Sugar and sodium content of baby foods in South Africa

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Declaration

I, Nicola Marais (Student Number 445224) declare that this research report is my original work. It is submitted in partial fulfilment of the requirements for the degree of Master of Public Health, in the field of Health Systems and Policy, at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination to this or any other university.

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Abstract

Introduction: The burden of non-communicable diseases (NCDs) in South Africa is growing and since 2010 the proportion of deaths due to NCDs relative to those due to communicable diseases has increased. Excessive sugar and salt consumption are associated with many of the risk factors for NCDs. Exposure to excess sugar and salt early in life affects subsequent eating behaviour, and creates a predisposition towards NCDs. The aim of this study was to describe and analyse the sugar and salt[1] content and labels of commercially produced baby foods and infant formulas in South Africa and to compare these to current recommended intake guidelines; as well as to determine whether there is a relationship between the price of baby food and the sugar or salt variables over the study period (2015)

Methods: This cross-sectional study was an analysis of the sugar and salt content of commercially available baby foods and formulas in South Africa using data collected from packaging and price. Photos were taken of labels, both of the front and back of the pack, including the nutritional table and ingredients list, and coded later. The sampling approach was purposive and after exclusions the sample was divided into: formula (n=53) and baby foods (n=283). The baby foods sample was fairly representative with 77% of the LBN brands included in the baby foods study sample. The formula study sample was fairly representative with 69% of LBN brands in the sample frame. Data on the sugar and salt content were compared to Elliott and Conlon (2015) recommended intake guidelines for salt and sugar. These recommended intake guidelines use dietary reference intakes from the US Institute of Medicine to set guidelines per serving for baby and toddlers. Dependent variables were created for sugar, salt and labelling. Bivariate analysis was used to determine if there were any associations between the dependent variables and the characteristics of baby food and formula and labelling variables including: manufacturer, formula type, food type, food subtype and target age. The two-sample Wilcoxon rank-sum (Mann-Whitney) test was used to detect associations between the price of the baby foods and formulas and the dependent variables for sugar and salt.

Results: The majority (96%) of baby foods (n=283) did not have added salt and were classified as having low-salt content. Although three quarters of baby foods had no added sugars, the sugar content due to lactose or fructose was high (78%). Cereals, snacks and desserts contained the most added sugar and had a high sugar content. There was an association between price and added sugar, with foods with added sugar having a lower median price. There was an association between price and added salt with the added salt category having a higher median price. The labels conformed to current standards, but did not have

[1] For the purposes of this study we use the term sodium when referring to nutrients as all food packaging should detail sodium content on their nutritional table. When listed as an ingredient, salt is assumed to be sodium chloride.

clear front-of-pack (FOP) information on levels or proportions of sugar or salt and whether there was any added salt or sugar.

Conclusions: This is the first study in South Africa on the sugar and salt content of baby foods and/or formulas. More than three quarters of baby food products sampled had a high sugar content (more than 20% of total calories were derived from sugar) and almost a quarter of baby food products sampled (24.3%) contain added sugars. This creates an environment favourable to the development of sweet-taste preferences. There is a clear need for regulations around baby foods as a starting point for developing healthy eating behaviours in the South African population, which can help to reduce NCDs. Recommendations include interventions which are in line with the sub-strategy of the Strategic Plan for the Prevention and Control of Non-Communicable Diseases 2013-17, which aims to "Prevent NCDs and promote health and wellness at population, community and individual levels". Additionally, these interventions tie into the more specific goals in detailed in the Strategy for Prevention and Control of Obesity (2015). These include: the creation of an environment which supports access to- and availability of- healthy food choices; the support of initiatives that aim to prevent obesity in early childhood; and communication aimed at the education and mobilisation of communities. Disclosure of added sugars should be enforced on packaging. An easy to understand front-of-pack (FOP) labelling system based on a traffic-light system would not only inform consumers about whether foods are healthy or not but would also most likely encourage manufacturers to revise sugar content of their products. Other considerations should include: providing guidance for parents/caregivers on feeding foods with high sugar content either through a media campaign such as posters in waiting areas; clear targeted messages in the *Road to Health* booklet on dangers of foods with high sugar content and education on how FOP traffic-light labelling works.

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Non-communicable diseases Non-communicable diseases are defined as diseases that are non-infectious, are of long duration and generally slow progression and include, amongst others, cerebrovascular diseases, diabetes mellitus, cancers, hypertension and ischaemic heart diseases (1).

Dyslipidemia Is an abnormality in the lipids and lipoprotein in the blood with lower levels of high-density lipoprotein, and higher levels of low-density lipoprotein, and higher triglycerides (2).

Hyperlipidemia Is higher than normal levels of lipids in the blood (2).

Dental caries Is the scientific name for tooth decay.

Baby foods For this study, the term means all commercially available foods marketed specifically to babies excluding formulas. This includes: cereals and prepared baby food products sold in jars, flexible pouches. The prepared baby food products category includes: pureed food, yoghurts, chilled desserts, soup, desserts marketed for babies. It also includes baby snacks or other baby-specific food not classified elsewhere, such as teething biscuits, baby rusks, Nestlé Jogolino dairy snack, baby-specific fruit juices and concentrates as well as teas (3).

Formulas For this study, the term means all commercially available infant formula to be used as a safe and suitable breast-milk substitute as well as a complementary food.

Salt Salt is the common name for sodium and these terms are often used interchangeably. Table salt is sodium in the form of sodium chloride. Sodium is present in other sodium containing compounds which are present in food such as sodium bicarbonate, sodium phosphate, sodium carbonate, monosodium glutamate, and sodium benzoate (4). Sodium is also found naturally in low levels in many foods. For the purposes of this study we use the term sodium when referring to nutrients as all food packaging should detail sodium content on their nutritional table. When listed as an ingredient salt is assumed to be sodium chloride.

Intrinsic sugar	Sugar that is present in underlying whole-food ingredients specifically sugars that occur naturally in fruit and vegetables and milk (5).
Added sugar or salt	Salt or sugar that has been added as part of processing and are not present in underlying whole-food ingredients.
Free sugars	This is new term coined by the World Health Organization (WHO), which includes added sugars as well as sugars naturally present in honey, syrups, fruit juices and fruit-juice concentrates added to sweeten foods (6).
Front-of-pack labelling	The presentation of certain key nutritional information on the front of the package. This is in addition to the prescribed tabular format for nutritional information which is usually on the back of the pack, with nutritional information on the front of the package.
***Road to Health* booklet**	A medical-record summary for the first five years of a child's life. It allows effective recording of the vaccinations within the context of comprehensive child care, records health and development information as well as contains health-promotion messages relevant to children under five.

List of acronyms

CVD	Cardiovascular disease
DOH	Department of Health
ESPGHAN	European Society for Paediatric Gastroenterology, Hepatology and Nutrition
FITS	Feeding Infants and Toddlers Study
FOA	Food and Agriculture Organization of the United Nations
HDL	High-density lipoprotein
HFCS	High-fructose corn syrup
LBN	Local Brand Name
LDL	Low-density lipoprotein
LMIC's	Low- and middle-income countries
SES	Socio-economic status
SSBs	Sugar-sweetened beverages
NCDs	Non-communicable diseases
NHANES	National Health and Nutrition Examination Survey
UK	United Kingdom
US	United States
WASH	World Action on Salt and Health
WHO	World Health Organization

Chapter 1: Introduction, aims and objectives and literature review

Chapter 1 provides a background to the study highlighting why the overconsumption of sugar and salt are public health concerns. The aims and objectives of the study were to describe the sugar and salt content (as well as added sugar and added salt) and labels of commercially produced baby foods and formulas in South Africa and to compare these to current recommended intake guidelines; as well as determine whether there is a relationship between the price of baby food and the sugar or salt variables. The literature review provides a history of salt and sugar consumption and goes into detail on health problems related to salt and sugar. It also examines infant feeding and explains the importance of early taste-preference development. It goes on to provide detail on recommended guidelines and also looks at food-labelling practices as food labels are a key way to inform consumers. The problem statement and justification for the study conclude this chapter

1.1 Introduction

The consumption of sugar and salt over the last couple of centuries has increased rapidly. The introduction of highly concentrated corn-derived sweeteners, such as high-fructose corn syrup (HFCS) has contributed to a very rapid increase in sugar consumption. In England the *International Sugar Economic Yearbook and Directory* shows that sugar consumption in England has increased by 1,500% between the 18th and 19th centuries (7). In the United States (US) the third *National Health and Nutrition Examination Survey* 1988–94 (NHANES III), which covers the period between 1977 and the 1990s, showed a 46% increase in the average daily fructose intake over a ten-to-16-year period (7). This survey also indicated that fructose consumption was higher in people with the lowest income compared to those with the highest incomes (7). In the United States about 75% of all packaged foods and beverages contain added sugar, and it is estimated that on average Americans consume from 88g to 188g of sugar a day, which includes the hidden sugar in processed foods (8). In South Africa the consumption of sugar seems to be increasing across the population with children consuming approximately 50g per day and adolescents up to 100g per day (9). The Food and Agriculture Organization of The United Nations (FOA) Food Balance sheets data (2007) put South Africa's available per capita sugar intake at 84.1g per day (9).

The use of salt in food preservation is thought to have resulted in early consumption levels, which were estimated at between three and five grams per day (10, 11). Today Americans consume between 3.7g and 9.6g per day (12, 13). In South Africa the average salt intake is 7.8g per day in black persons, 8.5g per day in mixed-race persons, and 9.5g per day in white persons (14). A study done in the United Kingdom (UK) found that most of the salt intake (75%) was derived from salt added by the manufacturers to processed foods (15). The discretionary salt intake (the salt added to food in cooking or at table) in South Africa is making up 45.5%, 32.8% and 42.2% of this total salt intake in black, mixed ancestry, and white

subjects, respectively, which is a much larger proportion of total salt intake than in Western countries where the majority of salt intake is from processed foods (14).

The inability of our bodies to cope with the rapid change in sugar and salt content in our diets is thought to be one of the reasons for the increase in many of the chronic non-communicable diseases (NCDs) (13). The World Health Organization's (WHO) *Global status report on non-communicable diseases 2014*, stated that 16 million of the 38 million deaths due to NCDs in 2012 were premature and thus preventable. In South Africa, it is estimated that NCDs account for 43% of total deaths (all ages, both sexes) and the probability of premature mortality due to NCDs is 27% (16).

The 1997 WHO consultation on obesity, recognised obesity as a chronic health problem (17). Obesity is a growing public health problem that is a risk factor for many chronic NCDs such as diabetes, hypertension, cardiovascular disease (CVD), and cancer (18-21). The WHO consultation on obesity also noted that obesity is no longer only a concern in the high-income countries, but is also becoming a major health problem in the low- and middle-income countries (LMICs) (17). The incidence of obesity in LMICs is increasing (22). It has been suggested in a number of studies that there has been an increase in prevalence of obesity in South Africa (23-25). In high income countries WHO has noted an increase in prevalence of childhood obesity (17). Armstrong *et al* (2006) have seen similar trends in South African children with regards to obesity and being overweight to those in high-income countries a decade before (26).

Childhood obesity increases the odds of obesity later in life and also leads to an increased prevalence of chronic disorders associated with obesity (17, 27-29). The main dietary factors associated with childhood obesity are high energy intake and high intake of sugar-sweetened beverages (SSBs) (30). As well as a link to obesity later in life (29), obese infants, children and adolescents have increased frequency of certain medical conditions such as hyperlipidemia, hypertension, and abnormal glucose tolerance (31).

In Africa and South Africa there are high rates of urbanisation resulting in a change from traditional rural diets, which are high in fibre, low in sugar and fat to a more westernised diet based on processed and commercially available foods (32, 33). In South Africa, the packaged baby food industry has increased from 36,8900 tonnes in 2009 to 43,6300 tonnes in 2014 with the bulk of the products sold in supermarkets (34). The Nielsen Company in its 2015 report on the South African baby food market identified two separate segments to the baby food market namely: formulas and baby foods (35).

Food preferences and exposure to foods in early childhood have been found to correlate with preferences and eating behaviour in later life (36-39). As early exposure to salt and sugar is crucial in developing later

taste preferences it is important to consider the salt and sugar content of commercially available baby foods as well as their labelling.

There are only a few studies that have looked at sugar and salt in baby foods globally and until 2010 it seemed that baby and toddler foods were passed over in public policy debates around the sugar and salt content of foods. Elliot was the first to examine the sodium and sugar content in baby and toddler food in the Canadian market into 2010 (40). Elliott and Conlon's study published in 2015 went on to examine the sugar and sodium content of commercially available baby and toddler foods marketed in the US in 2013 (41). This study found that more than half the baby and toddler foods examined were either high in sodium or sugar (41). Another study in 2013 looked at the salt and sugar content of commercial weaning foods in the UK as part of a broader study on commercial infant foods there (42). In 2015 a study was done in the US to fill the gaps in the data on the salt and sugar content of commercial infant and toddler foods in US (43). One study examined the nutrient composition of complementary foods in six to 12 month-old South African infants (44), however this study did not look at salt or sugar specifically but rather the overall nutritional status of the complementary diet fed to infants. This is the first study in South Africa on the sugar and salt content of baby foods and/or formulas.

1.2 Aim and objectives

The aim of this study was to describe and analyse the sugar and salt[2] content and labels of commercially produced baby foods and infant formulas in South Africa and to compare these to current recommended intake guidelines; as well as to determine whether there is a relationship between the price of baby food and the sugar or salt variables over the study period (2015). The specific objectives were:

1. To describe the sugar and salt content of the commercially produced baby foods and infant formulas.

2. To describe which of these commercially produced baby foods have "added" sugar or salt, and to describe which of the formulas have "added" sucrose or fructose.

3. To determine whether there is a difference in sugar and salt content between different manufacturers, types of infant formulas, food types and food subtypes of commercially available baby foods and formulas.

[2] For the purposes of this study we use the term sodium when referring to nutrients as all food packaging should detail sodium content on their nutritional table. When listed as an ingredient, salt is assumed to be sodium chloride.

4. To determine the relationship between sugar content, added sugar or "added" sucrose or fructose, salt content and added salt and the price of different baby foods and formulas.

5. To compare the nutritional labels of these commercially produced baby foods and formulas with current South African food labelling regulations and to describe if there is any front-of-pack (FOP) nutritional labelling with respect to salt and sugar.

1.3 Literature review

1.3.1 History of salt and sugar consumption

When *Homo sapiens sapiens* first appeared between 200,000 and 100,000 years ago, it is thought that they had an omnivorous diet with a significant meat-based component (45). Sugar was scarce and was encountered seasonally through fruit and honey. Consumption of sugar was low until the 1700s (7). Early humankind's diet was also limited to salt occurring naturally in meat or mineral deposits and sea water (46). The higher salt consumption levels are thought to have started between 5,000 and 10,000 years ago with the use of salt in food preservation (47-49).

There is at least 100,000 years of evolutionary history where humans had limited access to high levels of sugar and salt. Modern humans have genetically evolved nutritional requirements based on the environment of our ancestors (13). However, today the rapid industrialisation of food production has meant that people have easy access to sweet and salty food all year round. Additionally, many commercially processed foods have added sugar and added salt, often in high concentrations. The inability of our bodies to cope with significantly higher sugar and salt levels in our diets is thought to be one of the reasons for increases in many chronic NCDs (13).

1.3.2 Salt and links to health problems

While some salt is essential for many body functions such as maintaining the electrolyte balance, transmitting nerve impulses, and muscle contraction (50), a high-salt diet can have direct negative health consequences, such as increased risk of hypertension (47, 51). Hypertension is linked to CVD and in 2008 complications of hypertension accounted for 51% of stroke deaths and 45% of coronary heart disease deaths globally (52). Untreated hypertension can also cause a range of other serious health issues, such as kidney disease. A Dutch randomised trial (n= 476) found that a high-salt intake for infants over the period from birth to six months was associated with higher blood pressure 15 years later (53). The results of this study suggest that exposure to a high-salt diet may lead to long-term negative health consequences later in life.

Additionally, high-salt intakes have been linked to many other direct negative health consequences, many of which are independent of salt's effect on blood pressure, including an increased risk of left ventricular

hypertrophy (54). There is also an increased risk of stroke with a high-salt diet, which is also independent of its effect on blood pressure (55). Additionally, there is an increased risk of stomach cancer with high-salt intake (56). High-salt intake has also been linked to an increased risk of renal disease (57, 58). Devine *et al* (1995) showed in their study that a high-salt diet can cause calcium to be leached from bones, causing osteoporosis (59). A recent study on the link between a high-salt diet in overweight teenagers (n=766) showed it being associated with a reduction in the length of Telomeres, which is associated with premature aging (60).

1.3.3 Sugar and links to health problems

Sugar that occurs naturally in whole unprocessed foods such as fruit or vegetables is termed intrinsic sugar. If eaten in moderation there is no reported evidence to associate consumption of intrinsic sugars as well as sugars from milk (lactose or galactose) with any negative health effects (6). However, added sugars, which are sugars added to food or drinks during preparation or processing have become a public health concern as these added sugars are resulting in an overconsumption of sugar. In addition to being highly refined, added sugars are devoid of food nutrients other than being sources of energy. Many of the international guidelines on sugar pertain to added sugars rather than total sugars (61, 62) as there is evidence of many negative health consequences related to overconsumption of added sugars (63). The WHO guidelines have gone one step further and coined the term "free sugars", which includes added sugars as well as sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates, which are attributed to negative health outcomes (6). A summary of negative health outcomes and evidence of the associations are described in Table 1.

Table 1: Summary of some of the evidence supporting associations between sugar and negative health outcomes

Author, Year	Country	Study Design	Sample Size	Key outcome or association	Result
Obesity					
Te Morenga, Mallard et al. 2013	Global	systematic review and meta-analyses of randomised controlled trials and cohort studies	30 trials and 38 cohort studies	People who consume more sugar usually tend to gain more weight	Increased sugar intake was associated with a comparable weight increase (0.75 kg, 0.30 to 1.19; P=0.001)
Dental caries					
Moynihan, Kelly 2013	Global	systematic review	3 intervention, 8 cohort, 20 population, and 24 cross-sectional	positive association between increased sugar intake and caries	evidence of moderate quality showing that caries is lower when free-sugars intake is less than 10% of energy intake

Type 2 Diabetes					
Basu, Yoffe et al. 2013	Global	econometric models based on cross section data	n/a	Increased sugar availability as proxy for consumption is associated with increase diabetes prevalence	150 kcal/person/day increase in sugar availability was associated with increased diabetes prevalence by 1.1% (p ,0.001)
Hypertension					
Chen et al. 2010	US	18-month multicenter randomized trial	n = 810	Reduced sugar consumption was significantly associated with reduced BP independent of weight loss	Reduction in consumption of combined Sugars by 10 g/day significantly associated with reduced BP P<0.001
Dyslipidemia					
Welsh et al 2010	US	Cross-sectional study	n =6113	Increased sugar consumption significantly associated dyslipidemia	In individuals with high added sugar consumption the odds of low HDL-C levels were 50% to more than 300% greater compared with the reference group (consuming less than<5% added sugars)
CVD					
de Koning, Malik et al. 2012	US	Prospective cohort study	n = 42 883	Consumption of SSB was significantly associated with increased risk of CVD and its intermediate biomarkers	top quartile SSB intake participants had a 20% higher relative risk of CVD than those in the bottom quartile (RR=1.20, 95% CI: 1.09, 1.33, p for trend < 0.01) Intake of SSBs was associated with increased intermediate CVD biomarkers (p < 0.02)

The WHO guideline on sugars was based on two major public health problems, namely obesity (21, 64, 65) and dental caries (66-72) as there was conclusive evidence that linked excessive sugar intake to these health problems. The increased risk of dental caries with overconsumption of sugar occurs as sugars break down and provide a substrate for the oral bacteria, which lower the PH of both plaque and saliva, providing a favourable environment for tooth demineralisation (72). Many studies have shown the relationship between the increased intake of dietary sugar and the incidence of dental caries but the time that sugars are in the mouth as well as the frequency of intake and type of sugar are important factors (66-68, 70, 71). When teeth appear in late infancy, the consumption of added sugars in the form of SSBs has been shown to increase the risk of dental caries late in childhood (69).

In its 1997 report WHO recognised that obesity is a chronic lifestyle disease and is a global health problem (17). The incidence of obesity in LMIC's is increasing (22) and South Africa is no exception (23-25). People

who consume more sugar usually tend to gain more weight (73) and have a higher risk of obesity (21, 64, 65).

In high-income countries WHO has noted an increase in prevalence of childhood obesity (17) and Armstrong *et al* (2006) have seen similar trends in obesity and overweight in South African children to those in developed countries ten years ago (26). These indicate that South Africa is moving towards the high rates of obesity of the developed world.

Childhood obesity increases the odds of obesity later in life and also leads to an increased prevalence of chronic disorders associated with obesity (17, 27-29). The main dietary factors associated with childhood obesity are high energy intake and high intake of SSBs (30, 74). As well as a link to obesity later in life (29) obese infants, children and adolescents have increased frequency of certain medical conditions such as hyperlipidemia, hypertension, and abnormal glucose tolerance (31).

There is an increased risk of Type 2 Diabetes and other metabolic disorders associated with overconsumption of sugar (75). Diabetes can cause blindness, renal failure, and damage the nerves, leading to impotence and foot disorders, possibly amputation. With all these negative outcomes, this disease places a huge burden in terms of cost on health-care systems and has an impact on the quality of life of the sufferers (76).

Obesity is strongly associated with the development of Type 2 Diabetes, but other risk factors include: genetic history of Type 2 Diabetes; age; lack of physical activity; poor diet; stress; and urbanisation (77). Previously it was thought that the link between sugar and Type 2 Diabetes was that sugar consumption led to obesity and that it was the obesity that predisposed people to Type 2 Diabetes. However in 2013, it was suggested that sugar may also have a direct link to diabetes, which is independent of obesity (78). Research on metabolic changes in response to added fructose such as HFCS indicates that added fructose is more of a danger than other sugars (lactose and galactose or glucose) (79-81) as non-fructose sugars such as lactose and galactose have been found to be less harmful to metabolic health (82). Studies on HFCS suggest that fructose has more effect on obesity than just its calorific value with fructose possibly having a causal role in diabetes (75). It has been suggested that fructose does not stimulate insulin and leptin secretion (83), which are key in appetite regulation. When insulin and leptin are out of balance this can result in overeating (84) resulting in obesity and other metabolic problems. Another study found that overconsumption of dietary fructose specifically may increase the risks of developing diabetes, as excess fructose may exacerbate the adverse metabolic profiles in obese individuals (85).

Overconsumption of sugar has also been linked to an increased risk of hypertension. Excess sugar consumption has also been associated with a direct effect on increasing blood pressure, which is

independent of other health problems, such as obesity, which can trigger hypertension (80, 86-88). Hypertension is one of the largest risk factors for CVD and in 2008, complications of hypertension accounted for 51% of stroke deaths and 45% of coronary heart disease deaths globally (52).

Furthermore, there is an association between sugar and an enhanced rate of de novo lipogenesis, which results in dyslipidemias (89-91). Decreased high-density lipoprotein (HDL) cholesterol levels as well as high triglycerides and low-density lipoprotein (LDL) cholesterol levels, have been associated with regular intake of added sugar (85, 92). Dyslipidemias increase the risk for CVD.

It has also been shown that excessive sugar intake is linked to CVD and is often independent of obesity (19-21). There are approximately 17 million deaths a year globally as a result of CVD and more people die annually from CVDs than from any other cause (52). Many of the negative health consequences that are associated with excessive sugar and salt consumption are risk factors for CVD (19, 21). It has also been shown that excessive sugar intake is associated with inflammation markers, which are on their own a key factor in the progression to CVD (20, 21).

Poverty and urban-rural migration nutritional transition have seen substitution of fresh nutrient-dense foods such as fruits and vegetables with low-cost, energy-dense, sugary foods (9, 93). The empty calories in these low-cost, energy-dense sugary foods are thought to be displacing other foods containing nutrients and micronutrients, which are essential to growth and development from the diet (94). However, the evidence on the nutrient and micronutrient diluation effect of added sugars is not strong, and exsiting studies have methodical and conceptual differences as well as differ on type of sugars studied (95) In infants with a poor nutrient status there has been a modest impact of high-sugar products on micronutrient intakes, however further research is required using different types of sugars and to quantify inedequte intakes (94). In a German study increased the intake added sugars in children and adolescents was found to decrease intake of all other important nutrient-bearing food groups ($P<0{\cdot}0001$) (96).

1.3.4 Food preference development

Eating behaviour and food preferences develop during the first 24 months of life, with a key period being from approximately six to 24 months with the transition from milk to foods of different of textures and tastes (97). Food preferences in early childhood have been found to correlate to preferences in later childhood, adolescence and young adulthood, indicating that the early food exposure experiences and eating behaviour can have an impact on subsequent food preferences and eating behaviour (36-39, 98).

There is preference for sweet and salty tastes in infants with sweet-taste preference present at birth and salty-taste preference developing around four to six months (99-102). Initial predispositions for sweet and salty tastes is thought to have evolved in order to address nutritional problems. The salt-taste preference

is thought to be a response to regulate sodium balance and to ensure intake of mineral-rich foods (103, 104). The sweet-taste preference is thought to be a response to ensure sufficient calories are obtained from plant sources such as fruit thereby safeguarding intake of a variety of nutrients (105). Additionally pain-reducing properties of sugars may encourage the preference for sweetness in young children (106). These predispositions mean that sweet and salty flavours are preferred by most infants and sour and bitter tastes such as those in vegetables and other healthy foods are rejected (99, 100).

However, genetic predispositions can be modified by nutritional experience (38, 107). Specifically, exposure to too much sugar and salt early in life can affect subsequent eating behaviour by contributing to the establishment and/or maintenance of the preference for sweet and salty tastes (37). In order to promote healthy food preferences, increased exposure to bitter flavours should be encouraged as liking increases with exposure (108). The sweet-flavour preference is enhanced by the ready availability of foods that are energy dense and high in sugar (109). If children are only exposed to sweet foods, they will not develop healthy food preferences.

Many weaning guidelines across the globe recommend that complementary foods without added sugars or salt should be used in order to make sure that the threshold for sweet and salty tastes is set at lower levels (110-112) and prevent health problems caused by too much salt and sugar both in childhood and in later life.

1.3.5 Infant feeding

Both the WHO and the South African Infant & Young Children Feeding Policy prescribe exclusive breastfeeding up to six months (113, 114), however if this is not possible, a WHO report stated that “infant formula prepared in accordance with applicable Codex Alimentarius standards was a safe and suitable breast milk substitute” (114). The WHO recommends that complementary feeding should start from the age of six months (115) when breast milk/supplementary formula is no longer enough to meet the nutritional needs of the infant. Complementary foods are fed in addition to an adequate intake of breast milk or supplementary formula.

Formula is a synthetic substitute for breast milk, which has been designed to match the composition of breast milk as breast milk contains the full nutritional needs of a developing baby for the first six months and provides nutritional support for up to two years. Therefore, formula plays a different role relative to baby foods in the diet of infants.

The European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN), which is an international expert group commissioned by The Codex Alimentarius Commission in November 2004, is responsible for the global standards on the nutritional composition of formula. The ESPGHAN standards

recommend that all formulas must contain key macro- and micro-nutrients within specific ranges. These guidelines include ranges for: energy proteins, fats, sugars, minerals, salts and trace elements.

All formulas have added sugars of some description as sugars are used to provide calories for energy needed by term infants. Lactose is the preferred glycaemic carbohydrate for infant formula and follow-on formula as it matches the composition of human breast milk (116). Neither sucrose or fructose occur naturally in breast milk (117) but in some formulas, especially hypoallergenic formulas, other sugars such as fructose and/or sucrose are used to substitute for lactose. Fructose and sucrose are much sweeter than lactose and an early exposure to sweeter tastes lead to increased preferences for sweet foods and rejection of less sweet foods (98, 104, 118). Sucrose is the most cariogenic sugar (119). Therefore, it is important to limit sucrose and fructose in formula where possible.

It is also important to have some sodium in formula as it is essential to maintain the electrolyte balance and sodium deficiencies have resulted in failure to thrive in infants (120) and development deficiencies later in childhood (121). However high sodium is more concerning as infants cannot excrete excess sodium as efficiently as adults (122) and excess sodium accumulates, which has both immediate and long-term health implications. Dehydration and increased blood pressure are some of the immediate results of high sodium intakes (123). High sodium intakes in infancy can also lead to higher blood pressure in later life (124) as well as create a preference for salty foods, which can lead to higher salt consumption in later years, which again can have negative health implications .

INFANT FEEDING IN SOUTH AFRICA

However, the current knowledge of complementary feeding practices in South Africa indicate that there is an early introduction of supplementary foods such as maize meal or sorghum during first 3 months and exclusive breast feeding is rare (125). A study in the Moretele district in South Africa found that cereals were the dominant commercial products that were given as first foods with 35% of mothers feeding their infants commercial cereals, with a thin home-made maize-meal porridge making up the majority of weaning first foods (149). Another South African study in Ga-Rankuwa also found that commercial infant cereal was fed to 32% of infants as first foods with home-made maize-meal porridge again dominating the sample (150).

1.3.6 Recommended guidelines

There are many guidelines set around salt and sugar consumption, from professional associations, which are concerned with diet such as the American Heart Association, to international guidelines such as those set by WHO (6, 61, 62).

The WHO guideline recommends that we keep our intake of “free sugars” in food and drink to less than 10% of calorific intake and suggests that a further reduction in the daily intake of “free sugars” to below 5% of calorific intake is recommended (6). The WHO recommends that adults eat less than five grams of salt a day. These guidelines are aimed at adults, and there are no global or universal guidelines on salt and sugar intake levels for babies and toddlers. In review of the literature the researcher has found the following guidelines that have been proposed in various studies and forums. These have been used to form the basis for the guidelines used for this study.

The Elliott and Conlon study published in 2015 used the dietary reference intakes from the US Institute of Medicine to set guidelines per serving for baby and toddlers for sugar and salt (41). This Elliott and Conlon 2015 salt guideline will be used for this study for baby foods. It classifies baby foods that are less than 130mg of salt per serving as low salt, between 130mg and 260mg as moderate salt, and over 260mg per serving as high-salt foods. However as formulas are meant to be a substitute for breast milk the guidelines on the sodium content were based on the Cribb *et al* (2012) study on the composition of breast milk, which deemed the acceptable salt content for formulas to be in the range of 15 to 30mg per 100ml (126).

The American Heart Association recommendation was non-specific and spoke to the reduction of intake of beverage and foods with added sugar for children under two years old (127). In a 2007 paper to support South African paediatric food-based dietary guidelines, it was recommended to reduce the intake of sweet treats or drinks, based on public health concerns such as obesity and dental caries (128). The matching sugar guideline from the Elliott and Conlon study published in 2015, will be used for this study (41). It classifies baby foods that have more than 20% of total calories, which are derived from sugar as having high proportions of sugar and those that have less than 20% of total calories derived from sugar as having acceptable proportions of sugar.

1.3.7 Food labelling – regulations, guidelines and consumer preferences

The South African food labelling and advertising regulations, namely R146 and the two subsequent amendments passed in 2010 and in 2012 (34, 129, 130) came into came into effect on 1 March 2012. In May 2014, amended regulations relating to the labelling and advertising of foods (R429 of 29 May 2014) (131) were published for comment as well as new guidelines drafted for the updated regulations relating to the labelling and advertising of foods. One of the main aims of this legislation is to ensure that the nutritional information (including the compositional information), and other information related to foodstuffs manufactured, imported and sold in South Africa is provided to consumers on packaging. The objectives of the new regulations in regards to food labelling is to make sure only facts are stated on labels, and to ensure that there are no confusing statements or half-truths are present on food labels that could induce consumers to choose their products.

Specifically relevant to this study are the Regulations Relating to Foodstuffs for Infants and Young Children R991 of 6 December 2012. The relevant requirements for nutritional information presented on packaging as per the regulations that are applicable to this study are as follows: the nutritional label information must be presented in the prescribed tabular format "which must contain the heading 'Typical Nutritional Information'; and an indication of the mass/volume of single serving and minimum mandatory information as prescribed per 100g/ml and single serving" (34).

Packaging has an impact on consumer choices, specifically the nutritional information on food labels has been seen as a way to encourage healthier choices when purchasing food (132). In a move to make nutritional information simpler and easier to understand, the nutrition information on the back of packs has been supplemented with front-of-pack (FOP) labelling, rating systems and symbols on many products globally (133). This trend was started during the late 1980s by non-profit organisations, which placed single symbols on front of the pack to indicate food was healthy. Over the past three decades there has been a growth globally in FOP labelling from single symbols to include simplified nutritional profiles and colour-coded rating systems (134). The many different designs, formats and schemes for FOP labelling systems are being studied to see which is most effective. Two popular formats of FOP labelling include the traffic-light scheme, which highlights varying levels of information about the four key nutrients (total fat, saturated fat, sugar, and sodium) and energy; and the Choices symbol, which, when it appears on a product, means that the product has met dietary guidelines developed by an international scientific committee (135).

The South African Department of Health guidelines drafted for the updated regulations relating to the labelling and advertising of foods (R429 of 29 May 2014) aim to use food labels as a platform for consumer education. These guidelines define front of FOP labelling as "means the emphasis of certain nutritional information associated with the risk of developing and contributing to non-communicable diseases, outside of the table with nutritional information" (131).

A recent review of nutritional labelling in Asia, Africa, the Middle East and Latin America found that "consumers prefer front-of-pack labelling and information that shows per serving or portion as a reference unit" (136). There is an increasing awareness of the importance of nutritional choices in maintaining health and in a study in Missouri in the US, those consumers who were more aware of the role of nutritional choices to maintain health were more likely to use of the nutritional information supplied on food labels (137, 138).

1.4 Problem statement

The burden of NCDs in South Africa is increasing and since 2010 the proportion of deaths due to non-communicable diseases relative to deaths due to communicable diseases has increased, with 51% of

total deaths in 2013 beings as a result of non-communicable diseases (139). Specifically the proportion of deaths due to diseases that could have links to excess salt or sugar in the diet, which include diseases of the circulatory system, neoplasms and endocrine diseases, nutritional and metabolic diseases, increased from 2011 to 2013 (139). Although we recognise multi-causality in many NCDs, associations between NCDs and high sugar or salt consumption have been made globally (54, 55, 140) .

South Africa's rapid rural-urban migration has provided access to processed commercial foods not available in traditional settings (141). This change of diet has been rapid and contributes to nutrition-related non-communicable diseases (32, 33). There is evidence of rapid increases in overweight and obesity in South African adolescents (142).

Sugar and salt are often used as an ingredient in a processed food to enhance the flavour of the food. Sugar added to food or drinks during preparation or processing has become a public health concern as these added sugars, are resulting in an overconsumption of sugar. The foods responsible for caloric sweetener intake in South Africa are much more varied than in the United States and HFCS is not the sweetener of choice in South Africa with sucrose added to foods such as squash, jam, cookies, and cold drink (9).

World Action on Salt & Health (WASH) estimates that around 80% of our salt consumed is hidden in processed food. Bread contributed an average of 38% to the weighted average salt intake. Foods considered high in salt that are consumed in South Africa include margarine, soups and gravies (143).

There is no data on salt and sugar content of baby foods in South Africa. However, the current knowledge of complementary feeding practices in South Africa indicate that there is an early introduction of supplementary foods such as maize meal or sorghum during first 3 months and exclusive breast feeding is rare (125). Using the Feeding Infants and Toddlers study (FITS) from the United States as a proxy for a westernised diet, we can see problem areas in the consumption patterns of children from four to 24 months. Key findings were that they were low vegetable and fruit consumption, and concerns about the levels of sweetened food and salty snack consumption (144). Specifically, 46% of infants in the seven to eight month range consumed at least one sweetened food a day and 79% of the 12 to 14 month group consumed at least one sweetened food a day (144).

Another US study found that 44% of the infant ready-to-serve mixed grains and fruit meals were high in sugar but that almost all the infant dinners were low in salt with only 1% of the infant dinners falling in the moderate salt category (141 to 210mg per serving) (43). The same study found that snacks aimed at infants were generally low in salt (43). Elliot in Canada also noted that over 50% of the foods sampled (both toddler and infant foods) exceeded the guideline proportion of calories coming from sugar with 53%

of these high-sugar foods specifically aimed at infants such as desserts and cereals (40). Nineteen percent had a type of sugar listed as either the first or second ingredient (40). The Elliot study found that over 12% of products had moderate (131 to 260mg per serving) or high (>260mg per serving) levels of salt. A study in the UK found that the dry finger foods and snacks were the foods, which had the higher sodium content in comparison with other infant foods but still fell within the moderate salt category according to either Cogswell or Elliot's definition.

1.5 Justification for the study

Sugar and salt have been shown to have a harmful effect on many areas of health. Exposure to too much sugar and salt early in life can affect subsequent eating behaviour, growth and create a predisposition towards obesity and related metabolic disorders (37).

Eating behaviour and food preferences develop during the first 24 months of life with the transition from milk to proper foods. Food preferences in early childhood have been found to correlate to preferences in later childhood, adolescence and young adulthood, indicating that early food-exposure experiences and eating behaviour can have an impact on subsequent food preferences and eating behaviour (36, 37).

Many weaning guidelines across the globe recommend that complementary foods without added sugars or salt should be used in order to make sure that the threshold for sweet and salty tastes is set at lower levels (110-112) and to prevent health problems caused by too much salt and sugar both in childhood and in later life.

Given that commercial baby foods are easily available it is therefore important that we understand the sugar and salt content of our commercially available baby foods in South Africa. This study will provide a baseline for further investigations and recommendations about the sugar and salt in commercial baby food. This baseline can also be used to develop policies around baby food labelling and/or the addition of sugar or salt to baby foods. Targeted messaging on the importance of developing healthy eating habits by modifying the preferences and intake of sweet and salty foods, together with clear labelling on sugar and salt content can enable parents and/or caregivers to buy baby foods that will reduce the consumption of, and the harmful health effects of, sugar and salt.

Chapter 2: Methods

2.1 Study design

This was a cross-sectional descriptive and analytic study, using information available on the packaging of baby food products as well as the price of these products.

2.2 Study population

All commercially available replacement, supplementary and complementary baby food products (including beverages), which were specifically targeted at children under 12 months and sold in supermarkets and any other retailers that sell baby food products in South Africa during the sampling period (2015). The population was divided into infant formulas (to be referred to as "formulas" in rest of report); and baby foods other than formula (to be referred to as "baby foods" in rest of report) in line with the two separate segments of the baby food market identified in The Nielsen Company 2015 report on the South African baby food market.

2.3 Sampling

The retail stores which sell baby food and formula products in Gauteng were purposively selected. Stores were chosen based on the following criteria: they were major retailers of baby foods and formula targeted at children under 12 months in South Africa with a large national footprint; they sold brands mentioned either in the *Euromonitor Baby Food in South Africa* report (3), or formulas mentioned in the list of available infant formulas in South Africa from Owens *et al* (2012) (145).

All baby foods and formulas for children under 12 months of age were eligible for inclusion in the study. All single ingredient fruit or vegetable purees were included as they might have intrinsic sugar. The study sample excluded any foods to be mixed with milk or formula if the total sugar or salt content of prepared food could not be evaluated from the label (i.e. label does not include nutritional information of whole prepared food for both serving size and per 100g/ml of food). Exclusions totalled 35 records, which were all dry cereals to be mixed with breast milk or formula. Products were included in the sample if they were in stock at the time of the study in at least one of the branches visited during the study period. All products that were available on shelves, even those from additional brands that were not mentioned in the *Euromonitor Baby Food In South Africa* report (3) or the Owens *et al* (2012) infant formula list (145), were included in the study sample. Products that were out of stock or not available in stores at the time of data collection were not included in the study sample.

A total of 374 products were photographed for data capturing. Three of the records in the baby foods sample were incomplete as images were not clear enough to read all data. After exclusions the sample was divided into: formula (n=53) and baby foods (n=283).

2.4 Data collection

Labelling and nutrition data were collected using photographs of back and front of packaging, which were taken in store. Pricing data were sourced from both online stores and shelf labels. An example of the photographs is presented in Appendix B.

The investigator visited two or three branches of four major retailers in Gauteng, which sold formula and baby foods over the period of July to August 2015 in order to see if there were any brands that were missing based on the inclusion criteria described above. Most of the baby foods were available.

The formulas that were captured on the data-coding sheet were compared to the list of available infant formulas in South Africa from Owens *et al* (2012) article on infant formula(145).

Electronic images of each product were saved by brand and category on the investigators hard drive and backed up. Images were labelled with the product name and description (e.g. front or back, or ingredients etc.) when there was more than one image per product.

Where there were two products of the same name with different packaging and different ingredients and different values on the nutritional table, each of these products was included as a separate record.

The products in each brand were compared to the manufacturers' websites in cases where complete lists of products in each brand were available. The researcher also checked the shelf labels for products that were out of stock and not available at the time of photographing in each store in order to get a better picture of the population at the time of sampling.

2.5 Measurement

A data-coding sheet in Excel was used to collect data. The data-coding sheet is presented in Appendix C. The key fields that were collected are detailed below.

- Product name
- Brand
- Product description
- Food type (formula, dry baby food, prepared baby food, other)
- Food subtype (beverages, snacks, cereals, pureed fruit, pureed fruit and veg, pureed veg, pureed composite meal, pureed dessert)
- Formula type (specialised or normal)
- Target age group

- Is nutritional information presented in the prescribed tabular format as per Regulations Relating to Foodstuffs for Infants and Young Children R991 of 6 December 2012 (Formula as per Annexure A or baby foods as per Annexure B (34))?
- Is FOP nutritional information present?
- Is there any FOP detail on “no added sugar” for baby foods or “no added sucrose” for formula?
- Is type of sugar detailed on nutritional table (e.g. fructose/sucrose/glucose/lactose and maltose)?
- Package size (g)/ml
- Serving size
- Sugar per 100g (g)
- Sugar per serving (g)
- Energy per 100ml/g (kJ)
- Energy per serving (kJ)
- Salt per serving (mg)
- Salt per 100g (mg)
- Added sugar (yes = any type of sugar listed as one of the ingredients)
- Type of added sugar (for formula)
- Added salt (yes = salt listed as one of the ingredients)
- Price per unit (by store)

The price was standardised using the following technique: Pricing data were sourced from online stores and shelf labels in each retailer. If price was different between stores, the lowest price was used. The price was adjusted to exclude any special offer running at any store where price data were collected.

The following fields were calculated from the raw data as part of data collection:

- Calorific value (kJ) per serving (1 kcal = 4,18 kJ)
- Calorific value (kJ) per 100g (1 kcal = 4,18 kJ)
- % of total kJ come from sugar (based on 1g of sugar = 17kJ)
- Standardised price per 100g
- Standardised price per serving.

2.6 Data-processing methods and analysis

2.6.1 Variables

Data were transformed for analysis. The following dependent variables were defined for specific objectives one, two, three and four; and various labelling variables were created for objective five as detailed below.

OBJECTIVES ONE AND TWO – ADDED SUGAR AND ADDED SALT

Categorical variables were created for added sugar and added salt. Added sugar for baby foods was categorised for an item as "yes" if it had sugar listed in the ingredient list. Added fructose and/or sucrose for formula categorised for an item as "yes" if it had corn syrup (fructose) and/or sucrose listed in the ingredient list.

Similarly added salt was categorised for an item as "yes" if it had salt or sodium chloride listed in the ingredient list for both formulas and baby foods.

OBJECTIVES THREE AND FOUR – SUGAR CONTENT AND SALT CONTENT

Categorical variables were created for sugar content and salt content based on the most appropriate guidelines available as discussed in the Recommended Guideline discussion (section 1.3.6).

The Elliott and Conlon (2015) salt guideline was used for this study. It classified baby foods that were less than130mg of salt per serving as low salt, between 130mg and 260mg as moderate salt, and over 260mg per serving as high-salt foods. The salt content of each product was therefore compared to recommended intake values and was categorised into three categories namely "low", "medium" and "high". However, it was found that only two products had high-salt content and the high category was collapsed into the medium category for analysis purposes.

The Cribb *et al* (2012) study on the composition of breast milk deemed the acceptable salt content for formula to be in the range of 15 to 30 mg/100ml (126). The salt content of each formula product was compared to this acceptable range and was categorised into three categories namely "low", which was below 15mg/100ml, "acceptable", which was between 15 and 30 mg/100ml and "high", which was above 30 mg/100ml.

The Elliott and Conlon (2015) sugar guideline was used for this study. It classified baby foods that had more than 20% of total calories that are derived from sugar as having high proportions of sugar and those that had less than 20% of total calories that were derived from sugar as having acceptable proportions of sugar. The sugar content of each product was compared to recommended intake values and was categorised into two categories namely high and acceptable.

OBJECTIVE FIVE – CONFORMS TO SOUTH AFRICAN FOOD-LABELLING REGULATIONS, FOP LABELLING AND SUGAR MENTIONED FRONT OF PACK

The categorical variable "conforms to South African food-labelling regulations" was created based on adherence to the following mandatory requirements around labelling:

- Nutritional information conforms with regulations (it is presented in the prescribed tabular format "which must contain the heading 'Typical Nutritional Information'; and indication of mass/volume of single serving and minimum mandatory information as prescribed per 100g/ml and single serving"(34)).

If all conditions were met then the product was as "yes" and if any condition was not met, the product was categorised as "no". The categorical variable "FOP labelling" was created for both baby foods and formulas. An item was categorised as "yes" if there were any front-of-pack nutritional data relating to sugar or salt. The categorical variable "sugar mentioned FOP" was created for baby foods. An item was categorised as "yes" if there was any FOP text relating to sugar, for example, "no added sugar" or "sugar free". For formulas, if "sucrose free" was advertised front of pack, an item was categorised as "yes" and additionally, if there was any FOP text relating to sucrose or fructose, for example, "no added sucrose" or "no added fructose", an item was also categorised as "yes".

2.6.2 Cleaning

The Excel dataset was cleaned by the researcher and converted to Stata software (version 9.0, STATA Corp., College Station, Texas, US). Additional cleaning and recoding was done using Stata to check the integrity of the dataset as well as to find any missing values. Any errors were recorded and the new, clean dataset was saved under a new name. Outliers are an important part of a dataset and were not removed.

2.6.3 Data analysis

For the continuous variables (sugar content per 100g; sugar content per serving; salt content per 100g; salt content per serving; and standardised price), the Shapiro–Wilk test and the Q-norm plot and skewness and kurtosis (D'Agostino) test for normality were used to determine if data was normally distributed. The Shapiro–Wilk test was not used on the standardised price data as there were many ties (many products having the same price) and this test is affected by too many ties (146). In Stata 9.0, the skewness and kurtosis test for normality implements the test described by D'Agostino *et al* (1990) with the empirical correction developed by Royston (1991c) (147, 148). All distributions were found to be non-normal except for the sugar-content variables.

Across all objectives the following data were transformed for target ages. Any products marked "from four months" were collapsed into the "from six months" category for the target age variable for baby foods. In the target age variable for formulas the researcher determined only three categories, 1) infant formula for zero to six months, 2) follow-on formula for six to 12 months and 3) specialised formulas that are used across the entire period from zero to 12 months of age. The preterm formula category was collapsed into the "zero to 12 months" category as it was to be fed to preterm babies from birth to 12 months.

For Objective One, descriptive statistics were used to describe the sugar and salt content as well as the added sugar and added salt of the sample. For normally distributed variables, the mean with standard deviation, and for skewed data the median with the range, were presented.

For Objectives Two and Three, most data were categorical and Pearson's chi-squared tests using Stata (version 9.0, STATA Corp., College Station, Texas, US) were used to detect associations between variables. The Fisher's exact test was used when one or more of the categories had an expected frequency of five or less.

Data were transformed for some of the analyses as detailed in Table 1 as there were too many zero categories, which made it impossible to run the chi-squared test or Fisher's exact test.

Table 2: Data transformation details

Objective	Association	Transformation
Objective Two	Manufacturer and added sugar	All manufacturers with 100% of the products with added sugar, namely Aspen, SMI International – Barney, Bumbles, Ella's Kitchen, Oli Organic, Organix, Pure and Woolworths; were collapsed into one category
Objective Two	Food subtype and added sugar	The categories pureed fruit, pureed fruit and veg, and pureed veg were collapsed into one category
Objective Three	Manufacturer and sugar content	All manufacturers that had zero products with acceptable sugar content, namely Aspen, SMI International – Barney, Nestle, Bumbles and Pure – were collapsed into one category.
Objective Three	Food subtype and sugar content	The categories pureed fruit, pureed fruit and veg, and pureed veg were collapsed into one category
Objective Four	Salt content and standardised price per 100g	The categories low and acceptable were collapsed into one category as a two-sample Wilcoxon rank-sum (Mann-Whitney) test requires two categories only.

For Objective Four, the relationship between dependent variables and the standardised price per 100g was analysed. Not all the data were normally distributed, so the non-parametric two-sample Wilcoxon rank-sum (Mann-Whitney) test was used to test significance of relationship between variables. For formulas the associations between standardised price per 100g versus sodium content (low and acceptable sodium vs high sodium), as well as added salt and added sugar were analysed. For baby foods the associations between standardised price per 100g versus sodium content (low sodium vs medium and high sodium), sugar content (acceptable sugar versus high sugar) as well as added salt and added sugar were analysed.

For Objective Five, the data were categorical and Pearson's chi-squared tests using Stata (version 9.0, STATA Corp., College Station, Texas, US) were used to detect associations between:

- the proportion of products where sucrose free was mentioned FOP and added sucrose in formulas
- the proportion of products where sugar free mentioned FOP and the sugar content in baby foods

- the proportion of products where sugar free mentioned FOP and added sugar in baby foods.

The Fisher's exact test was used when one or more of the categories had an expected frequency of five or less.

2.7 Ethics

No human subjects were involved in this study and the study only used information that was in the public domain so an Ethics Waiver (W-CJ-151111) was obtained from the University of the Witwatersrand's Human Research Ethics Committee (HREC Non-Medical) (Appendix D).

Permission to take photographs was verbally requested at each store. This was given by either store or regional management, with a caveat that no store names would be mentioned in the final report.

Chapter 3: Results

The aim of this study was to describe the sugar and sodium content (as well as added sugar and added salt) and labels of commercially produced baby foods and formulas in South Africa and to compare these to current recommended intake guidelines. The researcher sought also to determine whether there is a relationship between the prices of baby foods with the sugar or salt variables.

The study sample is compared to the population in the "Brand Availability" section (Section 3.1) by noting how many items were not captured in the sample. The characteristics of baby food include manufacturer, food type, food subtype and target age, which are presented using percentages and frequencies. The characteristics of formulas include manufacturer, formula type and target age, which are presented using percentages and frequencies. These characteristics are used to describe mean sugar and salt content per 100g and per serving for baby foods and formulas (where applicable).

The categorical variables used in this study are presented using percentages and frequencies. Pearson's chi-squared or Fisher's exact tests were used to detect associations between the dependent variables and the characterises of baby food and formula. The Wilcoxon rank sum (Mann-Whitney) test was used to detect associations association between the "standardised price per 100g" variable and the dependent variables for formulas and baby foods. Characteristics of the labelling of formulas and baby foods are presented using percentages and frequencies. Pearson's chi-squared test or Fisher's exact test were used to detect associations within the labelling section.

3.1 Brand availability

3.1.1 Baby foods

The baby foods sample frame was based on the Local Brand Name (LBN) brands as detailed *Euromonitor* report plus new brands found on shelves as part of a pilot study. The representativeness of the baby foods study sample is detailed in Table 3, of the LBN Brands with products that met inclusion criteria 77% of the LBN brands were included in the baby foods study sample.

Table 3: Representativeness of the baby foods study sample

LBN Brand	Products included in study sample	LBN Brand	Products included in study sample
Aspen Infacare Juice	Yes	Nestlé Baby Menu	No
Barney	Yes	Nestlé Jogolino	Yes
Bumbles	Yes	Nestum	Exclusion - mixed with milk
Cerelac	Yes	Olli Organic	Yes
Ella's Kitchen	Yes	Organix	Yes
Farley's	No	Pro Nurtro	Exclusion - only for 12 months plus
Hipp Organic	Yes	Pure	Yes
Hot-Kid	Yes	Purity	Yes
Nestlé Baby Delight	No	Wooliesbabes	Yes

Further research was done on the LBN Brands in sample frame but not included in the study (Farley's brand as well as Nestlé Baby Delight and Nestlé Baby Menu) and it was discovered that they were not available in any of the stores visited in sampling or in pilot or the South African online stores. Both Nestlé brands seem to have been discontinued as they were not available in Nestlé's current brand list in 2015.

Checking product lists online for each brand, it was found that 17 baby food products (one from Bumbles brand, seven from Ella's Kitchen brands, two from Organix brand and seven from Purity brand) were out of stock or not available at the time of the study.

3.1.2 Formulas

The formula sample frame was based on the Owens *et al*'s (2012) infant formula list which included 50 LBN brands (145) plus new LBN brands found on shelves as part of a pilot study. Twenty-four of the 79 products in sample frame were not captured in the formula study sample, so the formula study sample had 69% of LBN brands in the sample frame. The Pfizer, SMA brand (11 products) was not available in stores sampled or any online retailers and the assumption was made that these products are no longer widely available. The Aspen Infacare® Nurture brand (five products) is a more expensive version of Aspen Infacare®, which includes omega and pre and probiotics, and was not available in the retailers sampled.

Preterm formula products were not widely available and the S26 PDF Gold Powder was the only preterm product captured in the sample. As such, it was not listed in the infant formula table although the table listed four preterm formula products, all of which were not available in the stores sampled. The following soya-based formula products were not captured in sample: Aspen Infacare® Soya, Aspen Infacare® Gold Soya 1 and 2, and Pfizer Infasoy 1 and 2. The speciality formula Aspen Infacare® AR and S-26 LF were also not available in the stores sampled.

3.2 General characteristics of formulas and baby foods

The characteristics of formula in the study sample (n=53) are detailed in Table 4. There were eight formula manufacturers. Three manufacturers (Nestlé, Novolac and Wyeth) dominated the study sample, having a wider range of products than the others. There was an almost equal split between normal formula and those that are specialised for certain conditions or health issues such as lactose intolerance or reflux. There was one premature formula, which, along with some of the specialised formulas, was suitable from birth to 12 months.

Table 4: Characteristics of formula in the study sample

Characteristics	Frequency	Percentage (%)
Manufacturer (n =53)		
Abbot	5	9.4
Aspen	5	9.4
Hipp Organic	2	3.8
Holle	2	3.8
Nestlé	12	22.6
Novalac	15	28.3
Nutricia	2	3.8
Wyeth	10	18.9
Formula type (n =53)		
Specialised formula	28	52.8
Normal formula	25	47.2
Target age (n =53)		
From birth to 12 months [a]	14	26.4
From birth to 6 months	21	39.6
From 6 to 12 months	18	34.0

[a] Includes one product for premature to 12 months

The characteristics of baby foods in the study sample (n=283) are detailed in Table 5. There were 12 manufacturers. However, the smaller ones with fewer than 10 products were combined into an “other” category. Purity had the biggest percentage of the sample with over 40% of baby foods being from Purity. The majority (82%) of the baby foods came from the prepared baby food category, with the biggest category in the food subtype being pureed fruit (31%) and the next biggest being pureed composite meals (20.1%). Only one cereal out of 22 sampled was not sweetened with sugar or fruit, namely Olli Organic Plain Rice Cereal. Creamy Carrots with Semolina & Honey had added Honey and Purity Breakfast Oats & Banana (from seven months) and Purity Breakfast Oats & Honey (from seven months) were the only pureed composite meals to have added sugar. For target age, the “from six months” category was the biggest with 46% of the sample. There are 131 products in the “from six months” category versus 80 in the “from seven months”, 43 in the “from eight months”, 10 in the “from nine months” and 19 in the “from 10 months” category. The only food subtype categories, which had a higher number of products available for ages above six months were the desserts, snacks and the pureed composite meals.

Table 5: Characteristics of baby foods in the study sample

Characteristics	Frequency	Percentage (%)
Manufacturer (n =283)		
Aspen Infacare®	5	1.8
SMI International - Barney	2	0.7
Bumbles	11	3.9
Ella's Kitchen	18	6.4
Hipp Organic	22	7.8
Nestlé	15	5.3
Olli Organic	17	6.0
Organix	16	5.7
Pure	25	8.8
Purity	127	44.9
Hot-Kid	2	0.7
Woolworths	23	8.1
Food type (n =283)		
Dry baby food	22	7.8
Prepared baby food	232	82.0
Other	29	10.2
Food subtype (n =283)		
Beverages	14	5.0
Snacks	18	6.4
Cereals	22	7.8
Pureed fruit	90	31.8
Pureed fruit and veg	18	6.4
Pureed veg	23	8.1
Pureed composite meal	57	20.1
Pureed dessert	41	14.5
Target age (n =283)		
From 6 months	131	46.3
From 7 months	80	28.3
From 8 months	43	15.2
From 9 months	10	3.5
From 10 months	19	6.7

3.3 Overview: Sugar and salt content summary

Most of the formula labels sampled did not give any nutritional detail on total sugar content but gave information on carbohydrates and occasionally on lactose. The researcher was not able to do analysis on the sugar content as only four products provided information on sugar content.

Table 6 details the characteristics of formula in the study sample with regards to salt and sugar. Only 15% of the formula items had added sucrose or fructose. Almost half (47.2%) of the formulas in the sample had added salt (sodium chloride). The majority (67.9%) of the formulas had an acceptable level of sodium, and a few (7.6%) had a low level of sodium chloride.

Table 6: Frequency and percentage of added sugar and salt and sugar and salt content of formulas in the study sample

	Frequency	Percentage (%)
Added sucrose/fructose (n =53)		
Yes	8	15.1
No	45	84.9
Added salt (n =53)		
Yes	25	47.2
No	28	52.8
Sodium content (n =53)		
Low	4	7.6
Acceptable	36	67.9
High	13	24.5

Table 7 details the characteristics of baby foods in the study sample with regards to salt and sugar. The majority (96%) of baby foods did not have added salt and sodium content, and the majority (97%) of baby foods were also classified as low in salt content. Three quarters of baby foods had no added sugars. The sugar content, however, was high in 78% of the baby foods sampled.

Table 7: Frequency and percentage of added sugar and salt and sugar and salt content of baby foods in the study sample

	Frequency	Percentage (%)
Added salt (n =283)		
Yes	12	4.25
No	271	95.76
Sodium content (n =283)		
Low	274	96.82
Medium	7	2.47
High	2	0.71
Added sugar (n =283)		
Yes	69	24.38
No	214	75.62
Sugar content (n =283)		
Acceptable	53	21.29
High	196	78.71

3.4 Sugar and sodium content

There were 34 items of baby food in the study sample, which did not detail sugar per serving or sugar per 100g on the label. This made a sample size n=249 for sugar per 100g and sugar per serving. Sugar per serving was normally distributed, so mean and standard deviation are presented in Table 8 . Salt per serving, salt per 100g were not normally distributed, so median and range are presented for Table 9.

Table 8 details the summary statistics for sugar in baby foods in the study sample. The sugar per 100g gives us an indication of the concentration of sugar in a product. Nestlé has the highest sugar per 100g of all the brands; Olli Organix and Woolworths products had the lowest concentrations of sugar. The highest sugar per serving was Aspen Infacare®, which was made up exclusively of beverages. Beverages was the food type, which had the highest sugar per serving, followed by pureed fruit and pureed desserts, which had an average of 12.2g per serving and 12.0g per serving respectively. Snacks and cereals and pureed fruits all had high mean sugar concentrations (sugar per 100g), however pureed fruit, which is high in intrinsic sugars only had 1.5% of products with added sugar. The beverages and pureed fruit categories, although high in sugar, did not have added sugar as many of the desserts did.

Table 8: Sugar content of baby foods per 100g and per serving by manufacturer, food type, food subtype and target age in the study sample

Characteristics	Sugar per 100g (g)		Sugar per serving (g)	
	Mean	Standard deviation	Mean	Standard deviation
Manufacturer (n =249)				
Nestlé	22.3	11.9	13.5	3.4
Bumbles	13.0	4.6	15.2	5.4
Hot-Kid	12.7	0.1	0.5	0.0
Organix	10.9	1.4	8.3	4.7
SMI International - Barney	10.2	0.6	10.2	0.6
Aspen Infacare®	9.8	0.7	19.5	1.4
Pure	9.8	2.3	12.1	3.2
Ella's Kitchen	9.4	5.5	9.5	4.0
Purity	8.7	9.1	8.9	5.4
Hipp Organic	7.8	8.5	8.8	7.6
Woolworths	6.6	5.6	7.5	6.1
Olli Organic	4.8	3.4	4.9	4.0
Food type (n =249)				
Dry baby food	28.8	11.3	11.0	5.8
Other	10.3	3.4	11.0	7.3
Prepared baby food	7.3	4.5	9.1	5.5
Food subtype (n =249)				
Cereals	28.8	11.3	11.0	5.8
Snacks	11.5	3.8	6.1	4.9
Pureed fruit	11.1	3.3	12.2	4.2
Beverages	8.6	1.4	17.2	2.8
Pureed fruit and veg	8.4	2.7	10.0	3.7
Pureed dessert	6.8	2.5	12.0	5.6
Pureed veg	4.6	3.6	5.4	4.5
Pureed composite meal	2.4	1.9	4.0	3.0
Target age (n =249)				
From 9 months	11.7	11.7	11.6	7.3
From 6 months	10.4	7.5	10.3	5.4
From 7 months	9.0	9.5	6.8	4.8
From 8 months	7.9	7.9	9.8	6.7
From 10 months	6.5	3.5	11.2	5.9

Table 9 details the summary statistics for sodium content of the formulas in the study sample. The median sodium per serving across all categories was 24mg of sodium per serving with a range of 62.5mg of sodium per serving.

Table 9: Sodium content of formula per 100g and per serving by manufacturer, food type, food subtype and target age in the study sample

Characteristics	Sodium per 100g (mg)		Sodium per serving (mg)	
	Median	Range (min – max)	Median	Range (min – max)
Manufacturer (n =53)				
Abbot	225.0	200 – 240	32.0	30 – 36
Holle	218.0	200 – 236	32.0	28 – 36
Nestlé	200.0	150 – 269	26.0	20 – 43
Nutricia	175.0	161 – 189	23.6	21 – 26
Aspen	164.0	127 – 240	22.0	17 – 35
Hipp Organic	160.0	150 – 170	22.0	20 – 24
Novalac	150.0	56 – 240	19.6	7 – 31
Wyeth	141.5	16 – 250	18.0	5 – 67
Formula type (n =53)				
Normal formula	180.0	16 – 250	25.0	5 – 67
Specialised formula	175.5	27 – 269	22.8	7 – 43
Target age (n =53)				
From birth to 6 months	200.0	34 – 250	27.0	5 – 67
From 6 to 12 months	165.5	27 – 269	21.5	8 – 43
From birth to 12 months [a]	164.0	16 – 240	22.0	5 – 36

[a] Includes one product for premature to 12 months

Table 10 details the summary statistics for sodium in baby foods in the study sample. The median per serving for all categories is within the low range for sodium. However, there are high ranges, which means that there are some products with higher sodium content within the categories. Purity had two products, both classified as pureed composite meals, that were high in sodium with 264mg (from eight months) and 287 mg (from 10 months) of sodium per serving.

Table 10: Sodium content of baby foods per 100g and per serving by manufacturer, food type, food subtype and target age in the study sample

Characteristics	Sodium per 100g (mg)		Sodium per serving (mg)	
	Median	Range (min – max)	Median	Range (min – max)
Manufacturer (n =283)				
Aspen Infacare®	5.0	3 – 7	10.0	6 – 14
SMI International - Barney	3.0	3 – 3	0.0	3 – 3
Bumbles	0.0	0 – 1	8.0	0 – 1
Ella's Kitchen	10.0	0 – 36	24.0	0 – 69
Hipp Organic	18.0	1 – 260	120.0	1 – 130
Nestlé	240.0	35 – 280	3.0	35 – 140
Olli Organic	5.0	1 – 18	1.5	1 – 18
Organix	2.0	0 – 13	13.0	0 – 6
Pure	11.0	4 – 25	18.0	5 – 31
Purity	11.0	0 – 306	31.0	0 – 287
Hot-Kid	287.5	285 – 290	10.0	12 – 12
Woolworths	24.0	2 – 85	0.0	2 – 119
Food type (n =283)				
Dry baby food	174.5	5 – 280	39.0	1 – 140
Prepared baby food	9.6	0 – 127	12.0	0 – 287
Other	5.0	0 – 306	10.0	0 – 40
Food subtype (n =283)				
Beverages	4.4	1 – 7	8.8	3 – 14
Snacks	35.0	0 – 306	12.0	0 – 40
Cereals	174.5	5 – 280	39.0	1 – 140
Pureed fruit	2.0	0 – 54	2.2	0 – 60
Pureed fruit and veg	16.0	0 – 28	12.0	0 – 31
Pureed veg	12.0	0 – 48	14.0	0 – 54
Pureed composite meal	30.0	0 – 127	43.0	0 – 287
Pureed dessert	9.0	0 – 110	13.2	0 – 151
Target age (n =283)				
From 6 months	9.0	0 – 306	10.0	0 – 140
From 7 months	18.5	0 – 250	22.5	0 – 143
From 8 months	12.0	0 – 127	26.0	0 – 264
From 9 months	8.0	0 – 250	14.0	0 – 125
From 10 months	6.6	0 – 111	13.2	0 – 287

3.5 Added sugar and added salt

All formulas have added sugar as lactose (a sugar) is key source of energy in formula. Those formulas that do not contain lactose have either glucose, sucrose or fructose as the key energy source (this has not been shown in a table). Table 11 describes which formulas have no added sucrose and/or fructose in the study sample. Of the eight items that fell into the added sucrose or fructose category, none of them had added fructose – only added sucrose. From the results it can be seen that in South Africa the added sucrose and/or fructose is found mainly in specialised formula products except for Aspen Infacare® Follow-on Formula (Stage 2) and Wyeth's S-26 Promil Stage 2 follow-on formula with iron.

Table 11: Associations between the characteristics of formulas and added sugar in the study sample

Characteristics	No added sucrose or fructose (n=45)		Added sucrose or fructose (n=8)		p value
	Frequency	Percentage (%)	Frequency	Percentage (%)	
Manufacturer (n =53)					
Abbot	0	0.0	5	100.0	<0.01 [b]
Aspen	4	80.0	1	20.0	
Hipp Organic	2	100.0	0	0.0	
Holle	2	100.0	0	0.0	
Nestlé	12	100.0	0	0.0	
Novalac	14	93.3	1	6.7	
Nutricia	2	100.0	0	0.0	
Wyeth	9	90.0	1	10.0	
Formula type (n =53)					
Specialised formula	22	78.6	6	21.4	0.17
Normal formula	23	92.0	2	8.0	
Target age (n =53)					
From birth to 12 months [a]	13	92.9	3	7.1	0.49
From birth to 6 months	18	85.7	3	14.3	
From 6 to 12 months	14	77.8	4	22.2	

[a] Includes one product for premature to 12 months

[b] Fisher's exact test used

Table 12 describes the frequency and percentage of baby food products that have added sugar in the study sample. Seventy-six percent (75.6%) of the baby food products had no added sugar. There were significant associations between brand, food type, food subtype and target age for added sugar. One hundred percent of Nestlé and Hot-Kid products had added sugar. Hipp Organic and Purity were the other brands that had added sugar, with 38.6% of Purity products and 13.6% of Hipp Organic products with added sugar. All other baby food brands (Aspen, SMI International – Barney, Bumbles, Ella's Kitchen, Oli Organic, Organix, Pure and Woolworths) had zero products with added sugar. The majority (86.4%) of the dry baby food products had added sugar while less than a quarter (17.2%) of the prepared baby food products had added sugar. The cereals and pureed desserts categories had over 80% of the products containing added sugar. This is contrasted with the pureed composite meal and pureed fruit and veg categories, which had less than 10% of their products containing added sugar. Beverages had zero products with added sugar, while in the snacks category 55.6% of the products had added sugar. Looking

at the target age, we can see that the “from six months” category had the lowest percentage of products with added sugar and the “from seven months” and “from eight months” categories had the highest percentage of products with added sugar.

Table 12: Associations between the characteristics of baby foods and added sugar in the study sample

Characteristics	No added sugar (n=214)		Added sugar (n=69)		p value
	Frequency	Percentage (%)	Frequency	Percentage (%)	
Manufacturer (n =53)					
All brands no added sugar	117	100.0	0	0.0	<0.01[a]
Hipp Organic	19	86.4	3	13.6	
Nestlé	0	0.0	15	100.0	
Purity	78	61.4	49	38.6	
Hot-Kid	0	0.0	2	100.0	
Food type (n =283)					
Dry baby food	3	13.6	19	86.4	<0.01[a]
Prepared baby food	192	82.8	40	17.2	
Other	19	65.5	10	34.5	
Food subtype (n =283)					
Beverages	14	100.0	0	0.0	<0.01[a]
Snacks	8	44.4	10	55.6	
Cereals	3	13.6	19	86.4	
Pureed fruit and veg	129	98.5	2	1.5	
Pureed composite meal	53	93.0	4	7.0	
Pureed dessert	7	17.1	34	82.9	
Target age (n =283)					
From 6 months	118	90.1	13	9.9	<0.01[a]
From 7 months	49	61.3	31	38.8	
From 8 months	24	55.8	19	44.2	
From 9 months	8	80.0	2	20.0	
From 10 months	15	78.9	4	21.1	

[a] Fisher’s exact test used

Table 13 describes the frequency and percentage of formula products that have added salt (sodium chloride) in the study sample. There was a significant difference in the proportion of products with added salt by manufacturer, with 100% of products sampled in Aspen, Hipp Organic and Nutricia having no added salt. One hundred percent of products sampled for Abbot and Holle had added salt and other brands were split with some products having added salt and some not.

Table 13: Associations between the characteristics of formulas and added salt in the study sample

Characteristics	No added salt (n=28)		Added salt (n=25)		p value
	Frequency	Percentage (%)	Frequency	Percentage (%)	
Manufacturer (n =53)					
Abbot	0	0.0	5	100.0	0.01 [b]
Aspen	5	100.0	0	0.0	
Hipp Organic	2	100.0	0	0.0	
Holle	0	0.0	2	100.0	
Nestlé	6	50.0	6	50.0	
Novalac	7	46.7	8	53.3	
Nutricia	2	100.0	0	0.0	
Wyeth	6	60.0	4	40.0	
Formula type (n =53)					
Specialised formula	13	46.4	15	53.6	0.32
Normal formula	15	60.0	10	40.0	
Target age (n =53)					
From birth to 12 months [a]	9	42.9	12	57.1	0.13
From birth to 6 months	13	72.2	5	27.8	
From 6 to 12 months	6	42.9	8	57.1	

[a] Includes one product for premature to 12 months

[b] Fisher's exact test used

Table 14 describes the frequency and percentage of baby food products that have added salt in the study sample. Ninety-six percent (95.8%) of the baby foods had no added salt. There were no significant differences between categories for added salt in the food type, food subtype and target age variables. There was a significant difference in the proportions of products with added salt by manufacturer, with most brands having no added salt. Only Hipp Organic, Nestlé, Hot-Kid and Woolworths had some products with added salt. The added salt in the Woolworths products, however, was an ingredient of the butter added and not added on its own.

Table 14: Associations between the characteristics of baby foods and added salt in the study sample

Characteristics	No added salt (n=271)		Has added salt (n=12)		p value
	Frequency	Percentage (%)	Frequency	Percentage (%)	
Manufacturer (n =283)					
Aspen Infacare®	5	100.0	0	0.0	<0.01[a]
SMI International - Barney	2	100.0	0	0.0	
Bumbles	11	100.0	0	0.0	
Ella's Kitchen	18	100.0	0	0.0	
Hipp Organic	18	81.8	4	18.2	
Nestlé	14	93.3	1	6.7	
Olli Organic	17	100.0	0	0.0	
Organix	16	100.0	0	0.0	
Pure	25	100.0	0	0.0	
Purity	127	100.0	0	0.0	
Hot-Kid	0	0.0	2	100.0	
Woolworths	18	78.3	5	21.7	
Food type (n =283)					
Dry baby food	21	95.5	1	4.5	0.51[a]
Prepared baby food	223	96.1	9	3.9	
Other	27	93.1	2	6.9	
Food subtype (n =283)					
Beverages	14	100.0	0	0.0	0.09[a]
Snacks	16	88.9	2	11.1	
Cereals	21	95.5	1	4.5	
Pureed fruit	89	98.9	1	1.1	
Pureed fruit and veg	18	100.0	0	0.0	
Pureed veg	23	100.0	0	0.0	
Pureed composite meal	51	89.5	6	10.5	
Pureed dessert	39	95.1	2	4.9	
Target age (n =283)					
From 6 months	124	94.7	7	5.3	0.14[a]
From 7 months	78	97.5	2	2.5	
From 8 months	43	100.0	0	0.0	
From 9 months	9	90.0	1	10.0	
From 10 months	17	89.5	2	10.5	

[a] Fisher's exact test used

3.6 Sugar and salt content of baby foods compared to a standard

Table 15 describes the frequency and percentage of baby food products that have acceptable or high proportions of sugar in the study sample. Only 21.3% of baby foods had acceptable proportions of sugar. There were significant differences in the proportion of products with acceptable and high proportions of sugar by manufacturer, food subtype and added sugar for sugar content. There were five manufacturers, which had zero products with acceptable proportions of sugar: Aspen, SMI International – Barney, Nestlé, Bumbles and Pure. One hundred percent of products in the beverages category had high proportions of sugar. Pureed composite meals had two thirds of the products with acceptable proportions of sugar. There were no significant associations for sugar content between food type and target age categories.

Table 15: Associations between the characteristics of baby foods and sugar content in the study sample

Characteristics	Acceptable sugar (n=53)		High sugar (n=196)		p value
	Frequency	Percentage (%)	Frequency	Percentage (%)	
Manufacturer (n =249)					
Brands with 0 products = acceptable sugar content	0	0.0	58	100.0	<0.01[a]
Ella's Kitchen	1	5.6	17	94.4	
Hipp Organic	11	50.0	11	50.0	
Oli Organix	6	35.3	11	64.7	
Organix	4	25.0	12	75.0	
Purity	18	19.4	75	80.7	
Hot-Kid	2	100.0	0	0.0	
Woolworths	11	47.8	12	52.2	
Food type (n =249)					
Dry baby food	3	13.6	19	86.4	0.69[a]
Prepared baby food	43	21.7	155	78.3	
Other	7	24.1	22	75.9	
Food subtype (n =249)					
Beverages	0	0.0	14	100.0	<0.01[a]
Snacks	7	38.9	11	61.1	
Cereals	3	13.6	19	86.4	
Pureed fruit and veg	8	7.1	104	92.9	
Pureed composite meal	35	68.6	16	31.4	
Pureed dessert	0	0.0	32	100.0	
Target age (n =249)					
From 6 months	20	15.6	108	84.4	0.12[a]
From 7 months	17	28.8	42	71.2	
From 8 months	10	30.3	23	69.7	
From 9 months	3	30.0	7	70.0	
From 10 months	3	15.8	16	84.2	
Added sugar (n =249)	53	21.3	196	78.7	
No added sugar	50	26.3	140	73.7	<0.01[a]
Added sugar	3	5.1	56	94.9	

[a] Fisher's exact test used

Table 16 describes the frequency and percentage of formula products that have low, acceptable or high levels of sodium in the study sample. Only 67.9% of the formula products sampled had acceptable levels of sodium relative to breast milk and 24.5% had high sodium content. There were no significant differences in the proportions of products with low, acceptable or high levels of sodium by any category for sodium content.

Table 16: Associations between the characteristics of formulas and sodium content in the study sample

Characteristics	Low sodium (n=4)		Acceptable sodium (n=36)		High sodium (n=13)		p value
	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)	
Manufacturer (n =53)							
Abbot	0	0.0	2	40.0	3	60.0	0.36 [b]
Aspen	0	0.0	4	80.0	1	20.0	
Hipp Organic	0	0.0	2	100.0	0	0.0	
Holle	0	0.0	1	50.0	1	50.0	
Nestlé	0	0.0	9	75.0	3	25.0	
Novalac	1	6.7	12	80.0	2	13.3	
Nutricia	0	0.0	2	100.0	0	0.0	
Wyeth	3	30.0	4	40.0	3	30.0	
Formula type (n =53)							
Specialised formula	2	7.1	19	67.9	7	25.0	1.00 [b]
Normal formula	2	8.0	17	68.0	6	24.0	
Target age (n =53)							
From birth to 12 months [a]	1	4.8	16	76.2	4	19.0	0.37 [b]
From birth to 6 months	2	11.1	9	50.0	7	38.9	
From 6 to 12 months	1	7.1	11	78.6	2	14.3	
Added salt (n =53)							
No added salt	3	13.0	20	87.0	5	21.7	0.36 [b]
Added salt	1	5.9	16	94.1	8	47.1	

[a] Includes one product for premature to 12 months

[b] Fisher's exact test used

Table 17 describes associations between the characteristics baby food and sodium content in the study sample. There was only one significant difference which was in the proportion of products with low, medium and high levels of sodium and food subtype.

Table 17: Associations between the characteristics of baby foods and sodium content in the study sample

Characteristics	Low sodium (n=274)		Medium and high sodium (n=9)		p value
	Frequency	Percentage (%)	Frequency	Percentage (%)	
Manufacturer (n =283)					
Aspen Infacare®	5	100.0	0	0.0	0.88 [a]
SMI International - Barney	2	100.0	0	0.0	
Bumbles	11	100.0	0	0.0	
Ella's Kitchen	18	100.0	0	0.0	
Hipp Organic	21	95.5	1	4.6	
Nestlé	14	93.3	1	6.7	
Olli Organic	17	100.0	0	0.0	
Organix	16	100.0	0	0.0	
Pure	25	100.0	0	0.0	
Purity	120	94.5	7	5.5	
Hot-Kid	2	100.0	0	0.0	
Woolworths	23	100.00	0	0.0	
Food type (n =283)					
Dry baby food	20	90.9	2	9.1	0.20 [a]
Prepared baby food	225	97.0	7	3.0	
Other	29	100.0	0	0.0	
Food subtype (n =283)					
Beverages	14	100.0	0	0.0	0.03 [a]
Snacks	18	100.0	0	0.0	
Cereals	20	90.9	2	9.1	
Pureed fruit	90	100.0	0	0.0	
Pureed fruit and veg	18	100.0	0	0.0	
Pureed veg	23	100.0	0	0.0	
Pureed composite meal	54	94.7	3	5.3	
Pureed dessert	37	90.2	4	9.7	
Target age (n =283)					
From 6 months	129	98.5	2	1.5	0.27 [a]
From 7 months	77	96.3	3	3.8	
From 8 months	40	93.0	3	7.0	
From 9 months	10	100.0	0	0.0	
From 10 months	18	94.7	1	5.3	
Added salt (n =283)					
No added salt	262	96.7	9	3.3	1.00 [a]
Added salt	12	100.0	0	0.0	

[a] Fisher's exact p value

3.7 Associations between price and sugar and salt content

Table 18 describes the results of a series of two-sample Wilcoxon rank-sum tests performed on the standardised price per 100g variable for formulas. There were no significant associations between price and added sugar and salt for formulas in the study sample.

Table 18: Associations between price and sugar content, sodium content, added sugar and added salt for formulas in the study sample

	Standardised price per 100g	p value
	Median price (R)	
Added fructose/sucrose (n=53)		
No added sugar	20.2	0.66
Added sugar	21.4	
Added salt (n=53)		
No added salt	18.4	0.11
Added salt	21.1	
Sodium content (n=53)		
Low and acceptable sodium	20.2	0.57
High sodium	21.3	

Table 19 below describes the results of a series of two-sample Wilcoxon rank-sum tests performed on the standardised price per 100g variable for baby foods. There were two significant relationships. The “no added sugar” category and the “added salt” category had a higher median price.

Table 19: Associations between price and sugar and sodium content, and added sugar and salt for baby foods in the study sample

	Standardised price per 100g	p value
	Median price (R)	
Added sugar (n=283)		
No added sugar	9.82	<0.01
Added sugar	6.79	
Added salt (n=283)		
No added salt	8.92	0.03
Added salt	11.97	
Sugar content (n=249)		
Acceptable sugar	11.97	0.10
High sugar	9.95	
Sodium content (n=283)		
Low sodium	9.35	0.07
Medium and high sodium	6.25	

3.8 Characteristics of formula and baby food labelling

Table 20 details the labelling characteristics of formulas. Labelling that adhered to current standards was found on 67.9% of the products sampled, those that did not conform were deficient in the following ways:

1) The nutritional information either not detailing lactose or glucose and presenting total carbohydrates only or presenting total sugars or monosaccharides instead of lactose and/or glucose, and/or

2) They were missing the third column required by regulations for formula to present data per 100kJ.

The five Abbot products were missing the per 100kJ column. Three of these products had no data on lactose or sucrose content. Two of these provided data on monosaccharides, which can be glucose (dextrose), fructose, galactose, or ribose. Novolac had seven of the 15 products in the sample missing information on lactose as well as missing the per 100kJ column. Wyeth had three products that did not adhere to standards as they were missing the per 100kJ column. Two of these Wyeth products were duplicate products, which had different packaging as well as different nutritional values compared to the products with same names. Both the Nutricia products did not detail the lactose or glucose content and were missing the per 100kJ column.

There were no formula products in the sample with FOP nutritional information. Only one of the formula products sampled mentioned “sucrose free” FOP.

Table 20: Characteristics of formula labelling

Characteristics	Frequency	Percentage (%)
Labelling adheres to standards (n =53)		
Yes	36	67.9
No	17	32.1
FOP nutritional info (n =53)		
Yes	0	0.0
No	53	100.0
Sucrose free mentioned FOP (n =53)		
Yes	1	1.9
No	52	98.1

Table 21 details the characteristics of baby food labels in the study sample. Labelling that adhered to current standards was found on 85.9% of the products sampled. There were no products in the sample with FOP nutritional information. Only 9.9% of packages sampled mentioned sugar FOP.

Table 21: Characteristics of baby food labelling in the study sample

Characteristics	Frequency	Percentage (%)
Labelling adheres to standards (n =283)		
Yes	243	85.9
No	40	14.1
FOP nutritional info (n =283)		
Yes	0	0.0
No	283	100.0
Sugar mentioned FOP (n =283)		
Yes	28	9.9
No	255	90.1

Table 22 shows that there were no significant differences in the proportion of formula products that mention "sucrose free" FOP and added sucrose. Only one item in the study sample had "sucrose free" FOP and it did not have any added sucrose.

Table 22: Associations between sucrose free mentioned FOP and added sucrose in formulas in the study sample

Characteristics	Sucrose free not on FOP		Sucrose free on FOP		p value
	Frequency	Percentage (%)	Frequency	Percentage (%)	
Sugar added (n =53)					
No added sucrose	44	97.8	1	2.2	1.00[a]
Added sucrose	8	100.0	0	0.0	

[a] Fisher's exact test used

Table 23 shows that there were no significant differences in the proportion of products that mention sugar FOP and the sugar content of products in the study sample. There was a significant difference in the proportion of products that mention Sugar free FOP and the added sugar of the products. All of the items that had "no added sugar" or terms indicated that they were sugar free on FOP did not have any added sugar.

Table 23: Associations between sugar free mentioned FOP and sugar content and added sugar in baby foods in the study sample

Characteristics	Sugar free not on FOP		Sugar free on FOP		p value
	Frequency	Percentage (%)	Frequency	Percentage (%)	
Sugar content (n =249)					
Acceptable	50	94.3	3	5.7	0.22[a]
High	171	87.2	25	12.8	
Sugar added (n =283)					
No added sugar	186	86.9	28	13.1	<0.01[a]
Added sugar	69	100.0	0	0.0	

[a] Fisher's exact test used

Chapter 4: Discussion

4.1 Introduction

The results are discussed in comparison to similar studies done in the US, UK and Canada on commercially produced baby foods as well as in light of relevant literature on the importance of healthy eating behaviour and food preference development with regard to health. Given that sugar is an inexpensive nutrient, the study also sought to investigate whether there was a relationship between of the price of baby food and the added sugar and sugar content.

Additionally, the nutritional labels of baby food and formula products were assessed in line with Regulations Relating to Foodstuffs for Infants and Young Children R991 of 6 December 2012. The use of front-of-packaging (FOP) labelling or FOP information on sugar or salt on baby food or formula packaging was also assessed. Packaging has an impact on consumer choices; specifically the nutritional information on food labels has been seen as a way to encourage healthier choices when purchasing foods. The South African Department of Health guidelines drafted for the updated regulations relating to the labelling and advertising of foods (R429 of 29 May 2014) aim to use food labels as a platform for consumer education.

The limitations of this study are presented at the end of this chapter.

4.2 Sugar

4.2.1 Formulas

Sugar content data on formulas were not available. This was because most formulas did not detail total sugars on their nutritional table, some only detailed carbohydrates and others different types of sugars. No single breakdown was consistently applied across all labels sampled and so the details on overall sugar content were not comparable.

This study was able to assess types of sugars used as ingredients in each formula. The types of sugars used as ingredients in formula samples in this study were lactose, maltodextrin, sucrose, corn syrup, corn syrup solids, fructose, dextrose (from results but not presented in Chapter 3). Approximately 15% of the formulas sampled had added fructose or sucrose; of these 75% were specialised formula. In this study it can be seen that in South Africa the added sucrose and/or fructose is found mainly in specialised formula products. This seems to be in line with the European guidelines as suggested by the EFSA NDA. However, the Aspen Infacare® Follow-on Formula (Stage 2) and Wyeth's S-26 Promil Stage 2 follow-on formula with iron were also found to have sucrose and these are standard infant formulas. As such, there was no reason to use sucrose instead of lactose.

There are no South African guidelines on formula composition. However, the European Food Safety Authority (EFSA) Panel on Dietetic Products, Nutrition and Allergies (NDA) recommends that sucrose and fructose should not be added to Infant Formula (birth to six months) for healthy infants as they do not hold any advantages over the consumption of lactose. Furthermore, as fructose and sucrose are much sweeter than lactose, they may increase the preference for sweet tastes in infants (19). This increased preference for sweet foods and rejection of less sweet foods can lead to an increased risk of the associated health conditions related to an overconsumption of sugar (98, 104, 118). It is therefore important to limit sucrose and fructose in formula where possible. Additionally added fructose may pose a risk to infants with fructose intolerance (116) and sucrose is the most cariogenic sugar (119). However, for infants that are lactose intolerant, some manufacturers use sucrose and fructose

According to the EFSA NDA Panel, sucrose is only allowed to be added to specialised infant formulas for allergic infants (birth to six months) and which use hydrolysates. Sucrose can be used to disguise the bitter taste of hydrolysates as long as it does not contribute more than 20% of the total carbohydrates in that formula (116). The EFSA NDA state that for follow-on formulas (six to 12 months), sucrose and fructose can be used as long as the sum of the sucrose, fructose and sugar from honey are less than 20% of the total carbohydrates (116).

4.2.2 Baby foods

The top 10 products with the highest amount of sugar per serving were from three categories: pureed fruit, pureed desserts and beverages. All of these had 20g or more sugar per serving. Only four of these products had added sugar, so we can assume that the high sugar content is coming from natural sugars such as fruit. Although many of the international guidelines, including the WHO guidelines, on sugar pertain to added or free sugars rather than total sugars; total sugars (regardless of whether sweetness comes from added or natural sugars) consumed in large amounts do set a preference for sweet tastes (37) and cause rejection of the sour and bitter tastes such as those in vegetables and other healthy foods (99, 100).

This availability of many more products with high sugar content on the shelves relative to savoury tastes might encourage the purchase of the easier accepted sweet flavours for infant feeding, which can have an impact on subsequent food preferences and eating behaviour (36, 37) and can create a predisposition towards obesity and related metabolic disorders.

The sugar per 100g gives us an indication of the concentration of sugar in a product and the researcher found that Olli Organix and Woolworths products had the lowest concentrations of sugar. Snacks and cereals and pureed fruits all had high mean sugar concentrations; however pureed fruit, which is high in intrinsic sugars only had 1.5% of products with added sugar. In order to avoid sugar in an infant's diet, carers should look at avoiding snacks and cereals especially in the case of snacks that have small serving

sizes, which, when not adhered to, result in an intake far exceeding the serving size. The Hot-Kids products were rusks to be served as snacks, which had a very small serving size. So although the sugar per 100g was very concentrated, the single serving was very low in sugar. The 10 products with the highest sugar per 100g were all cereals (from data but not presented in results).

Conversely, the Aspen Infacare® and beverages categories had very high per serving sugar content as the serving sizes were larger. The pureed desserts had a fairly low sugar concentration per 100g but the average per serving sugar content was high. So desserts contribute to sugar content based on serving sizes as most dessert products are targeted at "from seven months" and "from eight months" age category, which have larger portion sizes. There were only three dessert products in the "from six months" category and these were all 125g package sizes. Looking at average values for sugar per 100g for the prepared food type (which included all the pureed food subtype categories) they were very similar to results from a UK study on commercial infant food (42) with the fruit meals coming in at an average of 11.1g of sugar per 100g versus the savoury meals coming in at 2.4g of sugar per 100g.

Many of the international guidelines on sugar, including the WHO guidelines, pertain to added sugars rather than total sugars. The labels did not include the separation of added sugars and natural sugars so the researcher was not able to assess the amount of added versus natural sugars in baby foods. The products with added sugar were less than a quarter of the products sampled with many manufacturers not adding sugar to any of their products. Hipp Organic had three products with added sugar and these were their pureed dessert products. Purity had a range of products with added sugar. These included the pureed desserts, dry cereals, snacks (teething biscuits) and breakfast type-pureed foods with both fruit and cereal in jars. Both Nestlé and Hot-Kid had 100% of their products with added sugar – these were cereals and rusks respectively. The dry baby foods, which were composed solely of cereals to be mixed with water all had added sugar. The exceptions were the three cereal products from Olli Organic that also had significantly lower sugar content than the other cereals. The pureed desserts were mainly sweetened using added sugars, however, there were some products that were sweetened using fruit and natural sugars.

This study's overall findings on added sugars are similar to the Canadian and US studies (40, 41, 43) indicating many types of infant foods did not contain added sugars. It is concerning to note that most cereals had added sugar as cereals are often a first food given to infants in South African rural areas. A South African study in the Moretele district found that cereals were the dominant commercial products that were given as first foods with 35% of mothers feeding their infants commercial cereals, with a thin home-made maize-meal porridge making up the majority of weaning first foods (149). Another South African study in Ga-Rankuwa also found that commercial infant cereal was fed to 32% of infants as first foods with

home-made maize-meal porridge again dominating the sample (150). The three cereals that did not have added sugar were slightly more expensive than the average price per serving across all cereals sampled. This ties into the overall relationship found that the price per 100g was slightly more expensive for foods that did not have added sugar. The results of a variety of price-reduction intervention studies in the US and a randomised controlled trial in Australia show that people will choose healthy food if it is cheaper (151, 152). In South Africa, the pressure of dietary costs often forces low-income individuals to consume energy-dense, nutritionally inferior diets with added sugar and fat. The cost of a healthier diet in Cape Town was found to be 9-12% more expensive than non-healthy food options (153). According to the latest census data (2011) approximately 45% of the South African population are in the low-income or no-income bracket (154) and these economic factors may be pressuring them to choose the unhealthier food options with added sugar.

Despite the majority of baby foods having no added sugar, 78.7% of the products sampled had high sugar content. The categories which had 50% or more of the items in the acceptable sugar content category were the brands Hipp Organic and Hot-Kid; and the pureed composite meals category. These overall findings on sugar content are similar to the Canadian and US studies (40, 41, 43) that indicate many types of infant food products had high sugar content. Fruits are high in natural sugars and it is to be expected that the sugar content in fruit-based products will be high. In a South African study it was found that second- and third-stage weaning foods included fresh fruit and/or vegetables and commercial prepared food products such as Purity (149). Fruit are good first-weaning foods as they are easily digested and providing a variety of flavours will help in the introduction of new flavours (155). “Pureed fruit” was the largest category of prepared food in our sample, making up over 30% of all foods sampled. From this we can assume that many South African infants are exposed to sweet tastes through fruit. Again this is concerning as this can have an impact on subsequent food preferences and eating behaviour (36, 37) and can create a predisposition towards obesity and related metabolic disorders (37).

4.3 Salt

4.3.1 Formula

Almost half (47.2%) of the formula in the sample had added salt (sodium chloride). The complex design of formula means that many ingredients can be added to get the recommended levels of key minerals such as sodium, chloride and potassium. Salt or sodium chloride is not the only ingredient that can be used to get the required levels of sodium and chloride; many formulas have ingredients such as potassium chloride, sodium citrate, magnesium chloride, sodium selenite (from results but not presented in Chapter 3).

A few (7.6%) of the formulas sampled had a low level of sodium and salt-free formulas have in the past been linked to electrolyte imbalance, failure to thrive in infants (120) and developmental deficiencies later in childhood (121). However, these studies proposed that it was the chloride deficiency, rather than the sodium deficiency, that led to the failure to thrive and we only looked at sodium levels and not chloride levels in this study. The 13% of formulas that had high sodium is more concerning as infants cannot excrete excess sodium as efficiently as adults (122) and excess sodium accumulates, which has both immediate and long-term health implications. Dehydration and increased blood pressure are some of the immediate results of high sodium intakes (123). High sodium intake in infancy can also lead to higher blood pressure in later life (124). It can also create a preference for salty foods, which can lead to higher salt consumption in later years, which in turn, can have negative health implications as discussed in the literature review (Chapter 2).

4.3.2 Baby foods

Only 4.2% of baby foods had added salt, but there were significant differences between the manufacturers. Those with products with added salt included Hipp Organic, Nestlé, Hot-Kid and Woolworths. The Nestlé cereal with added salt was the savoury carrot and spinach cereal, and the two Hot-Kids' products were the rusks, which had small serving sizes and low salt per serving. The Woolworths products that had added salt were some of the pureed composite meals and the Pear & Banana Brekkie Oats, which had been classified as fruit, based on its high fruit content. However all of these products still fell within the low-salt category per serving. Salt is added to food for a variety of reasons. It can provide the salty taste, increase the intensity of the characteristic flavour of foods as well as affect the texture and shelf life of meat products(156). However, our data showed no significant association between salt content and added salt.

The overall sodium content of baby foods was low with 97% of baby foods sampled having low-salt content. Only two products were found to have high-salt content and these were both composite meals from Purity for ages from seven months – the Vegetable and Beef Lasagne and the Macaroni with Cheese flavour. Only nine products sampled in this study were in the medium or high salt per serving category, so overall the researcher's findings on sodium content are similar to the US and Canadian studies (40, 41, 43), which indicated that most types of infant food products are generally low in sodium. However, our study found that the median sodium per serving was 12mg compared to 10mg per serving found in a US study, which included toddler foods as well as infant foods (43). A mean of 7mg of sodium was found per 100g of commercially available baby foods sampled in a UK study (42).

Cereals and pureed composite meals had the highest median salt per serving. The US study found that infant meals also had the highest median salt per serving, but the US infant cereals had a median of 0g per serving for salt (43) compared to the 39mg per serving for salt in our South African data. The Canadian

studies found that pureed infant dinners had the highest average sodium content out of infant categories at 48mg of sodium per serving and that cereals had an average of 24mg of sodium per serving, which is more in line with South African data on cereals.

The sodium debate and pool of evidence about sodium being bad for health has been going on for a longer period than the sugar debate and therefore it seems that manufacturers have either always had no salt or adjusted their recipes to be low in salt. In the United States, Gerber, a major baby food manufacturer, stopped adding salt to its baby food products in late 1970s (157).

4.4 Labelling

4.4.1 Formula

Not all formula labelling adhered to the standards, and it is evident that there is more than one type of packaging on shelves for some of the formula products. For example during sampling, the researcher captured two different tins of the Wyeth S-26 Gold Stage 1 and Wyeth S-26 Promil Gold 2 Powder infant formulas. According to the tins, the Wyeth products with non-adherent labelling sampled are products that have been produced in South Africa. It is interesting to note that the nutritional composition and ingredients are different for these S-26 products. The researcher supposes that these products with non-adherent labelling must have been old stock and that new stock is compliant with labelling regulations.

The Nutricia products are distributed through a South African distributor, but the availability of these products is very limited and it is assumed there is also a limited market. We can suggest that the volume sold was very low and the packaging stock was still lagging behind the implementation of the labelling regulations.

Only 29% of the 17 formula products that were non-compliant with standards were missing the detail on lactose or glucose. However, they were all missing the per 100kJ column.

4.4.2 Baby foods

More than 85% of the baby food products had labelling that adhered to standards. The baby foods had products from Hipp Organic and Purity that were missing information either on per serving or on total sugars. Given the importance of serving sizes in controlling obesity (158) and the requirement to provide nutritional details on portion sizes on nutritional tables and packaging (129), it is necessary to detail how many nutrients are available per portion and how many portions are in a package.

Natural sugars and added sugars were not separately identified in the nutritional table. This is not required by regulations yet. However, the global trend is towards splitting the sugars into natural sugars and added sugars, due to the added sugars being the primary health concern.

4.4.3 Front-of-pack (FOP) labelling

Front-of-pack (FOP) labelling, rating systems and symbols on many products globally have been seen as a way to encourage healthier choices when purchasing food (132, 133), South African baby foods and formulas in the sample did not have any form of pack FOP labelling detailing nutritional information in any form, nor did they have any well-known symbols used to represent heathy food choices. Formula is a standardised product used as a supplement for breast milk, and as such the front-of-packaging information on sugars would not be informative as nutrient composition is driven by the ESPGHAN standards (116). However, baby foods are varied and many have high sugar or sodium, so there is a need for easy-to-understand nutrition labelling, which should be considered an important strategy to ensure that consumers choose the healthiest options for their children.

The FOP messages were analysed for both formulas and baby foods. In the formula products sampled, there was one product that claimed to be “sucrose free” even though the majority of formula products were sucrose free. For the baby foods sampled, all of the items that claimed to have “no added sugar” on the FOP did not have any added sugar. It was reassuring to see that there were no false claims on the labels.

The new draft guidelines want to disallow nutrition and health claims on food labels that serve as advertising instruments and rather advocate that there should be messages sanctioned by the Department of Health (DOH) on healthy food.

FOP labelling strategies are a good tool to induce healthy food choices and ultimately reduce obesity. This is because easily understandable caloric and nutritional information can alter the context in which the public make choices about food (159). It has been suggested that FOP labelling strategies can be cost-effective interventions (160, 161). Clear labelling of food packaging in the UK informing consumers on salt content is thought to be an essential component in the successful salt-reduction programme in the UK (162). Another implication of nutrition labelling strategies is that they might encourage manufacturers to reformulate foods to be healthier overall or to create healthier eating options (159).

4.5 Limitations

This study was not a systematic review and so it is important to note that that although many studies referenced in literature review can show link between sugar and NCDs independent of body weight, there is limited strong causal evidence here. Further research is recommended in many areas to assess strength of these associations.

The characteristics of baby foods and formulas used to assess the various objectives were determined during data collection based on a pilot of what information would be available on a packaging review. A decision was made to keep brands at a manufacturer level even though some of the manufacturers had multiple brands in a category. For example, Nestlé had various brands of formula and Purity had both dry and prepared baby foods. This detail was captured through other categories. Some items were difficult to classify within the food subtype list and so classification was done based on name and/or ingredients; this might have resulted in misclassification.

Another limitation of the classifications used is that the target age group category can be open to misinterpretation as the age group “from six months” includes foods that can be fed at a later stage but are suitable from six months. The introduction of whole foods at six months means that there is also a wider range of single-type fruits available in the “from six months” category.

Many of the international guidelines on sugar, including the WHO guidelines, pertain to added sugars rather than total sugars. However, the South African labelling regulations do not require the separation of added sugars and natural sugars on the nutritional information provided on packaging (34, 129, 130) so the researcher was not able to assess the amount of added versus natural sugars in baby foods.

As the researcher only relied on nutritional information reported on the packaging and not laboratory analysis she cannot be sure it reflects the true nutritional data.

This effect of these products on the food environments was not assessed in this study.

The validity and reliability of data collection instruments was not tested.

Some products were out of stock at the time of the study. The missing brands and items out of stock could have an impact on results if they had consistently higher or lower salt or sugar content. However, a few of these brands are not easily available so would not be purchased by the general consumer.

Additionally, the coding was done by the researcher and error could have occurring during capturing.

Since data collection was completed it has been noted by the researcher that there have been additional products added and some of the packaging has changed.

Chapter 5: Conclusion and recommendations

Overall the sodium content of baby foods is within the acceptable range and there are only a few products where salt is added. However, the sugar content, the number of cereals with added sugar as well as dessert-type products available on the market at time of the study suggest that South African commercial retailers are providing an environment that promotes the development of sweet-taste preferences. This study found that there are baby foods that are high in sugar and/or that have added sugar; and there is no labelling that identifies food as high in sugar or added sugar. In a country with the twinned problems of malnutrition and obesity, we need to move to counter this environment with easy-to-understand nutrition labelling that is mandatory on all packaging along with messages sanctioned by the Department of Health (DOH) on healthy food choices.

One of the key concerns in the statement of comment in the latest National Strategy for Prevention and Control of Obesity (2015) was that: "We are concerned that most South Africans consume diets low in fruits and vegetables and high in fat-and sugar-containing foods" (163). In order to discourage the consumption of sugar-containing foods it is essential that consumers can identify easily which foods are high in sugar, especially added sugars.

5.1 Recommendations

The Strategic Plan for the Prevention and Control of Non-Communicable Diseases 2013-17 aims to "Prevent NCDs and promote health and wellness at population, community and individual levels" (164).The researcher recommends a multi-disciplinary approach which can be a combination of some or all of the following interventions in line with this aim. The proposed interventions tie into the more specific goals in the Strategy for Prevention and Control of Obesity (2015). These goals include: the creation of an environment which supports access to and availability of healthy food choices; support of initiatives that aim to prevent obesity in early childhood; and communication aimed at education and mobilisation of communities (163).

5.1.1 Disclose added sugar

Goal number two of the National Strategy for Prevention and Control of Obesity (2015) is to "Create an enabling environment that supports availability and accessibility to healthy food choices in various settings" (163). In line with this goal, the disclosure of added sugar by manufacturers needs to be enforced. Currently South African labelling regulations require manufacturers to disclose total sugar content within the nutritional table and to verify nutritional information (34, 129, 130). However, the South African labelling regulations do not require the separation of added sugars and natural sugars on the nutritional information provided on packaging (34, 129, 130). Future regulations should require that manufacturers disclose the amount of added sugar separately from total sugars. Research in the UK suggests that consumers want

to be able to identify which products have added sugars versus those with intrinsic sugars only (165). The amount of sugar added to products is known by manufacturers, but in the US the confidentiality of recipes (5) and claims that sugar-detection techniques cannot distinguish between added and intrinsic sugars have prevented disclosure of added sugars. However added sugar-detection techniques are advancing either by identifying standard sugar isotypes for certain types of sugar used to sweeten foods or by using standard levels of naturally occurring sugars and subtracting them from the total sugars detected in the food (5).

5.1.2 FOP labelling

In conjunction with disclosure of added sugar, traffic-light style FOP labelling that identifies those products that are high in added sugar should become mandatory. Products that are high in added sugar should receive a red traffic light, whereas those that are sweet because of intrinsic sugars should receive an orange traffic light. Currently in South Africa FOP labelling is voluntary (136). A South African study found that metropolitan consumers tend to consult food labels for health information and preferred products that were represented as healthy in the labelling (166). The cost effectiveness of FOP labelling in the form of traffic-light labelling was assessed in a study in Australia and was found to be "good value for money"(167) Food labelling was found to be one of the "best buys" in a cost effectiveness study of interventions to address diet, physical activity and obesity done as part of the Strategic Plan for the Prevention and Control of Non-Communicable Diseases 2013-17 (164).

Enforcement of regulations on labelling could have a knock-on effect of manufacturers relooking at recipes to see if they can eliminate added sugar rather than advertise on labels that their food is high in sugar.

5.1.3 Reduce availability and accessibility of baby food products with high sugar content

Goal number two of The National Strategy for Prevention and Control of Obesity (2015) supports the creation of an environment which supports access to and availability of healthy food choices (163). In line with this goal, the number of baby food products with high sugar content and those that have added sugar, need to be reduced in favour of healthier alternatives. Environments which provide access to large amounts of unhealthy foods affect food preferences and create a demand for unhealthy foods

This should be a multipronged approach involving NGOs supported by both Government and professional associations. Mandatory labelling regulations that identifies unhealthy foods clearly, can help to move consumer choices towards healthy options (166) and ultimately influence products with high sugar content to be discontinued. A tax on unhealthy foods such as those high in added sugar, should make all foods with added sugars more expensive and result in a reduction in consumption of those foods. It has been demonstrated in a mathematical simulation that a 20% taxation on SSBs in South Africa as part of a multi-faceted effort, could reduce energy intakes and reduce obesity by 3.8% in men and 2.4% in women (168).

The Strategic Plan for the Prevention and Control of Non-communicable Diseases 2013-17 showed that the most cost effective interventions to reduce obesity were fiscal measures (e.g. food taxes on unhealthy food) and food advertising regulations (164). The Woolworths "Good Food Journey" programme has already taken steps forward in providing healthier options for consumers by changing the access and availability of unhealthy foods through reducing salt and sugar content of their recipes (169).

A local action group comprised of specialists concerned with sugar and its effects on health should be created, member should include relevant government officials, NGOs and professional associations. They should be involved in the development of awareness campaigns as well as to directly lobby manufacturers to reduce sugar content.

5.1.4 Information and education for carers

Goal number four of the National Strategy for Prevention and Control of Obesity (2015) is to "Support obesity prevention in early childhood (in-utero to 12 years)" and goal number five is "Communicate with, educate and mobilise communities" (163). In line with these goals; information and education on salt and sugar and health should be provided to parents or caregivers of infants.

The waiting rooms in clinics where carers bring infants for health check-ups and vaccinations provide an opportunity to display posters which communicate information on the traffic-light style FOP labelling intervention suggested above. Provision of patient-centric information displays in the form of posters as a standalone intervention has been assessed as being not effective at facilitating knowledge transfer (170). However, as part of a bigger campaign with other sources of educational interventions, posters were seen to play a part in facilitating knowledge transfer (170). Therefore, it is important to provide a multipronged approach to an educational campaign around sugar awareness. A message on sugar as well as the traffic-light labelling intervention should be included in the health promotion messages section of the *Road to Health* booklet and should be dated and signed by the sisters when they have explained the information to the carer.

5.2 Further research

Sugar content data on formula was not available and therefore a study involving laboratory analysis would be a useful tool to assess sugar content. Future studies should consider sweetness of formula, which would be useful in informing healthy choices in the formula universe as the first-taste exposure can increase preference for sweet tastes (37).

It is important to monitor trends in salt and sugar content of baby foods in South Africa to see if there is a move towards the reduction of salt and sugar in baby foods. As no literature has been found historically for this data, researchers would need to approach manufactures to source copy of old labels that could be assessed for sugar and salt versus current products.

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Appendix A. Prescribed tabular format for nutritional information

The prescribed tabular format as per the South African regulations for infant formula and complementary baby foods (34) are detailed below.

Annexure A – Format for minimum mandatory nutritional information for infant formula, follow-up formula or infant formula or follow up formula for special dietary management for infants with specific medical conditions.

	Per 100 g powder as sold	Per 100ml reconstituted ready to use	Per 100 kJ ready to use
Energy (kJ)			
Total protein (g)			
Added individual amino acids (mg)			
Total carbohydrates (g):			
of which lactose (g) and/ or glucose (g)			
Total fat (g):			
Linoleic acid (mg)			
Linoleic acid (mg)			
Linoleic acid (mg)			
Linolenic acid (mg)			
Docosahexaenoic acid *			
Eicosapentanoic acid *			
Arachidonic acid *			
Total dietary fibre (g)			
Total sodium (mg)			
Vitamins in alphabetic order (in appropriate unit of measurement)			
Minerals and trace elements in alphabetic order (in appropriate unit of measurement)			
Nucleotides*			
L(+) lactic acid producing bacteria*			

* Where applicable

Source: Regulations Relating to Foodstuffs for Infants and Young Children R991 of 6 December 2012

Annexure B - Format for minimum mandatory nutritional information for complementary foods, liquid milks, powdered milks, modified milk powders and powdered drinks.

	Per 100g/ml	Per single serving	Per %NRV serving*
Energy (kJ)			
Protein (g)			
Glycaemic or total carbohydrates (g):			
of which total sugar (g)			
Total fat (g):			
Of which saturated fat (g)			
**			
**			
***			
Total dietary fibre (g)			
Total sodium (mg)			
Vitamins in alphabetic order (in appropriate unit of measurement)			
Minerals and trace elements in alphabetic order (in appropriate unit of measurement)			
Any other nutrient or food component to be declared in accordance with these regulations	in appropriate unit of measurement		

* NRV Nutrient Reference Values for infants and young children from 6 months to 36 months (as per Annexure C) expressed per single serving

** place for subgroup nutrients such as mono-unsaturated fat, poly unsaturated fat. Omega-3 fatty acids etc.

*** place to insert cholesterol where cholesterol Information is provided

Source: Regulations Relating to Foodstuffs for Infants and Young Children R991 of 6 December 2012

Appendix B. Examples of data collection photographs

Image 1: Hipp Organic_6 to 24 months_spaghetti bolognese

Image 2: Nestlé Cerelac_from 9 months_carrot and spinach cereal

Image 3: Nestlé_NAN_HA follow up infant formula

Appendix C. Data coding sheet

First section - columns A to L

Brand	Product name - range	Product name detail	Food subtype	Food subtype detail (meal type)	Formula type	Target age group	Note	Nutritional information conform to standards	FOP labelling present	Any FOP detail on sugar or sucrose

Second section - columns M to W

Is type of sugar detailed	Package size (g)	Serving size	Energy per 100ml/ g	Energy per serving (kJ)	Total sugar (g) per 100ml	Total sugar (g) per serving	% of total kJ come from Sugar per 100g	% of total kJ come from Sugar per serving	Sodium (mg) per 100ml	Sodium per serving

Third section - columns X to AH

Ingredient list	Sugar listed on ingredient list	Types of sugar if detailed	Salt listed on ingredient list	Price Store 1 online	Price Store 2 Online	Price Store 3	Price Store 4	Standardised price	Standardised price per 100g

Appendix D. Ethics waiver

Human Research Ethics Committee (Medical)

Research Office Secretariat: Senate House Room SH10005, 10th floor. Tel +27 (0)11-717-1252
Medical School Secretariat: Tobias Health Sciences Building, 2nd floor Tel +27 (0)11-717-2700
Private Bag 3, Wits 2050, www.wits.ac.za. Fax +27 (0)11-717-1265

Ref: W-CJ-151111-1 11/11/2015

TO WHOM IT MAY CONCERN:

Waiver: This certifies that the following research does not require clearance from the Human Research Ethics Committee (Medical).

Investigator: **Nicola Marais (Student No.445224)**

Project title: **Sugar and sodium content of baby foods in South Africa.**

Reason: This study uses information in the public domain. There are no human participants

Professor Peter Cleaton-Jones

Chair: Human Research Ethics Committee (Medical)

Copy – HREC (Medical) Secretariat: Zanele Ndlovu, Rhulani Mkansi.

Appendix E. Plagiarism declaration

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG | FACULTY OF HEALTH SCIENCES

PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I *Nicola Claire Marais* (Student number: *445224*) am a student registered for the degree of *Master of Public Health, in the field of Health Systems and Policy* in the academic year 2016.

I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.

Signature: _____ Date: 22-Feb-2016