habits of the Geophagia group pre-intervention (cont.)

	Geophagia group (n=42)	
	N (42)	% of group
When pregnant, how often do you eat soil?		
Once a month	23	56.1
Once a week	1	2.4
Once a day	14	34.1
More than once a day	3	7.3
Do other people know that you eat soil?		
Yes	35	85.4
No	7	16.6
If Yes, who knows about it?		
No answer	5	11.9
Family members	6	14.6
Extended family members	4	9.8
Family members and friends	27	65.9
Which substances are eaten?		
Soil	19	46.3
Clay	12	29.3
Soil and Clay	7	17.1
Other	4	11.9
How are the substances eaten?		
With other food	3	7.1
Wet	32	78.0
Dry	7	17.1
What are the traditional names of the substances consumed and bought?		
Moby	42	100
Where do you obtain your preferred substance?		
From nature	11	26.8
Buy it	9	22.0
Get it from someone	2	4.9
Nature, and buy it	18	43.9
Hill/Mountain	8	19.5
Riverbed	1	2.4
Pit/Excavation	9	22.0
Market	5	12.2
No answer	1	2.4
If you buy it, indicate the price per handful (R/Pula):		
<R1	14	34.1
R1	18	43.9
R2	7	17.1
R5	3	7.1
What is the colour of your preferred substance?		
Reddish	2	4.9
Whitish	27	65.8
Yellowish	1	2.4
Khaki	3	7.3
Reddish and whitish	1	2.4
Reddish and yellowish	1	2.4
Reddish and khaki	1	2.4
Whitish and yellowish	2	4.8
Whitish and khaki	3	7.3
Reddish, whitish and khaki	1	2.4

Table 5.14 Geophagia knowledge and habits of the Geophagia group pre-intervention (cont.)

	Geophagia group (n=42)	
	N (42)	**% of group**
Why do you prefer to eat a substance of that specific colour?		
Not indicated	5	12.2
Taste	28	68.3
Easily accessible	4	9.8
Taste and easily accessible	3	7.3
Taste, tradition and easily accessible	2	4.8
Where do you store the substance?		
Do not store	9	21.4
Container	13	31.7
Plastic	16	39.0
Sun	4	9.8
For how long do you usually store the substance (days)?		
No storage	9	21.4
1	6	14.6
2	8	19.5
3	3	7.3
57	5	12.2
14	3	7.3
20	1	2.4
30	2	4.9
Where can your preferred substance been found?		
Hill/Mountain	8	19.5
Riverbed	1	2.4
Pit/Excavation	9	22.0
Market	5	12.2
Given by someone-else to you	2	4.9
Hill and pit/excavation	7	17.1
Hill and market	3	7.3
Riverbed and pit/excavation	1	2.4
Pit/excavation and market	3	7.3
Pit/excavation and given by someone	2	4.8
Is your preferred substance found close to rocks?		
Yes	24	58.5
No	2	4.8
Not sure	9	22
If Yes, what type of rock?		
Very hard	12	29.3
Hard	20	48.8
Soft	8	19.5
Both hard and soft	2	4.8
Substance-collection method		
Not indicated	5	12.2
Digging	26	64.4
Buying	5	12.2
Given	2	4.9
Both digging and scooping handfuls	2	4.8
Both digging and scraping	1	2.4

Table 5.14 Geophagia knowledge and habits of the Geophagia group pre-intervention (cont.)

	Geophagia group (n=42)	
	N (42)	% of group
If digging, how deep (cm)?		
0	14	34.1
10	7	17.1
11	2	4.8
20	8	19.5
30	2	4.9
50	5	12.2
60	4	9.8
How does the substance feel?		
Gritty	5	12.2
Silky	17	41.5
Powdery	2	4.9
Does not matter	2	4.8
Don’t know	9	21.9
Both gritty and silky	7	17.1
In what condition is the substance collected?		
Not sure	11	26.8
Wet	3	7.1
Dry	11	26.8
Both wet and dry	17	41.5
If collected wet, how does the substance feel?		
Not sure	14	34.1
Very sticky	2	4.9
Sticky	4	9.8
Very soapy	3	7.3
Soapy	12	29.3
None of the above	5	12.2
Both sticky and soapy	2	4.8
Is the substance processed before being eaten?		
Yes	11	26.8
No	27	65.9
Sometimes	4	9.5
If Yes, how is it processed?		
Grinding	4	9.5
Pounding	7	17.1
Is there any heat treatment of the substance before it is eaten?		
Yes	17	41.5
No	17	41.5
Sometimes	3	7.3
If Yes, specify the type of heat treatment:		
Baking	11	26.8
Sun	8	19.5
Both baking and sun	1	2.4

Table 5.14 Geophagia knowledge and habits of the Geophagia group pre-intervention (cont.)

	Geophagia group (n=42)	
	N (42)	**% of group**
Do you think that the substance could be harmful?		
Yes	19	46.3
No	22	53.6
Do not know	1	2.4
If Yes, in what way?		
Do not know constipationAbdominal pains	11	58.0
Poisoning of the body	2	10.0
Blocked veins	2	10.0
Problem skin and pregnancy	1	5.5
Kidney problems	1	5.5
Both constipation and abdominal pains	1	5.5
Constipation and poisoning of the body	1	5.5
Do you think there are harmful elements / parasites present in the substance?		
Yes	25	61.0
No	12	29.3
Don't know	5	11.9
Do you know the components of the substance?		
Yes	10	23.8
No	32	76.2
If Yes, name these components:		
Calcium	2	4.9
Iron	0	0.0
Salt	4	9.8
Minerals	3	7.3
Iron and salt	1	2.4

5.9.2 Geophagia knowledge and habits after the intervention

In the geophagia group, the percentage of participants practicing geophagia after the intervention was 60.7%. The frequency of eating soil was that 25.0% consume soil more than once a day, 17.9% once a day and 10.7% once a week. The reasons for eating soil were predominantly because of the craving for soil and standard practice. Of the geophagia group, 75% thought that eating soil can be harmful due to worms in

Table 5.15 The geophagia knowledge and habit compliance post-intervention*

Geophagia knowledge and habits	Geophagia group		Control group	
	N (28)	% of group	N (15)	% of group
Are you presently in the habit of eating soil?				
Yes	17	60.7		
No	11	39.3	15	100
If Yes, how often?				
Once a month	1	3.6		
Once a week	3	10.7		
Once a day	5	17.9		
More than once a day	7	25.0		
If No, have you stop eaten soil before?				
Yes	11	100		
What are you reasons?				
Standard practice	2	7.1		
Craving	20	71.4		
Medicine	2	7.1		
Taste	1	3.6		
Standard practice and craving	2	37.1		
Craving and taste	1	3.6		
Do you think soil can be harmful?				
Yes	21	75.0	12	80
No	7	25.0	3	20
If Yes, why?				
May cause constipation	14.3	14.3	0	
Worms	21.4	21.4	5	33.3
Prevent blood flow	7.1	7.1	0	
Damage teeth	3.6	3.6	2	13.3
Bacteria	4	14.3		
Decrease nutritional status	1	3.6		
Constipation, worms	2	7.1		
Constipation and damage teeth	2	7.1	1	6.7
Constipation and stomach problems	1	3.6	1	6.7
Constipation, worms and bacteria	2	7.1		
Constipation and bacteria	1	3.6		
Damage teeth, stomach problems and bad breath	1	3.6		
Bad breath	1	3.6		
Worms and bacteria			1	6.7
Prevent blood flow and damage teeth			1	6.7
No one			1	6.7
Who should not eat soil?				
Pregnant women	22	78.6	9	60.0
Pregnant women and children	6	21.4		
Sick people			1	6.7
People with HIV/AIDS			2	13.3
Pregnant women and people with HIV/AIDS			2	13.3
Pregnant women and sick people			1	6.7

Table 5.15 The geophagia knowledge and habit compliance post-intervention* (cont.)

Geophagia knowledge and habits	Geophagia group		Control group	
	N (28)	% of group	N (15)	% of group
If eating soil, how can you improve your health?				
Eat food rich in iron	5	17.9	3	20.0
Drink lots of water	1	3.6		
Not sure	2	7.1		
Eat healthy food	2	7.1		
Exercise	7	25.0	6	40.0
Drink supplements	1	3.6	1	6.7
Bake soil in oven or sun	1	3.6		
Eat fruit and vegetables	3	10.7		
Drink lots of water and eat fruit and vegetables	1	3.6		
Eat healthy foods	1	3.6		
Eat healthy foods and exercise	1	3.6	3	20.0
Eat healthy foods and fruit and vegetables	2	7.1		
Eat food rich in iron, healthy food, fruit and vegetables	2	7.1	1	6.7
Drink lots of water, eat healthy foods and exercise	1	3.6		
Drink lots of water and eat healthy foods	1	3.6	1	6.7
Did you have access to the brochure				
Yes	28	100	15	100
Did you change anything after you received the information?				
Yes	22	78.6	11	73.3
No	6	21.4	4	26.7
If <u>Yes</u> what did you change?				
No change	6	21.4	4	26.7
Reduce eating soil for more than once a day to only once a day	2	7.1	–	–
People should stop eating soil	5	17.9	–	–
Eat healthy foods	2	7.1	1	6.7
Bake soil	1	3.6	2	13.3
Stop eating soil with meals	1	3.6	–	–
Drink more water	1	3.6	–	–
Eat a variety of foods	–	–	–	–
Stop eating soil and eat healthy foods	–	–	–	–
Eat healthy foods and test blood iron levels at clinic	–	–	–	–
Exercise more and bake soil	1	3.6	1	6.7
Bake soil and stop eating soil with meals	1	3.6	–	–
Stop eating soil and drink more water	2	7.1	–	–
Reduce eating soil and drink more water	1	3.6	–	–
Eat healthy foods	1	3.6	–	–
Exercise more	1	3.6	4	26.6
People must stop eating clay to prevent damage to teeth	1	3.6	1	6.7
Eat more fruit and vegetables	1	3.6	2	13.3

* A relevant statistical analysis of this table will be provided in Table 5.17

the soil as well as getting constipation. In the control group, 80.0% of participants agreed that the soil can be harmful to geophagists and 33.0% answered ‘Yes’ because of the worms which could be present in the substance geophagists consume. Both the geophagia group (78.6%) and control group (60.0%) felt that pregnant women should not be practicing geophagia.

In the geophagia group exercise and eating food rich in iron were the dominant reasons geophagists' health can be improved (17.7%; 17.9% respectively). The control group agreed that exercise can improve your health, as well as eating food rich in iron (40%; 20% respectively).

5.9.3 Food-based Dietary Guidelines compliance after the intervention

The geophagia knowledge and habit compliance post-intervention is presented in Table 5.15 and compliance towards the Food Based Dietary Guidelines in Table 5.16.

All the participants in the geophagia and control groups agreed that a variety of food represented the food-based dietary guidelines and starchy foods should form the basis of most meals (Table 5.16). The majority of participants in both groups disagreed on the statement that chicken, milk and eggs cannot be eaten daily (G = 71.4%; C = 66.7%). Everyone in the geophagia group responded positively that fruit and vegetables should be eaten every day, while 93.3% in the control group agreed. The geophagia and control groups disagreed on the statement that dry beans, peas, lentils and soya should not be eaten regularly (G = 64.3%; C = 60%). Both groups agreed 100% that salt and fat should be used sparingly and disagreed that food and drinks containing sugar can be eaten as often as one likes (G = 75%; C = 80%).

Table 5.16 The Food Based Dietary Guidelines compliance post- intervention

FOOD-BASED DIETARY GUIDELINES	Geophagia group		Control group	
	N (28)	% of group	N (15)	% of group
Eat variety of foods				
◆ Agree	28	100	15	100
Starchy foods should form the basis of most meals				
◆ Agree	28	100	15	100
Chicken, fish milk and eggs cannot be eaten daily				
◆ Agree	8	28.6	5	33.3
◆ Disagree	20	71.4	10	66.7
Eat plenty of fruit and vegetables every day				
◆ Agree	28	100	14	93.3
◆ Disagree			1	6.7
Dry beans, peas, lentils and soya should not be eaten regularly				
◆ Agree	10	35.7	6	40.0
◆ Disagree	18	64.3	9	60.0
Salt should be used sparingly				
◆ Agree				
◆ Disagree	28	100	15	100
Fat should be used sparingly				
◆ Agree	28	100	15	100
Use food and drinks containing sugar as often as you like				
◆ Agree	7	25.0	2	13.3
◆Disagree	21	75.0	12	80.0

5.9.4 Differences between the Geophagia and Control group pre- and post-intervention

After the intervention (Table 5.17), there was a significant (p=0.000) change of 17 (39.3%) in the total number of participants consuming soil. The consumption of soil more than once a day also decreased significantly (p=0.000) from 42.9% to 25% of the group as a whole. After the intervention, more participants (+14%) in the geophagia group knew that soil contains harmful substances, whereas less participants in the control group (-13%) reported 'Yes' to the answer. Both groups showed a significantly positive difference in knowing that pregnant women and children should not consume soil (G = +97.6%; C = +63.3%) (p=0.000).

Every participant had access to a brochure, which was distributed during the intervention phase. In the geophagia group 17.1% changed their geophagic habit of eating soil more than once a day to only once a day. The majority of participants did

Table 5.17 Significant Differences between the Geophagia and Control group before and after the intervention

	Geophagia group						**Control group**					
	Before intervention		**After intervention**		**Diffe-rence**	**P-value within groups**	**Before intervention**		**After intervention**		**Diffe-rence**	**P-value within groups**
	n=42	%	n=28	%	%		n=27	%	n=15	%	%	
Total participants practicing geophagia	42	100	17	60.7	39.3	0.000*	--	--	--	--	--	
Change in frequency of soil consumed:	18	42.9	7	25.0	18.9	0.000*	--	--	--	--	--	
Do you think the substance can be harmful? No	25	61.0	21	75.0	14	NS	28	93	12	80	-13	NS
Know that pregnant women and children should not consume soil	1	24.0	28	100	97.6	0.000*	1	3.4	10	66.7	63.3	0.000*
Food Based Dietary Guidelines												
Have heard about the FBDG before the intervention	7	16.6	28	100	83.4	0.000*	4	14.8	15	100	85.2	0.000*
Number of questions answered correctly	--	--	10	80.3	--	--	--	--	10	87.5		

* Statistically significant p≤0.05; NS= non-significant

change one or more habits after reading the brochure (G = 78.5%; C = 73%).

The majority of participants in the geophagia and control groups (G = 80.3%; C = 87.5%) answered all of the questions from the Food-Based Dietary Guidelines correctly. The number of participants not knowing what the FBDGs were, decreased significantly after the intervention (p=0.000).

CHAPTER 6

DISCUSSION

6.1 Introduction

In this chapter the socio-demographic data, nutritional and anthropometric status, physical activity as well as blood results of the study participants will be discussed. The measured associations between the dietary intake and blood results; the geophagic status of the geophagia and control groups before and after the intervention, as well as the risk factors associated with geophagia will be elaborated on. Where possible, the results will be discussed and compared to available literature. The current study was the first of its kind in South Africa to determine the nutritional status and risk factors associated with the practice of geophagia, which made it difficult to compare data with other like studies in local communities.

6.2 Limitations of the study

The limitations of this study included the large geographical area in QwaQwa that needed to be covered, which was exacerbated by the lack of directions and road signs to follow. In some instances, no street names were available. This was overcome by making use of a credible fieldworker who knew the area well. During the recruitment phase one, the fieldworker became familiar with the geographical details and surroundings of QwaQwa to ensure that the identified participants could be found again when the study started. He made detailed notes on locations and house numbers and a local person was identified in each area to contact for directions.

The total sample consisted of 69 participants, of whom 42 were in the geophagia group (G) and 27 in the control group (C), at baseline. After the intervention, 44 participants could be contacted, with 29 in the geophagia group and 15 in the control group. The reasons for a lower availability of respondents were mainly that they had either moved away to urban areas or had left the area to study further away from home.

The fieldworker, who was also involved in the large study, was familiar with the community. Initially, the fieldworker was responsible for meeting with community leaders to obtain permission to work in the community. The fieldworker walked from door to door to recruit participants for the study over a period of a year. In this way he gained the participants' trust.

The fact that the practice of geophagia is a private matter (Woywodt & Kiss, 2002) also made it very difficult to find participants to consent to participate in the study, which contributed to the small sample size. Even though originally planned to see participants in focus groups, participants were seen either alone or in pairs, depending on their individual preferences. A high value was put on the protection of privacy, because of the cultural beliefs associated with the practice of geophagia in the community, which became obvious right from the beginning of the project. The community, from which the study population was selected, is still relatively traditional in their way of life. It was therefore, required of the researcher to take into consideration cultural beliefs and practices, not only to prevent stigmatisation of participants, but also for effective communication, and to maintain a high level of ethical conduct.

The laboratory costs of the study to evaluate blood samples were enormous, which limited the frequency of blood tests, and also the spectrum of laboratory analyses covered, which could have included additional micronutrients (such as zinc, selenium, etc. In this study blood samples were taken once during phase 2 before the intervention period. It would have been valuable to repeat blood sampling after the intervention period to compare values before and after the intervention. Due to financial constraints, this was not possible.

Although the food frequency questionnaire was not repeated after the intervention period. In future it might have value to determine the difference in dietary intake before and after a longer intervention period. The relatively short period of time between the pre-intervention and post-intervention (three months), was unlikely to result in changes in dietary intake and thus dietary intake was only assessed once. It did not influence the current study because the primary objective of this study was to determine the overall nutritional status of the women in QwaQwa consuming soil, at baseline. Also, a long-term follow-up would be recommended in order to evaluate whether the impact of the intervention was sustainable in this population.

6.3 Socio-demographic status

All participants in the current study were female. The mean age of participants was similar at 25 years in the geophagia group and 26 years in the control group. This age group was also very comparable to that of participants in a study by Koryo-Dabrah *et al.* (2012) at an antenatal clinic in Kenya, where 57.3% of 279 women between the ages of 20 and 39 practiced pica. This age group represents a women's reproductive years which is important since geophagia is strongly associated with pregnancy (Young, 2010; Nyaruchucha, 2009; Corbett *et al*., 2003; Karimi *et al*., 2002; Tayie & Lartey, 1999). Although participants in this study were not pregnant at the time of the survey more than half, 53.7% reported that they had practiced geophagia during pregnancy. It is also important to note that a large percentage of younger participants (33%) did not have children yet and had thus not been pregnant before. Abrahams *et al*. (2013) report that geophagia is not particularly restricted to a certain age group, race, gender, geographic reason or time. These authors do, however, report that it is more common amongst poorer populations (Abrahams & Parsons, 1996).

Young *et al*. (2010a) found that formal education and marital status in pregnant women practicing pica in Zanzibar, Tanzania, did not differ statistically from that of women who did not engage in pica. Similarly, women with pica had similar educational level, marital status and employment status as those without pica in Argentina (López *et al*., 2007a). Women in Nigeria practicing geophagia were, however, more likely to have a low income and no formal education than those that did not practice geophagia (Izugbara, 2003). In 2012 the SANHANES-1 was conducted to determine the health and nutritional status of South Africans. Nutritional and demographic information (such as education and income) were determined during the survey. In the current study 30% in the geophagia group and 37% of the participants in the control group completed grade 12 between the ages of 18 and 45 years, which compares with South Africans of the same age. In the SANHANES-1 study (n= 19319), in which 27% between the ages of 15 and 24 years and 40% between 25 and 34 years of the sample completed high school.

In this study there was no significant difference in marital status between the two groups. More than two thirds in both groups were unmarried, which mirrored the situation in the general population of South Africa where 68.6% of females in the age group 18 – 34 years have never been married (Stats, 2013). Young, *et al.* (2010a) also found no significant difference in marital status of women practicing pica compared to those who did not practice pica attending eight different health clinics in Tanzania.

According to Bhorat & Van der Westhuizen (2008) female-headed households are more likely to live in poverty. In a study amongst black, white and mixed racial patients from three public hospitals in Bloemfontein, in the Free State Province South Africa; pica was more prevalent in black patients (Louw *et al*., 2007). Literature reports from 1950 – 1990 also showed that pica seems to be prevalent in black women in other parts of the world (Horner *et al*., 1991). Although the majority of participants were unmarried, they were not necessarily the head of the household. The majority of participants in the current study indicated that a parent was the head of the household (Table 5.1), but the gender of the parent was not indicated.

There were no differences in socio-economic status, for type of house owned, income and the owning of appliances such as a microwave and/or stove between the geophagia and control groups. However, the control group did have more access to a refrigerator compared to the geophagia group (p=0.02), with the probability of practicing geophagia being lower in the group with a refrigerator (OR: 1.54; CI: 0.056; 0.849). In the current study 85.7% of participants in the geophagia group and 96.3% in the control group lived in brick houses. These findings were slightly higher when compared to the participants of the same age (15 – 34 years) in the SANHANES study where 77.6% lived in formal housing (brick) (SANHANES-1, 2013).

In the current study, the majority of participants in both the geophagia- and control group used electricity for cooking (83.3%; 85.2% respectively). Although more than the majority of South Africans have access to electricity (87.1% in the 15 - 24 year group and 86.1% in the 25 - 34 years of age group), alternative sources of energy are still used for cooking in 18.1% of the population (SANHANES-1, 2013). These statistics are similar to findings in the current study where less than ten percent of participants used alternative energy sources which included paraffin, gas and wood or coal.

As previously mentioned, female headed households in South Africa tend to have a lower income than male headed households, regardless of race (SANHANES-1, 2013). As indicated in Table 5.1 of the results, a significant negative association (p=0.014) was found between women who were wage-earners and those who were not wage-earners and the practice of geophagia (OR: 0.143; CI: 0.027; 0.755). These findings seem to indicate that a permanent income may decrease the likelihood of practising geophagia.

The literature reports controversial information related to the practice of pica and the prevalence of hunger. On the one hand it is hypothesised that geophagia is practiced because little food is available and people eat soil to ward of hunger (Young, 2011: 92). Woywodt & Kiss (2002) concluded that there is not enough evidence, to confirm this hypothesis. Young *et al.* (2010a) found that pregnant and non-pregnant women in Pemba did not practice geophagia because of hunger. In the current study participants also indicated that they did not eat soil because of hunger, but predominantly out of the craving for the soil and traditional reasons. The results of the current study confirmed that in this sample soil is rather consumed due to traditional reasons and cravings and not because of hunger or shortage of food.

In summary, in this study the socio-economic status of participants practising geophagia appeared to be similar to that of participants in other studies regarding some of the descriptive variables. However, the significant negative association between women who owned a refrigerator and those who did not as well as those who were wage earners and those who were not, and the practice of geophagia indicates that income may be a predictor of the practice of geophagia.

6.4 Dietary intake

The dietary intake of participants was measured at baseline, in order to investigate the possible link between the practice of geophagia and dietary intake. Although no significant differences in energy and macronutrient intakes were seen in the geophagia and control group at baseline, micronutrient intakes did differ. The dietary intakes with reference to total energy, macronutrients and micronutrients will be discussed in the following section.

6.4.1 Total energy and macronutrients

Energy and macronutrient intakes were similar in both groups. A study amongst pregnant women in Zanzibar, Tanzania also indicated no difference in macronutrient intake between women practising pica and those without pica. In that study, the number of meals eaten per day also didn't differ between pregnant women practicing pica or not (Young *et al*., 2010c). The total number of foods eaten in the last 7 days was very similar at 11.1 for pregnant women that did not engage in pica and 10.8 for those practising geophagia. The mean energy intake of the participants in the current study (G: 10324.3kJ; C: 10763.9kJ) was higher than the mean energy intake of Kenyan women aged 15 – 60 years from four primary regions in Kenya (non-geophagic), and also higher than non-geophagic South African women (n=4481) 15 years and older collected from the Demographic and Health Survey (DHS) (Steyn *et al*., 2012).

In the current study, energy contribution from carbohydrates in the geophagia and control groups was very similar at 54.1% and 54.4% of total energy respectively. The total protein intake for the geophagia- and control group was 74.6g and 85.6g respectively; which contributed to 12.5% (G) and 13.6% (C) of the total energy intake. The percentage total energy intakes from fat was 33.1% in the geophagia group and 31.5% in the control group, which indicates a moderate dietary fat intake. The SANHANES-1 survey also reported a moderate fat intake in rural women, using mean fat scores (SANHANES-1, 2013).

The macronutrient intake in both the geophagia- and control group fell within the recommended normal range for carbohydrates (45% - 65% of total energy), protein (10% - 35% of total energy) and fat intake (20% - 35%) (Institute of Medicine, 2002). The percentage energy from fat in the geophagia group tended to be slightly higher, but still less than the upper limit of 35%.

A global nutrition transition has been reported with developing populations tending to increase their intake of energy dense foods (Prentice, 2007; Popkin & Gordon-Larson, 2004). Although a nutrition transition has been reported to be more prevalent in urban areas of South Africa than rural areas (Steyn *et al*., 2012; MacIntyre *et al*., 2002; Vorster *et al*., 2010), rural areas are also becoming more westernised. Although the macronutrient intake in this study did not point to a confirmed nutrition transition, the tendency towards a high dietary fat intake might be an indication that it is in the process of developing. This hypothesis is strengthened by the results related to the anthropometry and physical activity levels of participants.

6.4.2 Micronutrient intake

Factors such as age, level of education, ethnicity and area of residence have a direct impact on the nutrient intake and consumption of South Africans (Puoane *et al*., 2002) and many South Africans do not meet their requirements for micronutrients (Vorster, 2010; Steyn *et al*., 2006; Vorster *et al*., 1997).

6.4.2.1 Minerals

The dietary calcium intake in both the geophagia- and control group was lower than the recommended estimated average requirements (EAR), but did not show in the blood levels which fell into the normal range in both groups. However, blood calcium levels are not a reliable indicator of calcium status, because 99% of calcium is stored in the bone (Charney, 2012: 183). Although geophagia is commonly practiced amongst pregnant women with low calcium intakes, experimental evidence does not show that treating micronutrient deficiencies decreases the consumption of non-food items (Young, 2011, p.109). In South African women low calcium intakes were also identified in the South African Demographic and Health Survey (Steyn *et al*., 2006).

Several studies as far back as the 1960s and 1970s have investigated the effect of soil on mineral absorption. Clay in Turkey has been shown to decrease iron absorption in humans (Arcasoy *et al*., 1978; Cavdar & Arcasoy1983; Minnich *et al.,* 1968). In South Africa, iron absorption also decreased from 17.4% to 5% after soil consumption (Sayers *et al*., 1974). Calabash chalk in Nigeria and Undongo geophagic materials in Kenya were investigated and showed the soils were not a good source of minerals, especially iron (Abrahams *et al*., 2013). Hooda *et al*. (2004) also share the view of Abrahams *et al*. (2013) that geophagia can potentially reduce the absorption of micronutrients such as iron, copper and zinc.

The significant difference in blood iron levels between the two groups in the current study may indicate that an interaction between iron status and the practice of geophagia exists. A possible mechanism is that the intestinal mucosa is covered with the soil substances which decreases the absorption of iron (Young, 2009, p.73) especially the whitish soil rich in kaolin which was commonly eaten by this sample. The mean platelet counts of participants in this study were normal in both the geophagia- and control group. In general, a normal platelet count indicates that bleeding is not present in an individual, which eliminate bleeding as a possible cause of iron deficiency in this study (Kuku *et al*., 2009).

As mentioned, indicators of iron status in women practicing and not practicing geophagia yielded important differences. These differences were confirmed when parameters of iron status were clustered to represent overall iron status. This will be discussed in a later section.

6.4.2.2 Vitamin intake of geophagia- and control groups

The intake of some vitamins of the geophagia group tended to be lower than that of the control group in the current study. The participants with geophagia, had a lower mean intake of vitamin A than the control group (G= 1078.8mg; C = 1731.0mg) (p=0.005), but vitamin A intake was still higher than the estimated average requirement (EAR) in both groups.

The prevalence of vitamin A deficiency in South Africa has decreased by 50% among females of reproductive age, since vitamin A supplementation (2002) and food fortification (2003) was implemented in South Africa (SANHANES-1, 2013). Vitamin A deficiency has a direct effect on iron utilization and the prevalence of anaemia (Gallagher, 2012, p. 60) and thus it is an important parameter to investigate. Because both the geophagia and control groups showed an intake of vitamin A that was higher than the EAR, it is unlikely that the iron deficiency seen in the geophagia group was associated with vitamin A deficiency. It is important to mention, however that blood values of vitamin A status were not determined.

Significant differences in the intake of certain other nutrients were also observed in the two groups. Although the intake of niacin (p=0.002) and riboflavin (p=0.003) differed significantly between the two groups, participants in both groups had intakes of niacin and riboflavin that were higher than the EAR. Intakes of vitamin D (G = 5.1mg; C = 5.8mg) and folate (G = 233.2mg; C = 282.6mg) were, however, lower than the EAR. Similarly, folate intake of pregnant women in Ghana with or without pica did not meet the daily requirements (Koryo-Dabrah *et al*., 2012). Intakes of vitamins E and C of the two groups did not differ significantly (p=0.34; p= 0.02, respectively), but mean intake of vitamin C in the geophagia group were lower than the EAR, a finding that was also reported in South African women that participated in the most recent South African Demographic and Health Survey (Steyn *et al*., 2006)

These findings suggest that low intakes of folate and vitamin C are not limited to women with pica, but are associated with South African women in general. Vitamin C intake is of importance in the utilization of iron in the body (Gallagher, 2012: 88). Thus, insufficient intake of vitamin C may also play a role in the development of iron deficiency. In addition, iron deficiency may be exacerbated by insufficient intakes of folate (Gallagher, 2012: 111).

To summarize, participants with geophagia had significantly lower dietary intakes of vitamin A, niacin and riboflavin than the control group but these were still higher than the EAR for those nutrients. Both groups had intakes below the EAR for vitamins D and folate and vitamin C in the geophagia group. Deficiencies of these nutrients may complicate iron deficiency, since nutrient-nutrient interactions are common.

6.5 Anthropometric nutritional status

There were no significant differences in BMI and weight circumference between the geophagia- and control groups. These findings in the current study are similar to those of other studies. Women with and without pica in Argentina also had similar BMI (López *et al*., 2007a). In contrast, Baig-Ansari *et al.* (2008) found that non-anaemic women in an urban community area in Pakistan had a higher BMI than anaemic women who practiced pica.

The mean BMI of participants in both groups of the current study fell within the overweight category of 25 - 30kg/m^2 (Lysen & Israel 2012: 470; Thomas & Bishop, 2007: 853). This finding mirrors the female population of South Africa. The recent SANHANES study reported a mean BMI of 28.9kg/m^2 for women aged 25 – 34 years (SANHANES-1, 2013). According to the International Obesity Task Force: Global Burden of Disease Analyses 2002 as referred to by Goedecke *et al*. (2006: 66), the mean BMI of South African women between the ages of 15 - 29 and 30 – 44 were 24.4 kg/m^2 and 28.5 kg/m^2 respectively. These findings seem to indicate that the problem of overweight has not changed in the last ten years in South Africa and suggest that a nutrition transition has developed in South Africa over an extended period of time. Karl *et al*. (2009) found that obese women (n=207) have a lower risk of iron deficiency, while overweight women are more likely to be iron deficient. In a study by Qin *et al*. (2013) women with central obesity, which is indicated by waist circumference of more than 88cm, were less likely to have anaemia. Overweight and an increased intake of dietary fat were associated with an increased risk of developing non-communicable diseases (WHO, 2003).

In the current study the mean waist circumference of both groups fell in the healthy range of ≤0.88m (Hammond & Litchford, 2012, p. 169).
A waist-to-hip ratio (WHR) above 0.8m indicates an android fat distribution, and is associated with a higher risk for cardiovascular disease and other lifestyle-associated diseases (Lysen & Israel, 2012: 470). Although WHR is less widely used than waist circumference on its own as a measure of health outcome, it was significantly associated with the practice of geophagia in this study (OR: 0.353; CI: 0.126; 0.985).

These results seem to indicate that women with geophagia are less likely to have a WHR in the android category.

In summary, BMI and waist circumference seem to be similar in women with and without geophagia. However, WHR was significantly associated with geophagia, with women with a high WHR being less likely to practice geophagia.

6.6 Activity levels

Globally low physical activity is an increasing public health concern (Vuori, 2004). A sedentary lifestyle is an independent risk factor for obesity, Type 2 diabetes, heart disease and dementia (Lövdén *et al*., 2013; O'Donovan *et al*., 2005). According to Carter-Parker *et al*. (2012) physical activity levels are decreasing in America and middle aged African American women have the lowest rates of physical activity. In South Africa, low levels of physical activity are also prevalent in 43.4% of Black African women (Stats, 2013). In a cross-sectional population study, Smit *et al*. (2011) also found that 83% of black South African women (n=1357) between 30 and 60 years of age were inactive. Low activity levels were also characteristic of the current study population as a whole, without any significant differences between the two study groups. The low levels of physical activity of participants, together with BMI in the overweight category could indicate that the participants are at risk of developing lifestyle diseases (Raymond & Couch, 2012, p. 751).

6.7 Blood results (Pathology)

A number of abnormalities related to blood levels of micronutrients in persons practicing pica have been reported in the literature. From this study also, it is evident that the practice of pica induces a physiological response, which is measurable by means of blood analyses. Case studies in women have reported an association between hypokalemia and pica during pregnancy (McKenna, 2006; Ukaonu *et al*., 2003). Hypernatremia has been reported in children (Kupiec *et al*., 2006; Shapiro & Linas, 1985) and young women (Morgan *et al*., 2010) addicted to salt . Yet, results of the current study indicated that participants in both the geophagia and control groups had normal mean serum values for sodium (136 - 147.0 mmol/L), potassium (3.5 - 5.1 mmol/l) magnesium (2.3 - 2.6 mmol/l) and calcium (2.15 - 2.50 mmol/l). Young (2011, p.113) concluded that not enough scientific evidence to confirm the hypothesis that geophagic soil can provide enough calcium to prevent its deficiency.

In contrast to the listed micronutrients, the mean serum iron levels of the geophagia group were significantly lower (p=0.000) when compared to that of the control group. There was also a significant difference in the serum ferritin levels between the geophagia and control group, with serum ferritin being significantly lower in the group practicing geophagia (p=0.00). Serum transferrin and serum transferrin saturation levels also differed significantly between the groups (p=0.00). The results of this study identified these blood variables as the most important risk factors associated with geophagia and this association will be discussed in more detail later in this chapter in the section pertaining to iron status and geophagia.

6.8 Correlation between dietary intake and blood (pathology) results

Significant correlations between serum iron, -albumin and dietary fibre intake have been documented in women practicing geophagia (Zimmerman *et al*., 2008; Madhaven *et al*., 2004; Thane *et al.*, 2003). This correlation between serum iron and –albumin was confirmed in this study (Table 5.12), with a significant linear positive correlation between serum iron and albumin levels (p=0.005), in the participants practicing geophagia. Thus, if serum albumin levels were low, serum iron levels also tended to be low. Serum-albumin is a recognised marker for protein status in humans (Litchford, 2012: 419), which might explain the normal albumin levels in the geophagia group who reported adequate protein intake. Although transferrin is also an indication of protein status, low iron-levels increase transferrin levels, as shown in the geophagia group. The increase in transferrin levels in the geophagia group is evident of a negative iron balance or iron-deficiency.

In this study a significant correlation was also identified between serum albumin and -calcium ($p<0.001$) and -phosphate levels ($p=0.004$). Low albumin levels are often associated with low calcium- and phosphate levels, a finding that has been reported in the literature (Peacock, 2010).

A significant correlation between dietary iron and energy intake ($p<0.001$) was measured in both the geophagia and control group, with a higher dietary iron intake being associated with higher energy intakes. As expected, low dietary intake of iron was also associated with iron deficiency anaemia among Tunisian women practicing pica (El Ati *et al*., 2008).

Insufficient food intake and the lack of resources to consume iron rich food is known to contribute to risk for anaemia. In the current study, however, energy and total iron intakes were adequate. Despite this, the geophagia group suffered from iron deficiency. This would seem to indicate that dietary intake of iron was not the only factor affecting iron status in women practicing geophagia.

6.9 Iron status and geophagia

The devastating effects of iron deficiency on human health have been well documented (Beard, 2005; Algarin *et al*., 2003; Saloojee & Pettifor, 2001; Lozoff *et al*., 2000). In addition to their own health, iron deficiency could also be detrimental for the offspring of the geophagist (Lambert *et al*., 2013). Iron deficiency can also be fatal in severely anaemic women suffering from post-partum haemorrhage and may be harmful to the neurological development of the child (Lambert *et al*., 2013).

Despite the negative effects of iron deficiency on health, the relationship between geophagia and iron deficiency is still not well understood. Geophagia has been documented as both a cause (Chaushey *et al*., 2003; Reid, 1992) and consequence (Antelman *et al*., 2000; Reid, 1992; Sayetta, 1986) of anaemia.

Iron status is determined by the amount of iron present in serum and red blood cells (Hughes-Jones *et al*., 2004, p.57). Iron status is diagnosed by investigating a number of parameters, including haemoglobin, serum iron, ferritin, transferrin and transferrin saturation. Iron deficiency is diagnosed by evaluating indicators such as ferritin, transferrin and transferrin saturation to determine the presence and degree of anaemia (Mogongoa *et al*., 2011). When iron stores are adequately depleted to reduce erythropoiesis then iron deficiency anaemia develops (Bermejo & García-López, 2009). Low haemoglobin levels alone are, however, not a reliable indicator for iron deficiency anaemia, because of the fluctuation of haemoglobin levels in healthy individuals. One cannot differentiate iron deficiency anaemia from other anaemia's based on haemoglobin levels alone, because low haemoglobin levels are only recognizable in a very late stage of iron deficiency.

A strong association between geophagia and iron deficiency was identified in non-pregnant women in this study. This association has been confirmed in other studies (George and Abiodun, 2012; Louw *et al*., 2007). Similar results have also been reported in 79 women from European and non-European countries of which 44% practiced pica (Kettaneh *et al*., 2005). Fifty six percent of pregnant women attending antenatal clinics in Coastal Kenya with geophagia also had low iron levels (Geissler *et al*., 1998). Argentinian women practicing geophagia were also more likely to suffer from iron deficiency anaemia (López *et al*., 2007a). In pregnant women of Eastern Sudan soil eating was significantly associated with anaemia (Adam *et al*., 2005). Similar results have been reported in Tanzania (Young *et al*., 2010a; Kawai *et al*., 2009). In another study in the Eastern Cape, South Africa, undertaken amongst pregnant women from three primary health care antenatal clinics, the prevalence of anaemia was significant higher in pregnant women practicing geophagia when compared to the group of pregnant women not practicing geophagia (George & Abiodun, 2012).

In contrast with our findings and the mentioned other studies, no significant difference was found in the prevalence of iron deficiency and iron deficiency anaemia between women with pica (ice) and without pica in a study by Barton *et al*. (2010) amongst women attending an oncology practice. Although no differences were found in iron status (defined by both SF <45 pmol/L and TS <10%) amongst these women, those with ice pica had lower haemoglobin and ferritin levels than those without ice pica. It is important to acknowledge that cancer and cancer treatment could also have impacted on these variables.

A significant association between geophagic pica and haemoglobin levels were found among pregnant women practicing pica in Zanzibar, Tanzania (Young *et al*., 2010a). These findings concur with those of a study by Janbabai *et al*. (2011) where 68.1% of partcipants (260) practiced one or more form of pica associated with low haemoglobin and ferritin levels. These findings were also confirmed in pregnant and non-pregnant European and non-European women where pica was also associated with iron deficiency anaemia (Kettaneh *et al*., 2005). In the East Anatolian Province in Turkey, 50% of anaemic women (n=823) had a transferrin saturation of less than 10% and 11.2% of the sample population practiced pica (Karaoglu *et al*., 2010). Malenganisho *et al*. (2007) also found an association between geophagia and haemoglobin.

Low ferritin levels were significantly associated with the practice of geophagia in the current study. Low ferritin levels are considered to be an indicator of iron deficiency without anaemia. Serum ferritin is not influenced by the current intake of iron, but rather by the size of the total body iron stores in the absence of inflammation (Umbreit, 2005). A serum ferritin level of less than 12µg/l indicates that iron stores are depleted (Thomas *et al*., 2013). Malenganisho *et al*. (2007) also confirmed an association between geophagy and serum ferritin levels.

Serum transferrin levels are often increased in iron deficiency (Hughes-Jones *et al*., 2004, p.59), but this parameter does not confirm iron deficiency anaemia when used in isolation. In the current study serum transferrin levels were increased, together with serum transferrin saturation of less than 16%. Transferrin saturation indicates the percentage of transferrin that transports iron in the body to macrophages for production of erythroblasts in the bone marrow (Hoffbrand *et al*., 2011: 37).

AlQuaiz *et al*. (2013) also found that women between aged 15 – 49 years with a high BMI have a 5% less chance of developing anaemia than those of a low BMI. In contrast no significant association could be established between BMI and iron deficiency ($p<0.001$) in this study, but it is suspected that the sample size was too small for the association to reach significance.

As discussed in the previous sections, the practice of geophagia had an impact on more than one of the measured variables of iron status in this study. As a result, it was decided to cluster the variables and to investigate whether it is possible to build a model that could be used to predict whether an individual in this cohort of subjects, practices geophagia or not by means of regression analysis. The following variables that significantly contributed to the model were included in the final equation: history of practicing geophagia, haemoglobin, serum-iron, -ferritin and –transferrin, haem iron, non-haem iron and transferrin saturation. These factors differed significantly between the geophagia- and control group and significantly affected the iron status of the geophagists in the current study.

In the current study low serum ferritin levels, an increase in serum transferrin levels and serum transferrin saturation less than 16% in the geopyhagia group confirmed the presence of iron deficiency. Mogongoa *et al*. (2011) also found in a sub-sample (17) of this study low haemoglobin, transferrin saturation, ferritin and transferrin levels in the geophagia group (n=12). From this, it is evident the practice of geophagia affects not only one single blood parameter, but rather a cluster of parameters, that collectively and comprehensively represent individual iron status (Table 5.17). Single blood parameters can diagnose iron deficiency which occurs before anaemia, while the cluster of parameters can diagnose iron deficiency anaemia (Huges-Jones *et al*., 2004: 17).

Significant predictors of pica identified by Barton *et al*. (2010) were mean corpuscular volume (MCV), platelet count and red blood cell distribution width (RDW). . In the current study additional significant predictors were associated with geophagia and iron deficiency, but whether iron deficiency develops because of geophagia or iron deficiency causes women to start practicing geophagia is still unclear. In this study the effect of geophagia on a cluster of blood parameters, indicates the significant effect of soil eating on iron homeostasis. Risk factors associated with iron deficiency are thus also linked to the likelihood of practicing geophagia.

6.10 Knowledge and habits related to geophagia in participants practicing geophagia and knowledge of geophagia in the control group before intervention

In participants practicing geophagia, the frequency of consuming soil was high at more than once a day (43.9%) and once a day (34.1%). This indicates an intake of about 30g or more than 30g per day (sample of soil shown was 30g and participants needed to indicate frequency accordingly). This intake is similar to that reported in other studies related to geophagia in Africa where daily intake of 30 – 40g of soil have been reported (Luoba *et al*., 2005; Saathoff *et al*., 2002; Geissler *et al*., 1998). A study among Argentine women with pica showed that the majority of the women ate soil on a daily basis, with the prevalence of 39.5% during the first semester of pregnancy (López *et al*., 2012).

The urge or craving for soil was the main reason for geophagists (97.6%) to practice geophagia in the current study, which is also documented as one of the main reasons among pregnant women practicing geophagia in Tamil Nadu, India (Placek & Hagen, 2013). In a study reported by Songca *et al*. (2010: 221) amongst women aged 17 – 60 years that practiced geophagia in South Africa, the researchers also found that the Sotho and Pedi speaking geophagists craving for soil was the main reason to ingest soil on a daily basis. These cravings are reported to be more prevalent during certain stages of the life cycle when an increased amount of nutrients are required such as during pregnancy (Reeuwijk *et al*., 2013; Njiru *et al*., 2011; Young *et al*., 2010a; Kawai *et al*., 2009). Golden *et al*. (2012), have however, reported that the prevalence of geophagia was not higher in pregnant women than in non-pregnant women that ate soil during a population based survey in Madagascar.

This prevalence of geophagia in pregnancy is often underestimated. Research from Latin America indicated a prevalence of 23.2% among pregnant Argentine mothers

(López *et al*., 2012). In Africa the prevalence of pica in pregnancy was reported to be higher, with 50% of women in Nigeria, 63% in Tanzania and 74% in Kenya practicing pica (Sule & Madugu, 2001; Nyaruhucha, 2009; Luoba *et al*., 2004, Ngozi, 2008). In contrast Mikkelsen *et al*. (2006) found that only 0.02% of Danish women practiced pica. Although geophagists in the present study were not pregnant at the time of the study, more than 50% reported that they have practiced geophagia during pregnancy (53.7%). Our findings also suggest that cultural beliefs (Table 5.14), soil colour and texture are important factors influencing the choice of clay (Ekosse *et al*., 2011). Whitish soil was the preferred substance consumed by geophagists in the current study. Similar findings were reported by Songca *et al*. (2010) for different ethnic groups namely Pedis, Zulus, Tswana and Sothos in South Africa who also preferred eating white clay. These whitish clays are commonly linked with kaolinite, which is well known for the treatment of diarrhoea and other stomach ailments (Bisi-Johnson *et al*., 2013). In other studies geophagists preferred red soils, (Songca *et al*. (2010), which is believed to be richer in iron, although not bioavailable for human consumption.

6.11 The knowledge and habits related to geophagia after the intervention

The aim of the intervention was to increase the participants' knowledge of geophagia and to address risks and problems identified during the baseline phase of the study. In general, a number of habits related to geophagia changed after the intervention. In this study the nutrition education programme was effective in improving some aspects of the participant's knowledge and practices related to geophagia, while others remained unchanged.

Some questions were asked before and after the intervention to evaluate any changes in the practice of geophagia and to determine if the brochure was understood. Almost forty percent of the participants in the geophagia group reported that they had stopped consuming soil after the intervention. The frequency of eating soil more than once per day also declined after the intervention from 42.9% to only 25% in the geophagia group. After the intervention, most participants in both the geophagia- and control group (100% and 66.7% respectively) agreed that pregnant women and children should not consume soil because it can be harmful to them; whereas before the intervention more than 50% of participants in the geophagia group thought that soil was not harmful when consumed by human beings. These changes in geophagic habits and knowledge indicate that the information given to the participants in the three month intervention period was sufficient to motivate them to make the decision to stop eating soil because it may be detrimental to their health.

The geophagia- and control group were adequately informed about the South African Food Based Dietary Guidelines (FBDGs) during the intervention. Questions were asked only after the intervention period to evaluate if the participants were familiar with the content of the brochure and to see if they applied any of this information. This was evidenced by the fact that participants answered more than 80% of the questions related to the FBDGs correctly after the intervention. Participants were asked to agree or disagree on statements regarding the FBDG. Both groups agreed totally (100%) to the following: eat a variety of foods; starchy foods should form the basis of most meals; eat plenty of fruit and vegetables per day and that salt and fat should be used sparingly.

A minority of participants, (approximately one third in both groups), incorrectly answered that chicken, fish, milk, eggs cannot be eaten daily. The same was seen for dry beans, peas, lentils and soya. In a cross-sectional study amongst 333 women in KwaZulu-Natal, South Africa, only 7% of participants indicated that legumes do not have to be eaten because they can be substituted with meat (Love *et al*., 2008).

The majority of participants (G = 78.5%; C = 73%) indicated that they changed at least one habit related to the FBDGs after reading the brochure. When what geophagists asked can do to improve their health after the intervention, only 7% was not sure. Love *et al*. (2008) also found that participants recognized the importance of applying the FBDGs to improve their health status.

In summary the results showed that the aim of the intervention to change the knowledge and practices related to geophagia were achieved as far as most aspects are concerned. The geophagists either stopped eating soil or decreased their daily consumption of soil and acknowledge that geophagia can be harmful to health.

These changes in geophagic habits may reduce the chances of developing iron deficiency or experiencing the side-effects related to the ingestion of soil.

Chapter 7

CONCLUSIONS AND RECOMMENDATIONS

In this chapter the conclusions and recommendations related to the study are discussed.

7.1 CONCLUSIONS

The overall aim of this study was to determine the nutritional status and risk factors associated with geophagia amongst women in QwaQwa. The results showed how the practice of geophagia can predispose those that practice it, to metabolic disturbances, especially those that relate to iron metabolism. The results also confirmed a link between socio-demographic factors and the practice of geophagia.

7.1.1 Socio-demographic status

The results confirmed that geophagia occurs most commonly amongst women of child-bearing age. A significant association was found between earning a wage and the practice of geophagia, with women that were wage earners being less likely to practice geophagia. In addition women who owned a refrigerator were also less likely to practice geophagia. These finding seem to suggest that socio-economic status might be a predictor of the practice of geophagia and that it is more likely for someone from a low socio-economic status to practice geophagia.

7.1.2 Dietary intake

No significant differences in energy and macronutrient intakes were found between women practicing geophagia and those not practicing geophagia, with both groups exhibiting a high energy intake. This may imply that hunger is not the factor motivating women to practice geophagia.

However, for some micronutrients, intakes were different in women practicing geophagia when compared to those not practicing geophagia. Intake of vitamin A differed significantly between the experimental group and control group, with the geophagia group having a significantly lower intake of vitamin A when compared to the control group. Vitamin A deficiency is also linked to iron deficiency anaemia. However, in this study, both groups had intakes above the EAR, suggesting that vitamin A intake was unlikely to be related to iron deficiency in this sample.

The intake of niacin and riboflavin also differed significantly between the geophagia- and control group, with the intake of these nutrients being significantly lower in the group practicing geophagia. However, for these two nutrients, intakes were also above the EAR for both groups.

For all women, the intake of vitamins D, C, and folate were lower than the EAR, but did not differ significantly between the groups. It is unknown whether the inadequate intake of these nutrients were related to geophagia (the control group also had low intakes), but it is known that both folate and vitamin C metabolism are associated with anaemia. In addition vitamin C intake improves absorption of non-haem iron, thus indirectly affecting iron status.

7.1.3 Anthropometric nutritional status and activity levels

No significant differences occurred with regards to BMI and waist circumference between the geophagia and control groups. However, a significant association was identified between WHR and the practice of geophagia, with women that practice geophagia being less likely to have a high WHR.

Mean BMI of participants in both groups fell in the overweight category, while levels of physical activity were low. These finding are similar to other studies that show that overweight and a sedentary lifestyle are becoming more common in African women of a low socio-economic background, undergoing a lifestyle and nutrition transition. Such a pattern increases the risk of developing lifestyle diseases. Both lifestyle diseases and iron deficiency may have a detrimental impact on overall health of those that practice geophagia. It is important to note, however, that no significant associations could be found between BMI and iron deficiency (defined by the cluster of variables in Table 5. 13 in this sample.

7.1.4 The relationship between geophagia and iron status

In the current study energy and dietary iron intakes were adequate, proposing that dietary iron intake was not the only aspect influencing iron status in the geophagia group, and that other factors such as the absorption of iron may be affected by the practice of geophagia.

A major finding of this study was the difference in iron status of participants practicing geophagia and the control group, with women that practiced geophagia being more likely to suffer from iron deficiency and iron deficiency anaemia. A logistic regression analysis indicated that a cluster of variables including haemoglobin, ferritin, transferrin and transferrin saturation are all affected by the practice of geophagia. Significantly lower haemoglobin and ferritin levels with elevated transferrin levels were prevalent in the group with geophagia compared to the control group. These results implicate that geophagia is a risk factor for iron deficiency and iron deficiency anaemia, confirmed by the aforementioned cluster of metabolic indicators. The precise mechanism that leads to this association requires clarification and further investigation.

7.1.5 Knowledge and habits related to geophagia and the impact of the intervention

The main reason for practicing geophagia in this sample was the urge or craving for soil, which compares well with the findings of other studies undertaken in South Africa. The intervention that was developed and applied in this research group was successful in significantly reducing the number of participants that practiced geophagia or the frequency of practicing geophagia. The intervention was also able to bring about an improvement in the knowledge related to geophagia, indicating that habits can be changed when knowledge is improved and that health can benefit.

To conclude, the results of this study showed that an interaction of factors, including social, nutritional, cultural and physiological may influence the iron status of women with geophagia. All of these need to be taken into account when planning interventions to address the risk factors associated with geophagia.

7.2 RECOMMENDATIONS

Recommendations related to practice and research is made in the following section.

7.2.1 Implications for practice

The factors associated with geophagis in this study could be developed into a possible tool to predict the likelihood of practicing geophagia. From the results obtained in the regression analysis the factors that were strongly associated with geophagia included being a wage earner, owning a refrigerator, a waist hip ratio below 0.8 and a cluster of pathological factors that collectively represent a state of iron deficiency.

The significantly strong association between geophagia and iron deficiency emphasizes the importance of identifying the practice of geophagia in women, especially during their child bearing years. From a public health perspective it is therefore recommended that pregnant women should be screened for the practice of geophagia during their visits to clinics at primary health care centres in South Africa. Kawai *et al*. (2009) and Young *et al*. (2010c) have also recommended that pregnant women should be educated about the risk of developing iron deficiency anaemia and other dangers related to the practice of geophagia. Health professionals involved in counselling pregnant women should enquire about the practice of pica, especially when iron deficiency is present (Kettaneh *et al*., 2005; Horner *et al*., 1991). Dieticians may play a vital role in identifying pica during dietary counselling.

For those women who do practice geophagia, a relevant and applicable health education programme needs to be made available. The results of this study have indicated that health education can make a difference to the knowledge and habits related to geophagia in such groups. Such programmes should focus on the impact of geophagia on health; importance of healthy dietary practices to improve or prevent iron deficiency; and discouraging women from practicing pica. The brochure that was developed as an educational tool during the intervention period provides an example of material that can successfully be applied in health education programmes to both persons practicing geophagia and the broad public. Koryo-Dabrah *et al*. (2012) also emphasized the importance of nutrition education to improve knowledge of food and nutrition and therefore empower women to make better food choices to improve their health during pregnancy and all other lifecycles.

In terms of the general public, health education related to geophagia and the impact thereof on human health is necessary (El Ati *et al*., 2008). This can contribute to an improved awareness of the condition and its implications for especially pregnant women and children. George & Abiodun (2012) have documented the need and importance of health promotion in the community at large. Health and nutrition programmes have also been identified by Sedehi *et al*. (2013) as an important method for combatting micronutrient deficiency in women of childbearing age.

7.2.2 Future Research

Further research related to both prevalence of geophagia and the impact of the intervention on the practice of geopagia is recommended in larger sample groups.

The prevalence of geophagia in South Africa is still largely unknown. In view of the major implications of this practice on health outcomes, a better understanding of the prevalence, degree and mechanisms of the condition as well as the impact thereof on various indicators is necessary.

The current study could be extended to investigate the effect of the intervention used in the current study in other population groups and areas. The impact of the intervention on other indicators, such as blood variables that were not included in this study, could also be determined. An assessment of micronutrient status that goes beyond dietary intake would be valuable.

Further research to establish whether the practice of geophagia is a cause of iron-deficiency, or whether it is the consequence thereof, would give a clearer view on how to recognise and treat the condition. Louw *et al*. (2007) suggest further research related to the pathophysiological mechanisms involved, while Placek & Hagen (2013) emphasise the importance of further investigation to determine the aetiology of geophagia.

This study was the first in South Africa to investigate nutritional status and risk factors associated with geophagia, and can be used as reference for further investigation.

7.3 BENEFITS OF THE RESEARCH AND IMPLEMENTATION OF THE FINDINGS

The importance of this study was to determine the relationship between geophagia and nutritional status in women. The study is of great value to the population of QwaQwa as well as the population of South Africa. To the best of our knowledge this is the first study in this area to investigate the nutritional status and risk factors associated with geophagia in South Africa.

- **Individual benefits** included an assessment of health and nutritional status of participants. All participants had access to the results and assessments were done free of charge. In cases where health problems were identified, participants were referred to relevant health professionals. Individuals have also benefited from the nutrition education programme and counselling.
- **National benefits:** A report related to the risks of geophagia and possible recommendations to address these risks will be submitted to the Department of Health after completion of the thesis;
- **Community**: Feedback regarding the results and recommendations was given to the community which formed part of the intervention process.

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ANNEXURE A

Information and Consent Document

Study Title: NUTRITIONAL STATUS AND RISK FACTORS ASSOCIATED WITH WOMEN PRACTICING GEOPHAGIA IN QWAQWA, SOUTH AFRICA

Human ad Enzootic Geophagia in South Africa, Botswana and Swaziland

Dear Participant

We, the geophagia team (researchers from the university of Limpopo and Central University of technology, Free State, University of Swaziland and Botswana) are doing research on geophagia (the purposeful ingestion of soils and clays by humans and animals) in Southern Africa. We are asking you to participate in this research project.

The study aims to identify and characterize selected soils and clays in Botswana, South Africa and Swaziland that are being ingested by local commu7nities as well as calves, lambs and kids. The study will be directed at identifying soils and clays in target areas, carry out appropriate mineralogical, chemical, microbiological, ecological and environmental health analyses geared towards the documentation of geophagic practices that have been going on for several centuries in these countries. We want to conduct structured questionnaires- response studies which will address aspects related to the environmental health and indigenous knowledge (IK) associated with geophagia in these countries. I South Africa the team will conduct structured interviews with 330 adults, 132 children, 110 students, and 66 farmers to determine the attitudes and beliefs, standard practice of geophagia as well as general health status of the respondents. The study will also be conducted in Swaziland and Botswana. In each of Botswana and Swaziland 110 adults, 66 children, 44 students and twenty farmers will be interviewed.

There is no risk being involved in the study. However, the study ultimately aims to advance more suitable harvesting techniques of the geophagic soils and clays which will aid in reducing down side effects.

You, as participant in the study will be given information on the results of the study once it is completed.

Please note that participation to the study is voluntary and that refusal to participate will involve no penalty. You may discontinue your participation at any time during the study without any penalty.

Efforts will be made to keep personal information confidential. Personal information may be disclosed if required by law. If results are published, this may lead to cohort identification.

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0727

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CONSENT TO PARTICIPATE IN RESEARCH

You have been asked to participate in a research study.

You have been informed about the study

by ______________________________

You may contact Prof L de Jager at Central University of Technology, Dr G Ekosse at the University of Limpopo, DR M Dittlhogo, University of Limpopo or Dr NO Simelane, University of Swaziland any time if you have questions about the research or if you are injured as a result of the research.

You may contact the Secretariat of the Ethics Committee of the Faculty of Health Science, UFS, Bloemfontein, South Africa at telephone number (051) 405 2812 if you have questions about your right as a research subject.

Your participation in this research is voluntary, and you will not be penalized or lose benefits if you refuse to participate or decide to terminate participation.

If you agree to participate, you will be given a signed copy of this document as well as the participant information sheet, which is a written summary of the research.

The research study, including the above information has been verbally described to me.

I understand what my involvement in the study means and I voluntary agree to participate.

______________________________	______________________________
Signature Participant	**Date**
______________________________	______________________________
Signature Witness	**Date**
______________________________	______________________________
Signature Interviewer	**Date**

Pampitshana ya Molaetsa

Sehloho sa Thuto:

Batho le Enzootic Geophagia Afrika Borwa, Botswana le Swaziland

Dumela Monka-karolo

Re le sehlopha sa diphuputso (Baphupotsi hotswa Yuniveshithi ya Limpopo, Yniveshithi e bohareng yea thekenolohi, Foreistata, Yuniveshithi ya Swaziland le Botswana) re etsa dipatlisiso kaho JA mobu letsopa ke batho le diphoofolo ho la Afrika e Borwa le di naha tse mabapi. Re kopehore o nke karolo phupotsong/patlisisong ena.

Thuto e ikemiseditse ho temoho le hlopolla mefute ya mebu le letsopa hola Botswana, Afrika Borwa le Swaziland e Jewang ke Batho metseng le diphoofolo mmoho le bana. Thuto e tla lebiswa ho temoho ya mobu le letsopa di bakeng tse kgethilweng ho mtsetsa hanyle mineralogical, dikhemikale, microbiology, ecological le patlisisa ka tsa bophelo ho I setsa ho ngolweng ha ntle ha tlhaello ena yah o ja mobu e e sa le e etswa ka dilemo lemo naheng tsena. Re rata ho ntshetsa pele dipotso ka tsela ya thuto e tla buwa ka mabaka a amanang le tsa bophelo di bakeng tsatsa rona le tshebo ya lehae e amanang le ho ja moba dinaheng tsena. Afrika borwa sehlopha se tlo etsa dipotso le Batho ba abholo ba kabang 330, Bana ba 132, Bithuti ba 110 le bo ramapolasi ba 66 ho fumana hatle thlaello le mokgwa, le tumelo mnoho le bophello ka kakaretso ho ba nkakarolo. Thuto ene e boetse e tla etsa dipotso tsena Swaziland le Botswana. Ho se seng le se seng sa sebaka 110 Batho be baholo, 110 Bana, baithuti 44bo rapolasi ba 22.

O kupuwe ho nka karolothutiong ea ya patlisiso

O se o fumane lesedi ka thuto ena?

by ______________________________________

Oka ikopanya le Moporofesa L de Jager Yunivesithing e bohareng ya Foreistata, Ngaka G Ekosse Yunivesithing ya Limpopo, Ngaka M Ditlogo Yunivesithing ya Limpopo, Ngaka Simelane Ynivesithing ya Swaziland ka nako tsohle ha ona le dipotso ka thuto kappa tse fumangeng patlisisong ena.

Oka Boela wa ikopanya le Mokgodi wa komiti ya mekgwa ya bophelo bo bottle le science, UFS, Bloemfontein Afrika Borwa ka mohala nomorong ena (051) 405 2821 ha ona le dipotso ka ditokelo tsa hae the ka monka-karolo.

Ho nka-karolo ha hao ke boithaopo, hape ha ona fumantshwa kotlo kappa wa latlehelwa ke omonyetla oitseng ka ho hana ho mka-karolo kappa ha oka nka qeto ya ditaba mabaqi le thuto, e ngotswe ditabana tsa patlisisong ena.

Patlisiso, ho kenyeletswa le ditaba tse ngotsweng ka dibuilwe ho nna. Ke othisisa ho makakarolo ha ka thutong ho bolellang hape e thaopile ho nkakarolo.

______________________________	____________________________
Saena ya Monka-karolo	**Letsatsi**
______________________________	____________________________
Saene ya Paki (ha ho tlokahala)	**Letsatsi**
______________________________	____________________________
Saena ya Motsamaisi/mobutsi	**Letsatsi**

ANNEXURE B

PHASE 1

QUESTIONNAIRE RELATED TO HUMAN GEOPHAGIA: ADULT

INTRODUCTION

The University of Limpopo in the Limpopo Province and the Central University of Technology, Free State in Bloemfontein, South Africa - in collaboration with the Universities of Swaziland and Botswana - are conducting a study to characterise habits related to human and enzootic geophagia in South Africa, Botswana and Swaziland. It is also designed to characterise, in physico-chemical, microbiological, mineralogical and ecological terms, the soils that are preferred by geophagic individuals and animals in these three countries. This exercise is mainly for academic purposes; however, the information gathered may be used generally to improve methods of harvesting geophagic soils that will guarantee the health of geophagic individuals. Strict confidentiality of the information provided is guaranteed at all times, and respondents are therefore urged to cooperate fully with the interviewers in order to facilitate this study.

For office use only

Number [ ][ ][ ][ ][ ][ ][ ] 1-7

Date of interview: ____________________________(dd/mm/yy) — 8-13

Name of interviewee (optional): ________________________________ — 14-16

Country:	RSA	Botswana	Swaziland	17
Region:	Free State			18
	Limpopo			
	North West			
	Gauteng			

District: ________________________________ — 19-20

A. DEMOGRAPHIC INFORMATION

1. Geographic Information

1. Location: Rural | Suburban | Urban — 21
2. Specify town or area: ________________________________ — 22-23

2. Personal and Demographic Information

3. Gender: Male | Female — 24
4. Age: ______________________(years) — 25-26
5. Ethnic Group: — 27
   - [ ] Afrikaans
   - [ ] English
   - [ ] Sesotho
   - [ ] Setswana
   - [ ] siSwati
   - [ ] isiXhosa
   - [ ] isiZulu
   - [ ] Other, please specify:____________________ — 28-29
6. Number of children: _________________________ — 30-31

	6.1 Age of Child	6.2 Gender of child	Office use (age)	Office use (gender)
1			32-33	34
2			35-36	37
3			38-39	40
4			41-42	43
5			44-45	46
6			47-48	49
7			50-51	52
8			53-54	55

7. Marital status: ☐ Married ☐ Divorced ☐ Single ☐ Widowed ☐ Engaged ☐ Cohabiting — 56

8. Income source: — 57
- ☐ Wage employment
- ☐ Non-wage employment
- ☐ Other, please specify:____________________ — 58-59

9. Occupation: ____ — 60-61

10. Monthly income: R/Pula____________________ — 62-67

11. Highest educational level attained: — 68
- ☐ No schooling
- ☐ Primary
- ☐ Secondary
- ☐ Tertiary

12. Highest grade/standard completed successfully:
- ____________________ (if GRADE is applicable) — 69-70
- ____________________ (if STANDARD is applicable) — 71-72

13. Number of years in formal education: _____________ years — 73-74

B. SOCIO-ECONOMIC AND CULTURAL ASPECTS

1. Geophagic Habits

14. Are you presently in the habit of eating soil? ☐ Yes ☐ No — 75

14.1 If **YES**, how often do you eat soil? — 76
- ☐ Once a month
- ☐ Once a week
- ☐ Once a day
- ☐ More than once a day

14.2 If **YES**, for how long have you been eating soil? __________________(years) — 77-78

15. What is/are your reason(s) for eating soil?
- ☐ Standard practice (cultural, traditional, spiritual) — 1
- ☐ Craving — 2
- ☐ Medicinal value — 3
- ☐ Supplement diet — 4
- ☐ Ritualistic — 5
- ☐ When hungry — 6
- ☐ When pregnant — 7
- ☐ Don't know — 8
- ☐ Other, please specify: _______________________ — 9 — 10-11

16. Do you ever crave soil? ☐ Yes ☐ No — 12

16.1 If **YES**, how often? — 13
- ☐ Regularly - Monthly
- ☐ Regularly - Weekly
- ☐ Regularly - Daily
- ☐ Only when pregnant

17. When do you crave soil?

☐ Pregnant	☐ Nauseous, but not pregnant	14	15	
☐ Lactating	☐ Constipated	16	17	
☐ Both pregnant and lactating	☐ Feeling weak	18	19	
☐ Having trouble sleeping	☐ Other, please specify: ________________	20	21	22-23

18. When **pregnant**, how often do you eat soil?

- ☐ Once a month — 24
- ☐ Once a week
- ☐ Once a day
- ☐ Other, please specify: ______________________________ — 25-26

19. Do you eat any other non-food substance? Yes / No — 27

19.1 If **YES**, name the substance: ____ — 28-29

20. How often do you eat this substance? — 30

- ☐ Daily
- ☐ More than once a day
- ☐ Weekly
- ☐ Monthly

21. How much of the soil do you eat?

Daily	1	2	3	4	5	31
More than once a day	1	2	3	4	5	32
Weekly	1	2	3	4	5	33
Monthly	1	2	3	4	5	34

22. Do other people know that you eat clay? Yes / No / Don't know — 35

22.1 If **YES**, who knows about it?

- ☐ Family members — 36
- ☐ Extended family members — 37
- ☐ Friends — 38
- ☐ Other, please specify: __________________________ — 39 — 40-41

23. How do people perceive this habit of eating non-food substances?

- ☐ Positive — 42
- ☐ Negative — 43
- ☐ Indifferent — 44
- ☐ Don't know — 45

24. Is this practice of eating soil more common among certain members of the community?

Yes / No / Don't know — 46

24.1 If **YES**, specify: ____ — 47-48

C. INDIGENOUS KNOWLEDGE

25. Which substances are eaten?

- ☐ Soil — 49
- ☐ Clay — 50
- ☐ Soil from termite mounds — 51
- ☐ Other, please specify: ___________________ — 52 — 53-54

26. How are the substances eaten?

- ☐ Wet — 55
- ☐ Dry — 56
- ☐ With other food — 57
- ☐ Other, please specify: ___________________ — 58 — 59-60

27. What are the traditional names of the substances consumed?

____ [ ][ ] 61-62

____ [ ][ ] 63-64

28. Where do you obtain your preferred substance?

[ ]	From nature	65
[ ]	Buy it	66
[ ]	Am given it	67
[ ]	Other, please specify: __________________	68 [ ][ ] 69-70

28.1 If you **BUY** it, give the brand name: __________________________________ [ ][ ] 71-72

28.2 If you **BUY** it, indicate the price per handful: R/Pula ____________________ [ ][ ][ ][ ] 73-76

29. What is the colour of your preferred substance?

[ ]	Reddish	[ ]	Yellowish	1	2
[ ]	Whitish	[ ]	Khaki	3	4
[ ]	Blackish	[ ]	Other, please specify: ______________	5	6 [ ][ ] 7-8

30. Why do you prefer to eat a substance of that specific colour?

[ ]	Taste	9
[ ]	Tradition / belief	10
[ ]	Easily accessible	11
[ ]	Other, please specify: __________________	12 [ ][ ] 13-14

31. Where do you store the substance?

____ [ ][ ] 15-16

32. For how long do you usually store the substance?______________(days) [ ][ ][ ] 17-19

D. PHYSICO-CHEMICAL, MINERALOGICAL, GEOLOGICAL AND CHEMICAL ASPECTS

33. Where can your preferred substance be found?

[ ]	Hill / mountain	20
[ ]	Riverbed	21
[ ]	Termitaria / termite mound	22
[ ]	Valley	23
[ ]	Pit / excavation	24
[ ]	Other, please specify: __________________	25 [ ][ ] 26-27

33.1 If a **termitaria/ termite mound**, from where specifically is the substance collected?

[ ]	From the outer surface of the mound	28
[ ]	Inside the mound above the surface of the soil	29
[ ]	Inside the mound below the surface of the soil	30
[ ]	Does not matter	31
[ ]	Not sure	32

34. Is your preferred substance found close to rocks? | Yes | No | Not sure | 33

34.1 If **YES**, what type of rock?

[ ]	Very hard	34
[ ]	Hard	35
[ ]	Soft	36
[ ]	Very soft	37

35. Substance-collection method

- [ ] Digging — 38
- [ ] Scooping handfuls — 39
- [ ] Scraping — 40
- [ ] Selective hand-picking — 41
- [ ] Other, please specify: ____________________ — 42 — 43-44

35.1 If **digging**, how deep?_______________cm — 45-47

36. How does the substance feel? — 48

- [ ] Gritty
- [ ] Silky
- [ ] Powdery
- [ ] Does not matter
- [ ] Don't know

37. In what condition is the substance collected? Wet | Dry | Both — 49

37.1 If **collected wet**, how does the substance feel? — 50

- [ ] Very sticky
- [ ] Sticky
- [ ] Very soapy
- [ ] Soapy
- [ ] None of the above

38. Is the substance processed before being eaten? Yes | No | Sometimes — 51

38.1 If **YES**, how is it processed?

- [ ] Grinding — 52
- [ ] Pounding — 53
- [ ] Sieving — 54
- [ ] Slurrying — 55
- [ ] Other, please specify: ____________________ — 56 — 57-58

39. Is there any heat treatment of the substance before it is eaten? Yes | No | Sometimes — 59

39.1 If **YES**, specify the type of heat treatment:

- [ ] Baking — 60
- [ ] Boiling — 61
- [ ] Burning — 62
- [ ] Combination, please specify: ____________________________ — 63 — 64-65
- [ ] Other, please specify: ______________________________ — 66 — 67-68

E. ECOLOGICAL ASPECTS

40. If applicable, please specify the type of termitaria from which you prefer to collect substances?

- [ ] Mound — 69
- [ ] Tree — 70

40.1 If the substance is collected from a **termite mound** (Section C), describe the preferred height of the mound. — 71

- [ ] < 0.5 m
- [ ] 0.5 – 1 m
- [ ] 1 – 2 m
- [ ] > 2 m

40.2 What is the preferred shape of the mound?

- [ ] Conical — 72
- [ ] Flat topped — 73
- [ ] Dome shaped — 74
- [ ] Other, please specify — 75

40.3 Do you prefer to eat the substance when
- [ ] Newly formed
- [ ] Old
- [ ] Does not matter
- [ ] Not sure

76

40.4 In what type of terrain do you normally find these mounds?
- [ ] Flat — 1
- [ ] Hilly — 2
- [ ] Undulating — 3
- [ ] Valley — 4
- [ ] Other, please specify: _________________ — 5 — 6-7

40.5 Do you collect the substance from
- [ ] Mound
- [ ] Base of the mound
- [ ] Some distance from the mound
- [ ] Other, please specify: _________________

8

41. If substance is collected from a **tree**, do you prefer it to be a particular type of tree?

Yes	No	Not sure	oes not matt

9

41.1 If **YES**, name the preferred type of tree: _____________________________ 10-11

F. HUMAN HEALTH ASSOCIATED WITH GEOPHAGIA

42. What is your height?__________(cm) 12-14

43. What is your weight?__________(kg) 15-17

44. Do you think that the substance could be harmful? Yes / No 18

44.1 If **YES**, in what way?
- [ ] Constipation — 19
- [ ] Abdominal pains — 20
- [ ] Poisoning the body — 21
- [ ] Causing tooth decay — 22
- [ ] Other, please specify: _________________ — 23 — 24-25

45. Have you ever undergone surgery for a stomach ailment? Yes / No 26

45.1 If **YES**,

How many times? _______________ 27-28

For what reason? ___________________________________ 29-30

____

46. Do you think there are harmful elements / parasites present in the substance?

Yes / No 31

47. Do you know the components of the substance? Yes / No 32

47.1 If **YES**, name these components:
- [ ] Vitamins — 33
- [ ] Calcium — 34
- [ ] Iron — 35
- [ ] Salt — 36
- [ ] Other, please specify: _________________ — 37 — 38-39

48. Why do you eat the substance(s) you do?

- [ ] To clean your body — 40
- [ ] For additional nutritional value — 41
- [ ] To protect against infections — 42
- [ ] Don't know — 43
- [ ] Other, please specify: ________________ — 44 [ ][ ] 45-46

49. Are you often ill (infections like colds, flu, etc.)? Yes / No — 47

49.1 If **YES**, how often? — 48

- [ ] More than once a month
- [ ] Once a month
- [ ] Once every three months
- [ ] Twice a year
- [ ] Once a year

50. Do you eat these substances when ill? Yes / No / Sometimes — 49

51. Any medical condition diagnosed/experienced Yes / No — 50

51.1 If **YES**, which of these?

- [ ] Constant headaches — 51
- [ ] Dizziness — 52
- [ ] Blood in stool — 53
- [ ] Fatigue — 54
- [ ] Chest pains — 55
- [ ] Coughs — 56
- [ ] Muscle pains — 57
- [ ] Tremors — 58
- [ ] Blood in urine — 59
- [ ] Nosebleeds — 60
- [ ] Iron deficiency — 61
- [ ] High Blood pressure — 62
- [ ] Constipation — 63
- [ ] Other, please specify — 64

52. Number of stillborn children (full time)? ________ — 65

53. Number of miscarriages? ________ — 66

54. Number of children born with abnormalities? ________ — 67

55. Name the abnormalities.

________________ — 68-69

________________ — 70-71

________________ — 72-73

ANNEXURE C

GEOPHAGIA
SOCIO-DEMOGRAPHIC QUESTIONNAIRE
PHASE 2

Respondent number: 1-3

Interviewer: ________________ 4

D D M M Y Y Y Y

Birth Date: ___________________________ 5-12

Interview Date: ______________________ 13-20

Age (years) if Birth Date unknown:__________________ 21-22

Group: Geophagia (1) / Control (2) 23

What is your marital status? 24

(1) Unmarried
(2) Married
(3) Divorce
(4) Widowed
(5) Living together
(6) Separated
(7) Traditional Marriage
(8) Other, specify ________________

What language do you speak? 25

1. Sotho
2. Tswana
3. English
4. Afrikaans
5. Xhosa
6. Swazi
7. Zulu
8. Other, please
Specify________________

Are you pregnant? 26

1. Yes 2. No

If yes, how many weeks? 27-28

____

Are you breastfeeding? 29

1. Yes 2. No

If yes, how old is the baby? 30-31

_____________months

Household composition:

How many persons live in the house permanently (5-7days per week)? 32-33

____

Number of children (<18 yrs): ________________ 34-35

Number of adults (≥ 18yrs): __________________ 36-37

What is your highest level of education? 38-39

____

Primary employment status of respondent (tick only one) 40

1. Housewife by choice
2. Unemployed
3. Self employed
4. Full time wage earner (receive a salary)
5. Other, specify (part-time, piece job etc) _______________________________
6. Don't know

Husband/partner's primary employment status (tick only one) 41

1. Retired by choice
2. Unemployed
3. Self employed
4. Full time wage earner (receive a salary)
5. Other, specify (part-time piece job etc) _______________________________
6. Not Applicable e.g. dead

Who is the head of the household? 42

1. Wife
2. Husband
3. Child/ren
4. Parent

5. Grandparent
6. Friend
7. Other, specify ____________________________

Type of dwelling?

1. Brick, concrete: (1) Yes (2) No 43
2. Traditional mud: (1) Yes (2) No 44
3. Tin: (1) Yes (2) No 45
4. Plank, wood: (1) Yes (2) No 46
5. Other: specify _______________ 47

What fuel is used for cooking?

1. Electric: (1) Yes (2) No 48
2. Gas: (1) Yes (2) No 49
3. Paraffin: (1) Yes (2) No 50
4. Wood, coal: (1) Yes (2) No 51
5. Sun: (1) Yes (2) No 52
6. Open fire: (1) Yes (2) No 53

Do you use cast iron pot for cooking? (1)Yes or (2) No. If yes how often? 54

1. ≤ Once a week 2. > Once a 3. Every day 55

Does your home have a working:

Refrigerator and/or freezer: 56
1. Yes 2. No

Stove (Gas, Coal or electric or Hot plate): 57
1. Yes 2. No

Primus or Paraffin Stove: 58
1. Yes 2. No

Microwave oven: 59
1. Yes 2. No

ANNEXURE D

GEOPHAGIA

ANTHROPOMETRIC QUESTIONAIRRE

PHASE 2

Respondent number: [ ][ ][ ] 1-3

Interviewer:____________________________ [ ] 4

Weight (kg):____________________________ [ ][ ][ ][ ] 5-9

Height (cm):____________________________ [ ][ ][ ][ ] 10-14

Circumference(cm)

Waist (cm):____________________________ [ ][ ][ ][ ] 15-19

Hip (cm):____________________________ [ ][ ][ ][ ] 20-24

ANNEXURE E

GEOPHAGIA PHASE 2

Respondent number: 1-3

Interviewer:__________________________ 4

(1) Baseline / (2) After Intervention 5

QUANTITATIVE FOOD FREQUENCY QUESTIONNAIRE

Greeting

Thank you for giving up your time to participate in this survey. We would like to find out what people usually eat and drink. This information is important to know as it will tell us whether you eat the right foods, and if you are healthy.

Please think carefully about the food and drinks you have consumed during the past 6 months. I will now go through a list of foods and drinks with you and I would like you to tell me:

- if you eat these particular foods,
- how the food is prepared,
- how much of the food you eat at a time, and
- how many times a day you eat it and if you do not eat it every day, how many times a week or a month it is eaten?

To help you to describe the amount of a food, I will show you models and examples of different amounts of the food. Please say which model is the closest to the amount eaten, or if it is smaller, between sizes or bigger than the models. Amounts can also be reported as cups (c), tablespoons (T) or teaspoons (t).

- **THERE IS NO RIGHT OR WRONG ANSWERS.**
- **EVERYTHING YOU TELL ME IS CONFIDENTIAL.**
- **IS THERE ANYTHING YOU WANT TO ASK NOW?**
- **ARE YOU WILLING TO GO ON WITH THE QUESTIONS?**

ENCIRCLE APPROPRIATE ANSWER

- **Do you use salt in your food during food preperation?** 6

  (1) Yes (2) No (3) Don't know

- **Are other flavoured salt e.g. Aromat used in food?** 7

  (1) Yes (2) No (3) Don't know

- **If yes, specify ______________________** 8-9

- **Do you use beef/chicken stock in your food?** 10
  (1) Yes (2) No (3) Don't know

- **Do you use laxatives on a regular basis (weekly)?** 11
  (1) Yes (2) No (3) Don't know

- **If yes, how often?** 12
  (1) Everyday
  (2) ≥ 3 times per week
  (3) Less then 3 times per week

- **Do you use any nutrient supplements regularly?** 13
  (1) Yes (2) No (3) Don't know

- **If yes, what kind of nutrient supplement?**

(1)Vitamins : (1) Yes (2) No 14

If yes: Specify ______________________________ 15-16

How often? 17
(1) Everyday
(2) ≥ 3 times per week
(3) Less than 3 times per week

If yes, what kind of nutrient supplement?

(2) Minerals: (1) Yes (2) No 18

If yes: Specify ______________________________ 19-20

How often? 21

(1) Everyday

(2) ≥ 3 times per week

(3) Less than 3 times per week

If yes, what kind of nutrient supplement?

(3) Proteins: (1) Yes (2) No 22

If yes: Specify ______________________________ 23-24

How often? 25

(1) Everyday

(2) ≥ 3 times per week

(3) Less than 3 times per week

If yes, what kind of nutrient supplement?

(4) Energy: (1) Yes (2) No 26

If yes: Specify ______________________________ 27-28

How often? 29

(1) Everyday

(2) ≥ 3 times per week

(3) Less than 3 times per week

If yes, what kind of nutrient supplement?

(5) Other: (1) Yes (2) No 30

If yes: Specify ______________________________ 31-32

How often? 33

(1) Everyday

(2) ≥ 3 times per week

(3) Less than 3 times per week

Do you drink coffee and tea (except rooibos) with your meals? 34

(1) Yes

(2) No

If yes, at which meals?

Breakfast (1) Yes (2) No 35

Lunch (1) Yes (2) No 36

Supper (1) Yes (2) No 37

Do you experience any problems with diarrhea on a regular basis (weekly)? 38

(1) Yes (2) No

If yes, how often? 39

(1) Everyday

(2) ≥ 3 times per week

(3) Less than 3 times per week

Do you experience any problems with constipation on a regular basis (weekly)? 40

(1) Yes (2) No

If yes, how often? 41

(1) Everyday

(2) ≥ 3 times per week

(3) Less than 3 times per week

Have you heard about the Food Based Dietary Guideines? 42

(1) Yes (2) No

EATING HABITS: (FREQUENCY AND TYPE OF CLAY CONSUMPTION)

Do you consume clay? (1) Yes (2) No 43

How often do you consume clay? 44

(1) Once a day

(2) More than once a day.

How much clay do you consume at a time (see samples)? [| |] 45-46

___________________________________**g**

What kind of clay do you consume most often?

(1) Red [ ] 47

(2) White [ ] 48

(3) Gray [ ] 49

(4) Other, specify __________________________ [ ] 50

Do you ever consume any other non-food items on a regular basis e.g. chalk, washing powder etc. [ ] 51

(1) Yes

(2) No

If yes, specify:

Non-food items	**Grams**	**How often consumed?**
		(1) Everyday
		(2) ≥ 3 times per week
		(3) Less than 3 times per week

________________ ________ ________________ [|] [| |] [ ] 52-57

________________ ________ ________________ [|] [| |] [ ] 58-63

________________ ________ ________________ [|] [| |] [ ] 64-69

________________ ________ ________________ [|] [| |] [ ] 70-75

SUMMARY OF FOOD FREQUENCY QUESTIONNAIRE

Respondent number: ☐☐☐ 1-3

FOOD	CALCULATIONS	CODE AMOUNT PER DAY (g)								
										(1-8)
										(9-16)
										(17-24)
										(25-32)
										(33-40)
										(41-48)
										(49-56)
										(57-64)
										(65-72)
										(73-80)
										(1-8)
										(9-16)
										(17-24)
										(25-32)
										(33-40)
										(41-48)
										(49-56)
										(57-64)
										(65-72)
										(73-80)
										(1-8)
										(9-16)
										(17-24)
										(25-32)
										(33-40)
										(41-48)
										(49-56)
										(57-64)
										(65-72)
										(73-80)
										(1-8)
										(9-16)
										(17-24)
										(25-32)
										(33-40)
										(41-48)
										(49-56)
										(57-64)
										(65-72)
										(73-80)
										(1-8)
										(9-16)
										(17-24)
										(25-32)
										(33-40)
										(41-48)
										(49-56)
										(57-64)
										(65-72)
										(73-80)

FOOD	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/DAY
			Per day	Per week	Per month	Seldom/ Never		
Maize-meal porridge	Stiff (pap)						**3400**	
Maize-meal porridge	Soft (slappap)						**3399**	
Maize-meal porridge	Crumbly (phutu)						**3401**	
Sour porridge	Specify ratio Mabella/Maize						**3399**	
Mabella porridge	Stiff, coarse, fine						**3437**	
Mabella porridge	Soft, coarse, fine						**3437**	
Oats porridge	Brand name:						**3239**	
Breakfast cereals	Puffed Wheat, plain						**3325**	
	Corn Flakes, plain						**3243**	
	Weet Bix						**3244**	
	Puffed Rice, sweet						**3372**	
	Specify types usually eaten ______________________ ______________________ Brand names of cereals available at home now:__________________							
Milk on porridge or cereal: Circle type usually used	None							
	Whole/fresh						**2718**	
	Sour						**2787**	
	2% fat						**2772**	
	Fat free/skimmed						**2775**	
	Milk blend						**2771**	
	Soy milk						**2737**	
	Condensed (whole,sweet)						**2714**	
	Condensed (skim, sweet)						**2744**	
	Evaporated whole						**2715**	
	Evaporated low fat						**2827**	
	Non-dairy creamer						**2751**	
Is sugar added to porridge or cereal? (Tick box)	None White Brown Syrup Honey Sweetener: type________						 **3989** **4005** **3988** **3984**	
Is fat added to porridge or cereal? (Tick box)	None Animal fat (butter) Hard margarine Soft margarine Oil Peanut Butter						 **3479** **3484** **3496** **3507** **3485**	
Samp/Maize rice **Samp and beans** **Samp and peanuts**	Bought Self ground Specify ratio (1:1) Specify ratio						**3250** **3725** **3402**	
Rice: specify brands names:	White Brown Sorghum rice						**3247** **3315** **3437**	
Stamped wheat							**3249**	
Pastas	Macaroni Spaghetti Spaghetti in tomato sauce Other:						**3262** **3262** **3258**	

HOW MANY TIMES A WEEK DO YOU EAT PORRIDGE OR BREAKFAST CEREAL AT ANY TIME OF THE DAY (NOT ONLY BREAKFAST)?____________

FOOD	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/DAY
			Per day	Per week	Per month	Seldom/ Never		
Bread/Bread rolls	White						**3210**	
Bread slices: thin	Brown						**3211**	
Medium, thick	Whole wheat						**3212**	
Other breads	Specify types e.g. Raisin Maize meal Sweetcorn Rye Other						 **3214** **3278** **3379** **3213**	
Pizza (specify toppings) **Hot Dogs(specify sausage)** **Hamburgers (specify meat)**	Cheese, tomato & onion ____________________ ____________________ ____________________ ____________________ ____________________						**3353**	
Are any the following spreads used on bread? **Fat spreads (Tick box)**	Butter Butro Animal fat (beef tallow) Lard Hard margarine (brick) Soft margarine (light) Cooking Fat						**3479** **3523** **3494** **3495** **3484** **3496** **3516**	
Peanut butter							**3485**	
Sweet spreads	Jam Syrup Honey						**3985** **3988** **3984**	
Marmite/ **OXO/** **Bovril**							**4030** **4029** **4029**	
Fish paste **Meat paste**							**3109** **2917**	
Cheese	Specify types: Cottage low-fat cheese Cream cheese Gouda Cheddar Other:_______________						 **2760** **2725** **2723** **2722**	
Cheese spreads	Low fat Full fat Specify types						**4310** **2730**	
Atchar							**3117**	
Other spreads: (Specify tipes)	____________________ ____________________							
Dumpling							**3210**	
Vetkoek							**3257**	
Provita **Crackers (refined)** **Crackers (whole wheat)**							**3235** **3331** **3391**	

Rusks *Home-made:*	Bran Buttermilk White Boerebeskuit, white All-bran Raisins Buttermilk, white Buttermilk, whole wheat Other						**3330** **3329** **3364** **3364** **3380** **3380** **3215** **3255**	
Scones							**3237**	
Muffins	Plain Bran						**3408** **3407**	

HOW MANY TIMES A DAY DO YOU EAT BREAD? ________

FOOD	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/DAY
			Per day	**Per week**	**Per month**	**Seldom/ Never**		
Chicken	Boiled: with skin without skin						**2926** **2963**	
Do you eat the chicken with the skin?	Fried: in batter/crumbs Fried, but not coated						**3018** **2925**	
Yes ☐ **No** ☐	Roasted/grilled with skin without skin						**2925** **2950**	
Chicken bones stew							**A003**	
Chicken heads, raw							**2999**	
Chicken stew, with veg. & skin							**3005**	
Chicken feet, raw							**2997**	
Chicken offal	Giblets						**2998**	
Chicken pie	Commercial Home-made						**2954** **2954**	
Red meat: Beef	Fried/grilled: with fat without fat						**2908** **2959**	
	Stewed/boiled: with fat without fat						**3006** **2909**	
	Mince with tomato and onion						**2987**	
Red meat: Mutton	Fried/grilled: with fat without fat						**2927** **2934**	
	Stewed/boiled: with fat without fat						**3040** **2916**	
Red meat: Pork	Fried/grilled: with fat without fat						**2930** **2977**	
	Stewed/boiled: with fat without fat						**3046** **3045**	
Red meat: Goat	Fried/grilled: with fat without fat						**4281**	
	Stewed/boiled: plain with veg						**4281** **4282**	
Offal: Specify type:	Intestines: boiled, nothing added						**3003**	
	"Vetderm" fried						**3003**	
	Stewed with vegetables							
	Liver						**2955**	
	Kidney						**2956**	

	Tripe "pens" trotters, head						**3003**	
	Pluck (lungs, heart, gullet)						**3019**	
Specify vegetables used in meat stews (only if not mentioned elsewhere)								
Wors / sausage	Fried						**2931**	
Bacon							**2906**	
Cold meats	Polony						**2919**	
	Ham						**2967**	
	Vienna's canned						**2936**	
	Russian						**2948**	
	Frankfutter						**2937**	
	Other (specify)							
Canned meat	Bully beef						**2940**	
	Other (specify)							
Meat pie	Bought						**2939**	

FOOD	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/DAY
			Per day	**Per week**	**Per month**	**Seldom/ Never**		
Legumes: specify dried beans/peas/ Lentils	Stews & curries (specify) Soups Salad						 **3157** **3174**	
Baked beans							**3176**	
Soya products e.g. Toppers/ Imana	Brands at home now Don't know_______________ **Show examples**						**3196**	
Fried fish (fresh or frozen fried in sun oil)	With batter/crumbs Without batter/crumbs						**3072** **3060**	
Fresh water fish **Specify type**	**Specify cooking method** Medium fat, batter, fried						**3094**	
Canned fish:								
Pilchards	In brine						**3055**	
	In tomato sauce						**3102**	
	Mashed with fried onion						**A005**	
Sardines	In oil In tomato sauce						**3087** **3087**	
Tuna	In oil In brine						**3093** **3054**	
Mackerel							**3113**	
Salmon							**3101**	
Pickled fish/curried							**3076**	
Do you remove fish bones before eating canned fish	YES □ NO □							
Fish cakes **Specify canned or other**	Fried: oil/butter/margarine, commercial						**3080**	
Salted dried fish							**3077**	

Eggs	Boiled/poached Scrambled in: oil butter margarine Fried in: oil butter margarine bacon fat Curried						**2876** **2889** **2886** **2887** **2869** **2868** **2877** **2870** **2902**	

HOW MANY TIMES A WEEK DO YOU EAT MEAT ________,

BEANS ________,

CHICKEN ________,

FISH ________ **AND**

EGGS __________**?**

FOOD	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom/ Never		
Cabbage	Boiled, nothing added						**3756**	
	Boiled with potato and onion and fat						**3813**	
	Fried, in margarine (nothing added)						**3810**	
	Fried, in oil (nothing added)						**3912**	
	Boiled, then fried with potato, onion						**A006**	
	Other:							
Spinach/morogo/imfino/other green leafy vegetables: List names	Boiled, nothing added						**3913**	
	Boiled fat added (margarine)						**3898**	
	Boiled with onion/tomato and fat						**A011**	
	-onion &potato (margarine)						**3901**	
	- onion, tomato & potato							
	- with peanuts							
	Other:							
Tomato and onion 'gravy'/relish/chow	Home made -with fat without fat						**3910** **3925**	
	Canned						**4129**	
Pumpkin Specify type:	Cooked in fat & sugar						**A010**	
	Boiled, little sugar and fat						**A010**	
	Boiled						**4164**	
_______________	Other:							
Carrots	Boiled, sugar & fat						**3819**	
	Boiled, nothing added						**3757**	
	Boiled, potato, onion, no fat						**3934**	
	Boiled, potato, onion, margarine						**3822**	
	Boiled, with sugar						**3818**	
	With potato/onion						**3934**	
	Raw, salad (orange juice)						**3711**	
	Chakalaka							
	Other:							

Mealies/Sweet corn	On cob						**3725**	
	Off cob -creamed sweet corn Off cob whole kernel						**3726** **3942**	
Beetroot	Cooked Salad (bought or home-made)						**3698** **3699**	
Potatoes	Boiled with skin						**4155**	
	- without skin						**3737**	
	Baked in skin(flesh and skin) - in skin (flesh only)						**3736** **3970**	
	Mashed - skim milk, margarine						**3875**	
	Mashed - whole milk, margarine						**3876**	
	Roasted in beef fat						**3878**	
	French fries/potato chips (oil)						**3740**	
	Salad (mayonnaise and egg)						**3928**	
	Other:							
Sweet potatoes	Boiled with skin						**3748**	
	without skin						**3903**	
	Baked with skin						**3748**	
	- without skin						**3903**	
	Mashed						**3903**	
	Other:							
Peas	Green, frozen Green, frozen with sugar With sugar and butter Tinned peas						**4146** **3720** **3859** **4149**	
Green peppers	Raw Cooked (stew with oil)						**3733** **3865**	
Brinjal/egg plant	Cooked Fried in oil Stew (oil, onions, tomato)						**3700** **3802** **3798**	
Mushrooms	Raw Sautéed in brick margarine Sautéed in oil						**3842** **3839** **3841**	
Onions	Sauteed in sun oil Sauteed in margarine						**3730** **3844**	
Salad vegetables	Raw tomato						**3750**	
	Lettuce						**3723**	
	Cucumber						**3718**	
	Avocado's						**3656**	
Green Beans	Boiled, nothing added						**3696**	
	Cooked, potato, onion, margarine						**3792**	
	Cooked, potato, onion, no fat						**3933**	
Cauliflower	Boiled							
Other vegetables; specify	____________________ ____________________							

If you fry veg or add fat specify type of fat usually used	Butter Butro Animal fat (beef tallow) Lard Hard margarine (brick) Soft margarine (tub) Soft margarine (light) Sunflower oil						**3479 3523 3494 3495 3484 3496 3524 3507**	

HOW MANY TIMES A WEEK DO YOU EAT VEGETABLES? _____________

FOOD	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom/ Never		
Mayonnaise/salad dressing	Mayonnaise: bought home-made Cooked salad dressing Salad dressing low-oil Salad dressing French Oil: Olive Sunflower Canola						**3488 3506 3503 3505 3487 3509 3507 4280**	
Apples	Fresh Canned, unsweetened						**3532 4216**	
Pears	Fresh Canned, in syrup						**3582 3583**	
Bananas							**3540**	
Oranges Naartjie							**3560 3558**	
Grapes							**3550**	
Peaches	Fresh Canned, in syrup						**3565 3567**	
Apricots	Fresh Canned, in syrup						**3534 3535**	
Mangoes	Fresh						**3556**	
Pawpaw	Raw						**3563**	
Pineapple	Raw Canned (syrup)						**3581 3648**	
Guavas	Fresh Canned (syrup)						**3551 3553**	
Watermelon							**3576**	
Spanspek	Orange flesh Green flesh						**3541 3575**	
Wild fruit/berries (Specify types)	____________________ ____________________ ____________________ ____________________ ____________________							
Dried fruit (also as snacks)	Raisins Prunes (raw) Prunes (cooked with sugar) Peaches (raw) Peach (cooked with sugar) Apples (raw) Dried fruit sweets Other ____________________ ____________________ ____________________						**3552 3596 3564 3568 3569 3600 3995**	

Other fruit	____________________ ____________________ ____________________ ____________________	________ ________ ________ ________	_____ _____ _____ _____	_____ _____ _____ _____	_______ _______ _______ _______	________ ________ ________ ________		________ ________ ________ ________

HOW MANY TIMES A WEEK DO YOU EAT FRUITS? ____________

WE NOW WILL ASK YOU QUESTIONS ABOUT WHAT YOU USUALLY DRINK

BEVERAGES	DESCRIPTION	AMOUNT USUALLY TAKEN	TIMES TAKEN				CODE	AMOUNT/ DAY
			Per day	**Per week**	**Per month**	**Seldom/ Never**		
Water							**4042**	
Tea	Ceylon Rooibos						**4038** **4054**	
Coffee							**4037**	
Sugar per cup of tea or coffee	White Brown						**3989** **4005**	
Milk per cup of tea or coffee What type of milk do you put in tea and/or coffee?	Fresh/long life whole						**2718**	
	Fresh/long life 2% Goat						**2772** **2738**	
	Fresh/long life/fat free (skimmed)						**2775**	
	Whole milk powder, reconstituted Specify brand: ____________________						**2831**	
	Skimmed milk powder, reconstituted Specify brand: ____________________						**2719**	
	Milk blend, reconstituted Specify brand: ____________________						**2771**	
	Whitener/non-dairy creamer Specify brand: ____________________						**2751**	
	Condensed milk (whole)						**2714**	
	Condensed milk (skim)						**2744**	
	Evaporated milk (whole)						**2715**	
	Evaporated milk (low-fat)						**2827**	
	None							
Milk as such: What type of milk do you drink as such?	Fresh/long life/whole Fresh/long life/2% Fresh/longlife/fat free (skimmed) Goat						**2718** **2772** **2775** **2738**	
	Sour / Maas						**2787**	
	Buttermilk						**2713**	

BEVERAGES	DESCRIPTION	AMOUNT USUALLY TAKEN	TIMES TAKEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom/ Never		
Milk drinks Specify brands, Including milk supplements and type of milk used	Nestle Nesquik Milo Flavoured milk Other						**4287** **2735** **2774**	
Yoghurt	Drinking yoghurt Thick yoghurt, plain, fruit						**2756** **2732**	
Squash	SixO Oros Lecol with sugar -artificial sweetener Kool Aid Other_______________ ____________________						**3990** **3982** **3982** **3990** **3982**	
Fruit juice	Fresh/Liquifruit/Ceres/						**2866**	
	"Tropica"/ mixtures with milk						**2791**	
Fruit syrups	Average Guava syrup						**2865** **2864**	
Fizzy drinks Coke, Fanta	Sweetened Diet						**3981** **3990**	
Mageu/Motogo							**4056**	
Alcoholic beverages such as Sorghum beer	Sorghum beer Specify:						**4039**	
Other , specify:	Beer average Wine Cider ____________________ ____________________ ____________________ ____________________ ____________________						**4031** **4033** **4057**	

PLEASE INDICATE WHAT TYPES AND AMOUNTS OF SNACKS, PUDDINGS AND SWEETS YOU EAT:

FOODS	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom/ Never		
Potato crisps/chips							**3417**	
Peanuts	Roasted, unsalted Roasted, salted						**3452** **3458**	
Cheese curls: Niknaks etc.	Average Savoury						**3267** **3418**	
Popcorn	Plain (no salt and butter) Plain (salt and butter added) Sugar coated						**3332** **3359**	
Raisins (seeds)							**4231**	
Chocolates	Milk Kit Kat Peppermint crisp Specify types and names ____________________						**3987** **4024** **3997**	
Candies	Sugus, gums, hard sweets (specify) Peppermint						 **3986** **4004**	

Sweets	Toffees						**3991**	

	Hard boiled Fudge, caramels (specify)						**3986** **3991**	
Biscuits/cookies	Specify type Home made plain Shortbread, butter Commercial, plain Commercial with filling						 **3233** **3296** **3216** **3217**	
Cakes & tarts	Chocolate, plain						**3419**	
Pancakes/ crumpets							**3344**	
Koeksisters							**3231**	
Savouries	Sausage rolls Samoosas - vegetable Samoosa - mutton Biscuits e.g. bacon kips Other: ____________________						**2939** **3414** **3355** **3331**	
Pudding: jelly							**3983**	
Baked pudding	Plain batter						**3429**	
Instant pudding	Skim milk Whole milk						**3314** **3266**	
Ice cream	Commercial regular Commercial rich Soft serve Sorbet Ice lollies Chocolate coated individual ice creams (e.g. Magnum)						**3483** **3519** **3518** **3491** **3982**	
Custard	Home made, whole milk Ultramel						**2716** **2716**	
Cream	Fresh						**3520/ 3480**	
Other puddings (Specify):	____________________							

HOW MANY TIMES A WEEK DO YOU EAT SNACK FOODS? _____________

SAUCES / GRAVIES / CONDIMENTS

FOODS	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom/ Never		
Tomato Sauce **Worcester sauce**							**3139** **4309**	
Chutney	Fruit						**3168**	
	Tomato						**3114**	
Pickles							**3866**	
Packet soups							**3158**	
Beef/chicken stock							**4029**	
Others:								

WILD BIRDS, ANIMALS, INSECTS OR FRUITS AND BERRIES (hunted or collected in rural areas or on farms: (specify)

- **PLEASE MENTION ANY OTHER FOODS YOU EAT MORE THAN ONCE EVERY TWO WEEKS WHICH WE HAVE NOT TALKED ABOUT AND OR FOODS EATEN IN OTHER HOMES OR PLACES DURING THE PAST WEEK**

FOOD	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom/ Never		

- **ARE THERE ANY FOODS THAT YOU EAT WHICH WE HAVEN'T TALKED ABOUT? PLEASE LIST THEM.**

FOODS	DESCRIPTION	AMOUNT USUALLY EATEN	TIMES EATEN				CODE	AMOUNT/ DAY
			Per day	Per week	Per month	Seldom/ Never		

THANK YOU FOR YOUR CO-OPERATION AND PATIENCE.
GOOD BYE!

ADAPTED FROM THE QUESTIONNAIRES OF THE THUSA STUDY (WITH ACKNOWLEDGEMENT TO THE RESEARCH GROUP OF PUCHO AND THE NATIONAL FOOD CONSUMPTION SURVEY

ANNEXURE F

Respondent number: 1-2

Interviewer: ________________ 3

24 Hour Physical Activity Recall for week day

Time of day	**Activity (Number): use attached coding list**					
12:00-12:30AM			.			
12:30-1:00			.			
1:00-1:30			.			
1:30-2:00			.			
2:00-2:30			.			
2:30-3:00			.			
3:00-3:30			.			
3:30-4:00			.			
4:00-4:30			.			
4:30-5:00			.			
5:00-5:30			.			
5:30-6:00			.			
6:00-6:30			.			
6:30-7:00			.			
7:00-7:30			.			
7:30-8:00			.			
8:00-8:30			.			
8:30-9:00			.			
9:00-9:30			.			
9:30-10:00			.			
10:00-10:30			.			
10:30-11:00			.			
11:30-12:00PM			.			
12:30-1:00			.			
1:00-1:30			.			
1:30-2:00			.			
2:00-2:30			.			
2:30-3:00			.			
3:00-3:30			.			
3:30-4:00			.			
4:00-4:30			.			
4:30-5:00			.			
5:00-5:30			.			
5:30-6:00			.			
6:00-6:30			.			
6:30-7:00			.			
7:00-7:30			.			
7:30-8:00			.			
8:00-8:30			.			
8:30-9:00			.			
9:00-9:30			.			
9:30-10:00			.			
10:00-10:30			.			
10:30-11:00			.			
11:00-11:30			.			
11:30-12:00AM			.			

TOTAL PAL VALUE (A)

	.			

For activities not reported in the recall, complete the frequency of the following:

Activity	Duration	Times/day	Times/week	Average/day	PAL/hr				
Carrying heavy items						.			
Chopping wood						.			
Driving a car						.			
Food preparation						.			
Gardening (watering)						.			
Gardening (mowing)						.			
Housework						.			
Playing soccer						.			
Riding a bicycle						.			
Riding a car/taxi/bus						.			
Running						.			
Shopping						.			
Skipping rope						.			
TOTAL PAL VALUE (B)						.			
Final PAL Value (A+B) +1.1						.			

Intensity and Impact of Various Activities on Physical Activity Levels in Adults (derived from Carrol & Johnson, 2004, Table 2-4, p.33)		
	PAL/10min	**PAL/30min**
Bath/shower/washing yourself	0.005	0.015
Chopping wood	0.037	0.111
Driving a car	0.005	0.015
Eating	0.005	0.015
Food preparation	0.014	0.042
Gardening – watering plants	0.014	0.042
Gardening-mowing lawn	0.033	0.099
House work (moderate effort)	0.024	0.072
Playing soccer	0.088	0.264
Riding a bicycle	0.024	0.072
Riding a car/taxi/bus	0	0
Running	0.088	0.264
Sitting with light activity	0.005	0.015
Sitting without activity (TV)	0	0
Sleeping	0	0
Walking (3.2km/hr)	0.014	0.042
Walking (4.8km/hr)	0.022	0.066
Weight lifting	0.061	0.183

ANNEXURE G


Eating
Soil or Clay
For further information
Please contact:
Annette van Onselen
Tel: 033 260 6154
Email: Vanonselen@ukzn.ac.za

Is it dangerous to EAT SOIL?

The answer is YES!

The soil may contain dangerous items such as:

- **bacteria**
- **parasites**
- **worms**
- **heavy metals (such as lead)**

The soil can also bind important minerals such as iron, calcium and zinc which are important for a healthy body.

Soil can also DAMAGE YOUR TEETH!

WHAT CAN I DO?

- Pregnant women and children should **NOT EAT SOIL**
- If you crave soil, visit your clinic or hospital to test the iron levels in your blood

If you are NOT PREGNANT and insist on eating soil, you should do the following:

- Eat food that is good for you (see guidelines on this brochure)
- Eat soil between meals and NOT with meals, to decrease the chances of the soil affecting the absorption of important nutrients
- Bake soil in an oven or in the sun before eating it, this will improve the chances of killing parasites and other germs in the soil
- Eat food rich in calcium like milk, yogurt, pilchards, cheese and mageu more often
- Eat food rich in iron like meat, beef liver, chicken liver, dry beans, spinach and tripe more often
- Be active

What food is GOOD for you?

- Eat a variety of foods
- Make starchy foods the basis of most meals
- Chicken, fish, meat, milk or eggs could be eaten daily
- Eat plenty of vegetables and fruit every day
- Eat dry beans, peas, lentils and soya regularly
- Use salt sparingly
- Use fats sparingly
- Drink lots of clean, safe water
- If you drink alcohol, drink it sensibly
- Use food and drinks containing sugar sparingly and not between meals
- Be active


Ho jewa ha Mobu kapa Lesopa
Mabapi le tlhaloso e tibileng ka kopo founela:
Annette van Onselen
Nomoro: 033 260 6154
E-mail: Vanonselen@ukzn.ac.za

A hokotsi ho ja MOBU?

Karaboke E!

Mobu o kaba le dintho tse kotsi tse kang:

- **Dibaketeria**
- **Diparasaete**
- **Majewa**
- **Letsepe (lead)**

Mobu o kaikopanya le dimererale tse bohlokwa mmeleng wa motho tse kang tsepe, calcium le zingki.

Mobu hape o ka senya meno!

NKA ETSA ENG?

- Basadi babaimana le bana ha ba a lokela o ja Mobu
- E bang o lakatsa Mobu e tela cliniking kappa Sepetlele o lo hlola madi ho re na e be ha o hahelwe ke tsepe.

E bang o se Moimana hape o latella ka ho ja Mobu, o lokelwa ke ho etsa tse latelang:

- E ja dijo tse o loketseng
- E ja Mobu di pakeng tsa dijo e seng le dijo, hona ho tlafokotsa monyetla wa Mobu ho nka dimenerale tse bohlokwa mmeleng wa hao.
- Baka Mobu ka ontong kapa o behle le tsatsing o ome, hona ho tla fokotsa dibaketeria le digerms.
- E ja dijo tse nang le Calcium jwalo ka lebese, yogurt, tlhapi, kase le mageu kgafetsa.
- E ja dijo tse nang le tsepe jwalo ka nama, sebete sa kgomo, dinawa, meroho le mohodu kgafetsa.
- Nka karolo ho i kwetliseng (eba active)

Ke dijo dife tse o loketseng?

- E ja mefuta e mengata ya dijo
- E tsa starch karolo e kgolo ya dilo tsa hao
- Kgoho, tlhapi, nama, lebese, kappa mahe di a jewa letsatsi le letsatsi
- E ja meroho le ditholwana letsatsi le letsatsi
- E ja dinawa tse omeng, dierekisi le Soya kgafetsa
- Se bedisa letswai ha ntle
- Se bedisa mafura ha ntle
- E nwa metsi a hlwekileng haholo
- Ha onwa jala bonwe ka hloko
- Sebedisa dino tse nang le tswekere hantle e seng le dijo
- Nka karolo ho i kwetliseng (eba active)

ANNEXURE I

INTERVENTION QUESTIONAIRRE

RESPONDENT NR [ ][ ] 1-2

CONTROL [ ] GEOPHAGY [ ]

1. Geophagic Habits

1 Are you presently in the habit of eating soil?

Yes	No

[ ] 3

If **YES**, how often do you eat soil?

1.1

[ ]	Once a month
[ ]	Once a week
[ ]	Once a day
[ ]	More than once a Day

[ ] 4

1.2 If no have you eaten soil before?

Yes	No

[ ] 5

2 What is/are your reason(s) for eating soil?

[ ]	Standard practice (cultural, traditional, spiritual)	[ ]	6
[ ]	Craving	[ ]	7
[ ]	Medicinal value	[ ]	8
[ ]	Supplement diet	[ ]	9
[ ]	Ritualistic	[ ]	10
[ ]	When hungry	[ ]	11
[ ]	When pregnant	[ ]	12
[ ]	Don't know	[ ]	13
[ ]	Other, please specify: _________	[ ]	14 [ ][ ] 15-16

3 Do you think soil can be harmful

Yes	No

[ ] 17 [ ][ ] 18-19

3.1 If yes specify

____

3.2 Which groups of people should not eat soil? | | | 20-21

4 If a person does eat soil what can he or she do to improve their health?

____

____

______________________________ | | | 22-27

FOOD BASED DIETARY GUIDELINES EVALUATION

.I am going to ask you some questions. Please tell me if you agree or not ree.

5	Eat a variety of foods	☐ Agree ☐ Disagree	☐	28
6	Starchy food should be the basis of most meals	☐ Agree ☐ Disagree	☐	29
7	Chicken fish, milk or eggs cannot be eaten daily	☐ Agree ☐ Disagree	☐	30
8	Eat plenty of vegetables and fruit everyday	☐ Agree ☐ Disagree	☐	31
9	Dry beans, peas, lentils and soya should not be eaten regularly	☐ Agree ☐ Disagree	☐	32
10	Salt should be eaten sparingly	☐ Agree ☐ Disagree	☐	33
11	Fats should be used sparingly	☐ Agree ☐ Disagree	☐	34
12	Use food and drinks containing sugar as often as you like	☐ Agree ☐ Disagree	☐	35
13	Did you have access to the geophagy brochure that was distributed to you and the community.	☐ Yes ☐ No	☐	36
14	Did you change anything after reading the brochure? If yes what did you change?	☐ Yes ☐ No	☐	37

____

____

____

THANK YOU FOR YOUR COOPERATION

ANNEXURE J

GEOPHAGIA

PHASE 2

<u>REFERRAL LETTER</u>

Ms/Mr/Mrs/Dr/Prof ____________________________________

The following patient ____________________________________has participated in a clinical study and the following have been observed and concluded.

____
____
____
____
____
____
____
____
____
____
____
____
____
____

For your further assistance and recommendations

Kind regards.

____

Contact details: ____________________________

ANNEXURE K

INSTRUCTION MANUAL FOR FIELDWORKER

1. OBJECTIVES OF BROCHURE

The three objectives of the nutrition intervention brochure are the following:

- Informing participants about the risk factors;
- Describing the impact of geophagia or consumption of soil on their health and
- Educating the participants about healthy eating habits.

Each objective will be discussed and explained in section 2.2.

2. NUTRITION INTERVENTION BROCHURE

2.1 Procedure

- The following steps will be followed with each participant:
    - Greet the person and ask which language she prefers we talk to her in English or Sotho?
    - Introduce yourself and other person(s)
    - Explain briefly that you have information to share regarding geophagia or the consuming of soil
    - Ask her if you can continue
    - Start explaining the brochure: if the participant does not understand English you will need to translate.
    - Inform the participant that she must please ask questions if she doesn't understand or if something needs to be repeated

2.2 Explaining the brochure

The brochure is developed in order to meet the objectives. Each objective must be explained to each participant.

<u>Objective 1</u>: Informing participants regarding risk factors (danger) of eating soil

Information in brochure: "Soil binds important minerals such as iron, calcium and zinc which are important for the body. Pregnant women and children should not eat soil."

Explanation: Minerals are inside food and your body needs the mineral like iron to keep you blood healthy, calcium to keep your teeth strong and zinc to help you fight sickness.

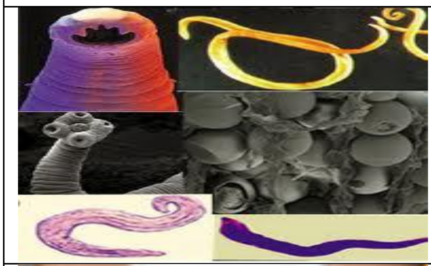
Women who are expecting a baby and children should not eat soil or 'moby' because can make them sick.

Start with objective 2.

<u>Objective 2</u>: Explain danger of eating soil

Information in brochure: "The soil may contain dangerous items such as bacteria, worms and heavy metals such as lead."

Explanation: Show and explain the following pictures:

	Bacteria: Can be found in soil and make you sick for example cramps and diarrhoea (running stomach)
	Parasites/Worms Can also be found in soil and make you sick. Can grow inside you make you sick
	Lead Toxic – make you very sick and can die of too much lead

<u>Objective 3</u>: Educate participants on healthy eating habits.

In brochure: “What food is GOOD for you?”

Explanation: You need food to keep you strong and healthy. There are some guidelines to follow when choosing what food to eat so that you get everything you need from different types of food. Some food should be eaten more than others so it is important to follow these guidelines.

- Eat a variety of foods

It is necessary to eat many different types of foods every day to be and stay healthy

- Make starchy foods the basis of most meals

Food like phuthu, pap, rice, bread and jeqe are all called starchy food. These foods give you energy and should be eaten with most meals

- Chicken, fish, meat, milk or eggs could be eaten daily

Meat and meat products like chicken, fish, beef, milk and eggs can be eaten every day

- Eat plenty of vegetables and fruit every day

Vegetables and fruit should be eaten every day to keep you from getting sick

- Eat dry beans, peas, lentils and soya regularly;

dry beans, peas, lentils and soya are good, cheaper substitutes for meat. These foods can be added to stews to make it go further. They are also good because they are from plants and help the stomach to work well

- Use salt sparingly

Too much salt can make you get high blood pressure which can make you you feel sick after a long time. It is important to stop this before it starts and you can do it by not using too much salt while cooking and over your food

- Use fats sparingly

Too much fats, like margarine, oil, butter, peanut butter is also not good over time you should try to eat a small amount everyday

- Drink lots of clean, safe water

Clean, water is important to drink because it is the main part of your body. Every day, you must drink lots of clean, safe water

- If you drink alcohol, drink it sensibly

Alcohol can hurt your body and make you very sick. If you do drink traditional beer, do not drink every day and make sure you do not overdrink

- Use food and drinks containing sugar sparingly and not between meals

Sweet tasting food is not good in big amounts. Try to eat a little bit of sweet things but not every day

- Be active

Do exercises example, walking, running, washing clothes etc. every day

These guidelines were used to educate the participants on healthy eating practices and to be active (Annexures G, H).

SUMMARY

Geophagia is the most common type of pica, characterized by the urge to consume clay or soil.

QwaQwa houses a very dense black African population and covers 254.2 km^2. This rural area with the largest concentration of Basotho's in South Africa is characterized by a strong focus on traditional beliefs and practices, making it a favourable area to investigate the phenomenon of geophagia. The main aim of this study was to determine the nutritional status and risk factors associated with women practicing geophagia in QwaQwa, South Africa. Socio-demographic factors, dietary intake, anthropometry, physical activity and blood measures were investigated at baseline. After the intervention, the impact of the nutrition education on knowledge and habits related to geophagia were determined.

The study design comprised of an observational epidemiological study which included an exposed (geophagia) and non-exposed (control) group followed by an intervention phase. An assessment of the impact of the intervention was also conducted. A logistical regression analysis was performed in order to identify factors that were likely to be associated with the practice of geophagia. At baseline, the sample consisted of 69 participants, of whom 42 were in the geophagic group (G) and 27 in the control group (C).

The majority of participants in both groups (G=77.5%; C=70.4%)were unmarried. Sotho was spoken by more than 90% of participants. A large percentage of participants in both groups had an education level of grade 11 - 12 (G = 42.9% and C = 51.9%) and were unemployed (G = 90.48% and C = 74.1%). Electricity was used by both groups as the main source of energy for cooking (G = 83.3% and C = 85.2%), followed by paraffin (G = 11.9% and C = 7.4%). The primary employment status of the group with geophagia was part-time or piece jobs (54.8%), while in the control group a full-time wage earner was present in 48.15% of households. The logistic regression showed that women who were wage earners and those that owned a refrigerator (and thus had a higher socio-economic status), were less likely to practice geophagia.

A food frequency questionnaire was implemented to determine dietary intakes of participants. The mean total energy intake for the group with geophagia and the control group were similar at 10324.31 ± 2755.00 kJ and 10763.94 ± 2556.30 kJ respectively, which was considered high. The macronutrient distribution was within the recommended levels. Mean total protein intake was also similar in both groups (G = 75.59 ± 20.12 g; C = 85.55 ± 29.07 g) at 12.5% (G group) and 13.6% (C group) of total energy intake. The percentage total energy intake from fat was 33.1% for the geophagia group and 31.5% for the control group. Both groups had intakes that were higher than the estimated average requirement (EAR) for dietary iron (G = 11.60 mg; C = 13.49 mg). The intake of nutrients that may be related to iron metabolism, are vitamin A, vitamin C and folate.

Standardized techniques were used to determine anthropometric measurements namely body mass index (BMI), waist circumference, and hip circumference. The mean BMI of both groups of participants fell within the overweight category (G = 25.59 kg/m^2; C = 25.14 kg/m^2).

The physical activity levels of participants were determined by recalling the physical activity of the previous day. Mean levels of physical activity fell in the low active category for both groups. Logistic regression indicated that women with a waist:hip ratio above 0.8 (android category) were less likely to practice geophagia.

The mean serum iron levels of the geophagia group were significantly lower (p = 0.000) than that of the control group (G = 6.92 µmol/L; C = 13.75 µmol/L). There was also a significant difference in the serum haemoglobin (G = 11.23 g/L; C = 13.26 g/L; p = 0.00) and serum ferritin levels (G = 11.98 µg/L; C = 42.31 µg/L; p = 0.00) between the geophagia and control groups. Serum transferrin and serum transferrin saturation levels also differed significantly between groups (G = 3.21; 7.97 and C = 2.68; 7.78; p = 0.00). The logistic regression also established which of the measured blood variables were significantly affected by the practice of geophagia. A highly significant association between the practice of geophagia and the cluster of metabolic indicators of iron status, including serum iron, haem-iron, non-haem iron, haemoglobin, ferritin, transferrin, and transferrin saturation was identified.

The majority (57.1%) of participants consumed soil once a day and 42.9% more than once a day. The craving for soil was reported by most of the participants as the reason that they practiced geophagia (97.6%) and a preference for whitish clay was also found.

A number of habits related to geophagia changed after the intervention. In this study the nutrition education programme was effective in improving some aspects of a participant's knowledge and practices related to geophagia, while others remained unchanged.

The intervention was successful in reducing the consumption of soil per day and almost forty per cent of participants in the group with geophagia stopped consuming soil after the intervention. Before the intervention, more than fifty per cent of participants did not know that pregnant women and children should not consume soil, while more than sixty per cent knew in the control group and all the partiipants in the geophagia group after the intervention.

Geophagia was confirmed to be a risk factor for iron deficiency in black women between 18 and 45 years of age. Factors that were identified as decreasing the likelihood of having geophagia included being a wage earner, owning a refrigerator, having a greater WHR (waist-to-hip ratio) and not having iron deficiency.

The significantly strong association between geophagia and iron deficiency emphasizes the importance of identifying the practice of geophagia in women, especially during their child bearing years. The intervention that was developed for this study could be applied in a wider setting to address the problem of geophagia and its harmful effects on health.

Key words: geophagia, iron deficiency anaemia, dietary intake, anthropometry

OPSOMMING

Geofagie is die algemeenste vorm van pika wat gekenmerk word deur 'n sterk drang om grond te eet.

QwaQwa huisves 'n dig bevolkte swart Afrika bevolking en beslaan 'n area van 254.2 km^2. Hierdie Suid-Afrikaanse plattelandse gebied bestaan hoofsaaklik uit Basotho's wat gekenmerk word deur 'n sterk fokus op tradisionele oortuigings en gewoontes, en dus dit 'n gunstige area is om die verskynsel van geofagie te ondersoek. Die hoofdoel van die studie was om die voedingstatus en risikofaktore te bepaal wat geassosieer word met vroue wat geofagie in QwaQwa, Suid-Afrika beoefen. Sosio-demografiese faktore, voedselinname, antropometrie, fisiese aktiwiteit en bloed-waardes was tydens basislynopname ondersoek. Na 'n intervensie is die impak daarvan op die kennis en gewoontes wat met geofagie geassoseer word, bepaal.

Die studie-ontwerp het bestaan uit 'n observerende epidemiologiese studie wat uit 'n eksperimentele (met geofagie) en kontrole (sonder geofagie) groep bestaan het, gevolg deur 'n intervensiefase. 'n Bepaling van die impak van die intervensie was ook uitgevoer. 'n Logistieke regressiewe analise is uitgevoer om faktore te identifiseer wat waarskynlik met die praktyk van geofagie geassosieer word. Met die basislynopname was daar 'n totaal van 69 vrouens, waarvan 42 in die groep met geofagie (G) geval het en 27 in die kontrole groep (K).

Die meerderheid vroue, in beide groepe (G=77.5%; C= 70.4%) was ongetroud. Sotho was die spreektaal in 90% en meer van die deelnemers. 'n Groot persentasie deelnemers in beide groepe het 'n onderwysvlak van graad 11 - 12 voltooi (G = 42.9% en K = 51.9%) en was werkloos (G = 90.48% en K = 74.1%). Elektrisiteit was deur beide groepe as hoofbron van energie vir kookdoeleindes gebruik (G = 83.3% and K = 85.2%), gevolg deur paraffien (G = 11.9% en C = 7.4%). Die primêre bron van werk in die groep met geofagie (54.8%) was deeltydse en stukwerk, terwyl in die kontrole groep 'n voltydse loonwerker in 48.15% van huishoudings voorgekom het. 'n Logistieke regressie het aangedui dat vrouens wat loonwerkers was en 'n yskas besit (en dus 'n hoër sosio-ekonomiese status gehad het), waarskynlik minder geneig sal wees om geofagie te beoefen.

'n Voedselfrekensie-vraelys is gebruik om die voedselinname van deelnemers te bepaal. Die gemiddelde energie-inname in die groep met geofagie en die kontrole groep was dieselfde (10324.3 ± 2755.0 kJ en 10763.9 ± 2556.3 kJ onderskeidelik), wat as hoog beskou word. Die makro voedingstof verspreiding was binne die aanbevole vlakke. Die gemiddelde totale proteïeninname was ook soortgelyk tussen albei groepe (G = 75.6 ± 20.1 g; K = 85.6 ± 29.1 g) met 12.5% (G-groep) en 13.6% (K-groep) van die totale energie-inname. Die totale persentasie energie afkomstig vanaf vetinname was 33.1% vir die groep met geofagie en 31.5% vir die kontrole groep. Beide groepe het hoër innames as die geskatte gemiddelde aanbevelings vir yster (G = 11.6 mg; C = 13.5 mg) gehad. Die inname van nutriënt wat heel moontlik met ystermetabolisme geassosieer word, is vitamien A, vitamien C en folaat.

Standaardtegnieke is gebruik om antropometriese metings, naamlik ligaamsmassa indeks (LMI), middelomtrek en heupwydte te bepaal. Die gemiddelde LMI in beide groepe het in die oormassa kategorie geval (G = 25.6 kg/m^2; K = 25.1 kg/m^2).

Die fisiek aktiwiteitsvlak van deelnemers is bepaal deur die vorige dag se fisiek aktiwiteite te herroep. Die gemiddelde fisiek aktiwiteitsvlak van albei groepe het in die lae aktiewe kategorie geval en was nie betekenisvol verskillend nie (p = 0.45). 'n Logistieke regressie het aangedui dat vrouens met 'n middel:heup-verhouding van bo 0.8 (androïede kategorie), minder geneig was om geofagie te beoefen.

Die gemiddelde serumysterwaardes in die groep met geofagie was betekenisvol laer (p = 0.000) teenoor die kontrole groep (G = 6.92 µmol/L; K = 13.75 µmol/L). Daar was ook 'n betekenisvolle verskil in die serumhemoglobien (G = 11.23 g/L; K = 13.26 g/L; p = 0.00) en serumferritienvlakke (G = 11.98 µg/L; K = 42.31 µg/L; p = 0.00) tussen die groep met geofagie en die kontrole groep. Serumtransferrien en serum-transferrin-versadigingsvlakke het ook betekenisvol verskil tussen die twee groepe (G = 3.21; 7.97 en K = 2.68; 7.78; p = 0.00). Die logistieke regressie het bepaal watter bloedwaardes betekenisvol deur geofagie geaffekteer word. 'n Hoogs betekenisvolle assosiasie is gevind tussen die gewoonte van geofagie en die *cluster* van metaboliese indikatore van ysterstatus, wat serumyster, heem-yster, nie-heemyster, hemoglobien, ferritien, transferrien en transferrien-versadigingsvlakke insluit.

Die meerderheid deelnemers (57.1%) het grond een keer per dag geëet en 42.9% meer as een keer per dag. Die sterk drang na grond is deur die meeste deelnemers (97.6%) as rede vir die beoefening van geofagie gegee en ook verkieslik wit klei. 'n Aantal gewoontes wat met geofagie geassosieer word, het wel na die intervensie verander. In hierdie studie was die voedingsonderrigprogram suksesvol in sekere aspekte deurdat die deelnemers se kennis en praktyke wat met geofagie geassosieer word, verbeter het, terwyl ander aspekte onveranderd gebly het.

Die intervensie was suksesvol deurdat ongeveer veertig persent van deelnemers die praktyk van geofagie laat vaar het. Meer as vyftig persent van deelnemers het voor die intervensie aangedui dat hulle nie kennis dra dat vrouens en kinders nie geofagie moet beoefen nie. Daarenteen was meer as sestig present in die kontrole groep en al die vrouens in die geofagie groep na die intervensie daarvan bewus.

Geofagie is bevestig as 'n risikofaktor vir ystergebrek in swart vroue tussen die ouderdom van 18 en 45 jaar. Faktore wat geïdentifiseer is om nie geofagie te beoefen nie, was deur 'n loonwerker te wees, 'n yskas te besit, om 'n verhoogde (>0.8) middel-tot-heup verhouding te hê (androide vet verspreiding) en nie aan ystergebrek te lei nie.

Die betekenisvolle verband tussen geofagie en ystergebrek beklemtoon die belangrikheid om die praktyk van geofagie in vrouens te identifiseer, veral gedurende hul fertiliteitsjare. Die intervensie wat vir hierdie studie ontwikkel is, kan in 'n groter mate toegepas word om die probleem en uitwerking van geofagie op gesondheid aan te spreek.

Sleutelwoorde: geofagie, ystergebrekanemie, dieetinname, antropometrie