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Mini Thesis

Title: The nutritional composition of snack foods available at grocery stores in the Western Cape, South Africa: a cross-sectional observational study.

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Abstract

Background: Snacking has become a popular dietary practice and the increasing frequency of consumption correlates positively with total energy intake. This is a public health concern as it contributes to obesity and NCDs. Obesity rates are as high as 28.3% in South Africa, with 31% of men and 68% of women either overweight or obese. The aim of this study was to describe the nutritional composition and variety of snack items available in supermarkets, and describe the in-store snack placement and marketing. **Methodology:** This was an observational cross-sectional, mixed-method study. Secondary data from six major supermarket chains (eight stores) in three different suburbs around Cape Town, South Africa, was used to analyse the nutritional composition of snack food and beverage items (n=4257). Stores in both middle- and low socio-economic status communities were included. The same eight supermarkets were revisited to obtain information on marketing and product placement via an observational checklist and interview conducted with store managers. **Results:** Most snack sub-categories were high in either energy, sugar, saturated fat, or sodium. The highest mean energy was found in nuts, seeds and potato crisps. Dried fruit, candy and chocolate contained the highest mean sugar. Chocolate, cheese snacks and potato crisps were the highest in saturated fats. The products containing the most sodium were dried meat, potato crisps, chips, popcorn, dips and spreads. Snacks were available at points of sale in all stores. Snack items were on promotion, found in "high volume" areas, and branded marketing had a large in-store presence. Most managers believed their store encourages healthy shopping behaviours and all receive cash or free stock from suppliers for prioritising product display or marketing. **Conclusion:** The current supermarket environment enables consumers to purchase unhealthy snacks. Most of the snacks which were assessed in this study cannot be recommended for regular consumption (due to containing excess amounts of nutrients of concern to limit) as they increase the risk of obesity, development of NCDs, and places a burden on the national health care systems. There

is a need for regulation on the marketing and the promotion of unhealthy snack products. Supermarkets are potential intervention points for limiting exposure to unhealthy products.

List of definitions

Term	Meaning
Big food	Multinational food and beverage companies that have a huge and concentrated market power (Brownell and Warner, 2009).
Body Mass Index	Formerly called the Quetelet index, BMI is a measure for indicating nutritional status in adults. It is defined as a person's weight in kilograms divided by the square of the person's height in metres (kg/m^2) (CDC, 2022).
Branded display cabinets	For the purposes of this study, the term branded display cabinets is understood as display cabinets with food industry branding. These display cabinets showcase brand specific products and attract attention e.g. solid storage fridge, cabinet, holder that is branded and has a long-term place reserved in grocery stores.
Branded notice boards	For the purposes of this study, the term branded notice boards are understood as food industry branded boards that pop out of shelves, often to display and encourage consumers to purchase new products.
Branded specific specials	For the purposes of this study, the term branded specific specials is understood to mean discounted prices from a specific brand i.e. "buy three x brand chocolates for the price of two".
Branded temporary display units	For the purposes of this study, the term branded temporary display units is understood as products in a grocery store setting presented in a cardboard display with shelves. These displays are for short-term use.
Empty calories	Sources of energy with little or no nutritional value (Reedy and Krebs-Smith, 2010).

Food environment	The interface where people interact with the wider food system to acquire and consume foods (FAO, 2016; Turner et al., 2018).
Health-halo	An effect where food is perceived to be healthier than it actually is because of health claims, by overlooking how unhealthy a product is because it contains one or a few healthy ingredients, or if a product falsely advertises itself as healthy (Chandon and Wansink, 2007). An example of this is fruit juice, muesli and yoghurt perceived as healthy, with the sugar content overlooked.
Junk food	A casual term commonly applied to ultra-processed products that are high in energy, salt, sugar, artificial colourants, and fats (Dunford et al., 2022; Sreenidhi et al., 2021). Junk food is often consumed in large quantities and is considered to contain little or no nutritional worth i.e. empty calories.
Non-communicable diseases	A medical condition or disease which, by definition, is non-infectious and cannot be passed from person to person. They may be chronic diseases of long duration and slow progression, or they may result in more rapid death such as a sudden stroke. The four main types of non-communicable diseases are cardiovascular diseases, cancer, chronic respiratory diseases, and diabetes (South African Government, 2022).
Obesity	Abnormal or excessive fat accumulation that presents a risk to health. A body mass index (BMI) over 30 is classified as obese (WHO, 2022).
Obesogenic environment	An environment that promotes unhealthy eating habits and lifestyles which results in excess energy intake and weight gain (Swinburn et al., 2011).
Overnutrition	Overnutrition is a term used when there is an excess intake of macronutrients and micronutrients (Maleta, 2006).
Point of Sale	The place at which a retail transaction is carried out (Oxford Learner's Dictionaries, 2022).

Snack foods	Food items consumed in between main meals (Gregori and Maffeis, 2007; Thornton et al., 2013). These items are usually considered high in energy, sugar, fat, sodium, and low in micronutrients. In this study, the terms “snacks”, “snack products”, and “snack items” are used interchangeably and refer to both snack foods and beverages.
Snake system	Also known as a serpentine line, the snake system is one single queue that customers stand in while they wait to pay for groceries in a retail setting. Once at the front of the line, customers are sent to the next available register, which drastically reduces wait times (Lariviere, 2016).
Store blueprint	The blueprint, or planogram, visually dictates the store layout in retail store environments (Merriam-Webster, 2022).
Stunting	Childhood stunting is defined as a height-for-age z score (HAZ) that is more than two standard deviations below the global median and is used as a marker of chronic childhood undernutrition (Huicho et al., 2020).
Ultra-processed food	Ultra-processed foods refer to the extent of industrial processing. Processes enabling the manufacturing of ultra-processed foods include breaking up whole foods into substances, chemical modifications of these substances, assembly of unmodified and modified food substances, frequent use of cosmetic additives and sophisticated packaging. Processes are designed to create highly convenient, hyper-palatable products. The nature of these processes makes ultra-processed foods intrinsically unhealthy (Monterio et al., 2019).
Undernutrition	Undernutrition is defined as insufficient intake of energy and nutrients to meet an individual’s needs to maintain good health (Maleta, 2006).

List of acronyms

Acronym	Meaning
BMI	Body Mass Index
FOPL	Front of Pack Labelling
INFORMAS	International Network for Food and Obesity / non-communicable Diseases Research, Monitoring and Action Support
GI	Glycaemic Index
HAZ	Height-for-age Z score
Kcal	Kilocalorie
KJ	Kilojoule
NCD	Non-Communicable Diseases
NDoH	National Department of Health
NFP	Nutrition Facts Panel
NNS	Non-nutritive Sweeteners
NPM	Nutrient Profiling Model
LMIC	Low- and Middle-Income Countries
POS	Point of Sale
RDA	Recommended Dietary Allowance
SA	South Africa
SANHANES	South African National Health and Nutrition Examination Survey
SANPM	South African Nutrient Profiling Model
SD	Standard Deviations z-score
SES	Socio-economic Status
SMS	Short Message Service
SoPH	School of Public Health
SPSS	Statistical Package for Social Sciences

SSB	Sugar Sweetened Beverages
UWC	University of the Western Cape
WHO	World Health Organization

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1. Introduction

In recent history eating patterns have changed (Hill et al., 2003) and snacking has become more popular (Johnson and Anderson, 2010; Piernas and Popkin, 2010). Studies report that snacks account for 17-21% of total daily energy intake (Johnson and Anderson, 2010; Myhre et al., 2015). These snacks are energy dense, but not as nutrient dense as the balanced meals which they displace in some instances (Webb et al., 2006). They are high in salt, saturated fat and added sugars (Hess et al., 2016) and low in most micronutrients (Webb et al., 2006).

High snack consumption results in weight gain, with the consumption frequency of snacks being higher in obese individuals (Bertéus Forslund et al., 2005). Global obesity rates are high and there is a growing body of evidence indicating that it is continuously increasing (Leist et al., 2021; Lobstein, 2010; WHO, 2021). According to the World Health Organization (WHO, 2021), the rate of obesity has nearly tripled since 1975. This contributes to the development of non-communicable diseases (NCD) (Johnson et al., 2017) which places a burden on the health care system as most countries struggle to cope with the burden of disease (Bradshaw et al., 2003; Delobelle et al., 2010).

Non-nutritious snack products are extensively marketed, and have a presence at checkout areas of most supermarkets, making them unavoidable and increases the likelihood of unwanted impulsive purchases (Basch and Fera, 2021; Thornton et al., 2013). The marketing of unhealthy products is a concern as it results in increased preference towards them, causing poor dietary patterns to be developed (Cairns et al., 2009; Qutteina et al., 2019).

1.1 Problem statement

South Africa is faced with high levels of obesity and NCDs (Bradshaw et al., 2007; Shisana et al., 2014; WHO, 2016). There has been a drive toward regular consumption of cheap ultra-processed foods (Armstrong et al., 2011; Temple and Steyn, 2011) which negatively impacts health outcomes as it contributes to the development of obesity and NCDs, placing a burden on the national health care system (Johnson et al., 2017).

Exposure to snack products are largely unavoidable within supermarkets and studies suggest that snacks account for approximately a fifth of total daily energy intake (Johnson and Anderson, 2010; Myhre et al., 2015). Considering that 76% of packaged foods in South African supermarkets are ultra-processed (Frank et al., 2021), it indicates that a large amount of food available to consumers are energy dense, high in fats, sugar or salt (Dunford et al., 2022; Monteiro et al., 2013).

Aggressive marketing by the food and beverage industry influences food purchases (Cairns et al., 2009), and when it is combined with increased supermarket shelf space and price promotions, consumers are tempted to purchase snack products more frequently. There is a limited body of research on the marketing and nutritional composition of snack items specific to South Africa. The findings of this study will provide insight and information on available snack products, and marketing thereof, for policy development aimed at stemming the rising obesity and chronic disease rates. It is suggested that in order to understand the reasons for unhealthy populations, one must look not just to individual factors, but also societal ones (Marmot, 2015; Rose, 1985).

2. Literature Review

2.1. Introduction

In recent decades, dietary patterns have changed (Hill et al., 2003). Diets in the 1970's started to shift towards ultra-processed foods and eating less home cooked meals (Popkin et al., 2012). The workplace and home are often far apart, and with busy schedules, it is not always practical to have joint family meals. This leads to snacking at times convenient to the individual. According to Reardon et al (2021), the South African per capita consumer expenditure of food and non-alcoholic beverages away from the home has grown by ninefold from 1990 to 2017. Snacking has become a popular dietary practice which is a concern as snack foods and beverages tend to be energy dense and nutrient poor. The increasing frequency of snack food consumption correlates positively with total energy intake (Hampl et al., 2003; Sreenidhi et al., 2021). This is a public health issue especially in a world where obesity continues to be a growing problem, both in developed and developing countries. The following literature review highlights the double burden of malnutrition in South Africa, what snack foods are and how they contribute to diets. This review also looks at the consumption of snack foods in South Africa and discusses the complex food environment where purchasing and dietary habits are formed. Supermarkets are becoming increasingly recognised as potential intervention points for limiting exposure to unhealthy food and beverages in order to improve public health (Glanz et al., 2012).

2.2. Nutritional status and Non-Communicable Diseases

Two broad groups of malnutrition exist, under- and over-nutrition. Undernutrition is defined as insufficient intake of energy and nutrients to meet an individual's needs to maintain good health. Similarly, overnutrition is a term used when there is an excess intake of macronutrients

and micronutrients (Maleta, 2006). In South Africa, both under- and over-nutrition coexist (Faber and Wenhold, 2007).

2.2.1 Undernutrition and stunting

Hidden hunger, or micronutrient deficiency, is a leading global problem of public health importance, especially in sub-Saharan Africa (Ruel-Bergeron et al., 2015). In South Africa undernutrition and micronutrient deficiencies are still prevalent (Faber and Wenhold, 2007; Mchiza et al., 2015).

Childhood stunting is defined as a height-for-age z score that is more than 2 Standard Deviations below the median which represents a short stature and is used as a marker of chronic childhood undernutrition (Huicho et al., 2020). Approximately 30% of children under the age of five years are stunted in sub-Saharan Africa (FAO, 2017). The 2021 Global Nutrition Report (Global Nutrition Report, 2021) indicated minimal progress has been made by SA towards achieving the target for stunting reduction, with 27.4% of children under five still affected. The consequences of stunting are alarming as it has the potential to give rise to poor cognitive development (Casale et al., 2014; Mendez and Adair., 1999) and the risk of developing NCDs like cardiovascular disease, type 2 diabetes mellitus and obesity in later adult life.

Micronutrient deficiencies of vitamin A, iron and zinc are associated with childhood stunting (Gibson et al., 2007), and these are the three most common micronutrients lacking in the diets of South African children under six years old, largely among economically disadvantaged communities (Faber and Wenhold, 2007). Shisana et al (2014) stated that for children under five, the national prevalence of vitamin A deficiency was 43.6% and the overall prevalence of anaemia was 10.7%. They also add that almost one third of women and children in SA are

anaemic. Iron deficiency is the leading cause of iron deficiency anaemia, poor cognitive development, and maternal and childhood deaths (Subramaniam and Girish, 2015). Vitamin A deficiency is the main cause of preventable night blindness, childhood morbidity and mortality (Stevens et al., 2015). Zinc deficiency is associated with childhood diarrhea, impaired immunity, and reduced growth or stunting (Mandal and Lu, 2017; Prasad, 2013).

There is a lack of national data regarding the dietary intake of South African adults since there has never been a national study on adults. The only National Food Consumption Survey (NFCS) was in children aged one- to nine-years old in 1999 (Labadarios et al., 2001). This survey found a serious dietary risk of deficiency for calcium, iron, zinc, folate, vitamin C, vitamin A, vitamin E, riboflavin, niacin, and vitamin B6 (Labadarios et al., 2001). A large percentage of these one- to nine-year olds were found to have intakes of less than 67% of the recommended dietary allowance (RDA), which was an indication for risk of inadequate intake (Monsen, 1989).

To address these nutritional disorders and food insecurity, the South African National Department of Health (NDoH) has implemented many strategies. One of which is the national food fortification programme initiated in 2003, which provides for the mandatory fortification of maize meal and wheat flour with vitamin A, thiamine, riboflavin, niacin, vitamin B6, folic acid, iron, and zinc (Shisana et al., 2014; UNICEF and FFI, 2014). However, this strategy has not adequately addressed micronutrient deficiencies because supplements, commercially fortified foods and diversified foods, are not affordable or accessible for poor individuals, and more so for those living in rural communities (Labadarios et al., 2011; Temple et al., 2011). There is also the National School Nutrition Programme (NSNP) which provides a mid-day school meal, comprising of a carbohydrate, protein and fruit or vegetable, to learners from 60%

of the poorest schools in South Africa (Hazell et al., 2016). Other initiatives have included iron, folate and vitamin A supplements to pregnant women and children from six to fifty-nine months old (Steyn and Temple, 2008).

2.2.2 Overweight, obesity and non-communicable diseases

Global obesity rates are high and are continuously increasing (Leist et al., 2021; Lobstein, 2010; WHO, 2021). According to the World Health Organization (2021), the rate has nearly tripled since 1975. In 2016, 39% of adults were overweight and 13% were obese globally (WHO, 2021). The prevalence of obesity began increasing around 1960 and then rapidly grew in the 1980's (Caballero, 2007; Finkelstein et al., 2005; Swinburn et al., 2011). The high prevalence of obesity has put large numbers of individuals at an increased risk of developing NCDs such as type 2 diabetes and cardiovascular diseases (Mokdad et al., 2003). In a study conducted by Guh et al. (2009) it was found that aside from type 2 diabetes and cardiovascular diseases, there were additional comorbidities associated with being overweight or obese, including asthma, chronic back pain, osteoarthritis, gallbladder disease, and certain cancers. Weight gain resulting in overweight or obesity is completely preventable (Balwan et al., 2021).

In 2016, the World Health Organization estimated that 28.3% of South Africans were obese (WHO, 2016). Gender specific findings reported that in South Africa 31% of men and 68% of women were either overweight or obese (SADHS, 2016). South African school children have a 13.5% combined prevalence for overweight and obesity, which is 10% higher than the prevalence globally (Shisana et al., 2014). Globally, diabetes has risen from 180 million cases in 1980, to 463 million cases in 2019 (International Diabetes Federation, 2020; Roglic, 2016), and is expected to rise to 700 million by 2045 if no preventative action is taken (Saeedi et al., 2019). Over the last few decades diabetes prevalence in South Africa has been on the rise.

From 2000 to 2009 the number of adults 30 years and older with diabetes had nearly doubled to two million (Bradshaw et al., 2007). In 2019 it had increased to an estimated 4.5 million people living with diabetes (International Diabetes Federation, 2020).

The South African National Health and Nutrition Examination Survey (SANHANES) reported that nearly one third of adults were hypertensive in 2012 (Shisana et al., 2014). More recent surveys estimate that it has increased to 35–49% (Berry et al., 2017; Owolabi et al., 2017). Cardiovascular disease is the leading cause of death worldwide, with most deaths attributed to hypertension (WHO, 2021). There is an increase in prevalence of multiple and poorly controlled NCDs especially in individuals over the age of 50 (Wong et al., 2021). The country's healthcare services are struggling to cope with the burden of disease (Bradshaw et al., 2003; Delobelle et al., 2010; Maphumulo & Bhengu, 2019).

2.3. The contribution of snack foods to dietary intake

Although the terms over- and undernutrition are complete opposites, it is possible to be both overweight and have micronutrient deficiencies. This can occur due to the overconsumption of "junk foods" which are energy dense but contain very little or no other nutrients, thus providing empty calories (Sreenidhi et al., 2021). When too many of these "empty calorie" foods replace a healthy diet (consisting of fresh fruit, vegetables, legumes and protein rich sources) it can result in weight gain, micronutrient deficiencies, and serious health implications (Imamura et al., 2015). Low income populations are at a disproportionate risk of this double burden of overweight and micronutrient malnutrition when energy dense foods are relatively cheaper than healthy foods (Steyn and Mchiza., 2014).

2.3.1 Definition of snack foods

A universal definition of “snack food” does not exist (Chamontin et al., 2003; Ciurzy'nska et al., 2019; Johnson and Anderson, 2010). Definitions can be broad or narrow and the looseness of the definition governs the number of products included in the category (Matz, 2012). Gregori and Maffeis (2007) therefore argue that having this key concept undefined and misunderstood is inappropriate in nutritional research as it may affect the accuracy and validity of gathered information.

A few ways that snack foods have previously been defined was to look at the time of the day it is consumed i.e. snacks were defined as foods eaten between meals (meal times were considered as between 8:00 and 10:00 am, 12:00 and 2:00 pm, and 6:00 and 8:00 pm)(Gregori and Maffeis, 2007). However, this method leads to misclassification due to variations in eating patterns according to individual lifestyle. Gatenby (1997) mentions that the definitions relating to energy content or time of consumption does not always correspond with cultural or individual perceptions of what constitutes a meal or snack. Food scientist, R. Gordon Booth (2012) suggested that snack foods naturally include popcorn, peanuts, products high in sugar and are sometimes referred to as a very light meal. Thornton et al. (2013) adds that it can be foods and beverages consumed outside of breakfast, lunch and supper. These items are usually considered high in energy, sugar, fat, sodium, and low in micronutrients. This includes potato crisps, corn chips, carbonated beverages, chocolates and confectioneries. These snacks are all readily available in supermarkets and form part of a typical Westernised diet (Thornton et al., 2013). The development of a universal definition is necessary however it is expected to be a challenging task since there are barriers to all snack definitions currently available (Johnson and Anderson, 2010).

2.3.2 Healthy and unhealthy snack foods

The concept of a healthy snack varies from country to country. In Greenland, a snack is an additional opportunity to eat a meal and it is recommended to consist of fruit, vegetables, crispy bread or dried fish (Jeppesen et al., 2011). In Sweden healthy snacks consist of margarine sandwiches, fruit, milk and occasional sweets, while in France, they consider it to be fruit, raw vegetables, and butter and jam sandwiches (Hess et al., 2016). Drewnowski and Fulgoni (2008) states that healthy snacks are those which are nutrient-dense and provide fewer calories. They are minimally processed and provide positive health outcomes, particularly fruits and vegetables (Svisco et al., 2019). Wyatt (2017) is in agreement and adds that healthy snacks also include fruit and nut trail mix, items with minimal added sweeteners or preservatives, chips made from whole ingredients, and dried legumes. Apart from fruits and vegetables, which provide fibre, vitamins, and minerals, healthy snacks are also considered to include whole grains, lean proteins and healthy fats (Rodriguez et al., 2009).

Junk food, or empty calories, is a casual term applied to unhealthy snack foods that contain very little or no nutritional worth (Sreenidhi et al., 2021) and are commonly ultra-processed (Dunford et al., 2022). Almost all foods undergo some form of processing before they have a presence at grocery stores (Monteiro et al., 2019). Ultra-processed snacks are manufactured to be attractive, highly flavourful, affordable, convenient ready-to-eat products that generally are high in energy, unhealthy fats, refined starches, or salt and have undergone extensive processing (Dunford et al., 2022; Monteiro et al., 2013; Wilson, 2020). Ultra-processed snack foods include carbonated soft drinks, sweet or savoury packaged snacks, chocolate, candy, ice-cream, cookies (biscuits), pastries, cakes, energy bars, energy drinks, milk drinks, fruit yoghurts, fruit drinks, cocoa drinks and desserts (Monteiro et al., 2018). Ultra-processed foods are increasingly known to have addictive qualities (Gearhardt and Hebebrand, 2021; Moss,

2021) and Hartmann et al. (2013) suggests that consuming these kind of items are associated with poor diet quality which is why regular consumption is not recommended (Reardon et al., 2021).

It is not clear how the term nutritious or healthy is understood by customers or what standards are utilized to determine if food items are healthy or not. In an Australian study where De Vlieger et al. (2017) examined this, high levels of processing or "unnaturalness" of snack foods were viewed negatively, and consequently ranked as less nutritious among young adults. Some snacks containing small amounts of healthy ingredients were rated highly in terms of their nutritiousness. An example of this was fruit juice, muesli and yoghurt perceived as healthy, with the sugar content overlooked. This concept is known as the 'health-halo', indicating that a food is evaluated as more healthy if it contains some healthy ingredients, or falsely advertises itself as healthy (Chandon and Wansink, 2007).

2.3.3 Contribution of snack foods to the diet

Snacking is a popular dietary practice that has increased over time (Johnson and Anderson, 2010). This increasing frequency of snack food consumption has been shown to positively correlate with total energy intake (Almoraie et al., 2021; Evans et al., 2015; Hampl et al., 2003). Aerts and Smits (2017) reported that both adults and children over-eat when offered snacks from a larger package, especially sugary foods. Studies suggest that snack foods and beverages account for between 17-21% of total daily energy intake (Johnson and Anderson, 2010; Myhre et al., 2015). This might result in weight gain, with the consumption frequency of snack foods being higher in obese individuals (Bertéus Forslund et al., 2005). However, the relationship between snacking and BMI is not always linear (Drummond et al., 1996; Tripicchio et al.,

2019). Other studies found that frequent snacking is not associated with a higher BMI (Larson et al., 2016; Skoczek-Rubinska & Bajerska, 2021) and that frequent snacking can be part of a healthy dietary pattern (Hartmann et al., 2013; Skoczek-Rubinska & Bajerska, 2021; Zizza and Xu., 2012). However, this difference might be due to an underreporting on snack intake, the type of snack consumed, or a high physical activity level. Besides energy, snacks can contribute to intake of other nutrients. Researchers have shown that both healthy and unhealthy snacks contribute largely to the intake of vitamin E (Jordão et al., 2020; Talegawkar et al., 2007), fibre, iron, folate, vitamin C (Stroehla et al., 2005) and monounsaturated fatty acids (Nicklas et al., 2004).

Although snacks provide some nutrients, Webb et al. (2006) found that snacks displace more nutrient dense foods in the diets of those with a high intake of snack foods, and diets were lower in most micronutrients compared to the group who consumed less snacks. Individuals from the United States who reported skipping meals but ate several snacks had less healthful overall nutrient intakes than individuals who ate three meals, with or without snacks (Kerver et al., 2006). In this study, individuals who classified their eating occasions as meals seemed to choose more nutrient dense foods. Snack foods are not as nutrient dense as balanced meals and provide lots of energy, salt, saturated fat and added sugars (Hess et al., 2016) which contribute to the development of NCDs (Johnson et al., 2017). The nutritional quality of snacks matter as they should, in combination with meals, help individuals meet their daily nutrient requirements (Zizza and Xu, 2012).

2.4. The food environment and snack foods.

2.4.1 The impact of the food environment on snack food intake

There are multiple factors that influence what consumers purchase, and in turn, their diet. The environment people live in is the driving force behind many of their unhealthy eating habits (Ball et al., 2006; Swinburn et al., 2011; Turner et al., 2018). Food environments have been described as "the interface where people interact with the wider food system to acquire and consume foods" (FAO, 2016; Turner et al., 2018). Turner et al. (2018) goes on by stating that there are external and personal food environment domains which determine what is acquired and consumed which ultimately results in health and nutrition outcomes (Figure 1).

The personal domain of the food environment consists of individual-level dimensions, including food accessibility, affordability, convenience, and desirability (Turner et al., 2018). These factors also include aspects such as distance to markets (Kerr et al., 2009), hunger (Bellisle, 2014), time, effort required for cooking and preparation of food items, taste, pleasure (Hennegan et al., 2013), food culture (Zizza, 2014), tradition, skills, and knowledge of nutrition (Chapman et al., 2014). Income and food prices are also important, especially for the poor (Headey and Alderman, 2019). About 55.5% of South Africans live in poverty (World Bank, 2020). As of the second quarter of 2021, the unemployment rate has risen to 34.4%, rendering even more families food insecure (Reuters, 2021).

The external domain consists of food availability, prices, vendor and product properties, marketing and regulation (Turner et al., 2018). This further branches into having food items present at markets, the operating hours of manufacturers, food processing, nutritional composition, shelf life and how food items are packaged. It also includes how products are branded, labelled, advertised, promoted, and the regulatory policies in place. The food

environment in low- and middle-income countries (LMIC) changed dramatically as globalization of food markets, the drop of production costs of oils and sweeteners, and increased production of animal-source foods allowed for great availability of affordable energy-dense products that appeal strongly to taste preferences for sweet, fatty and salty foods (Brug et al., 2005; Popkin, Adair and Ng, 2012).

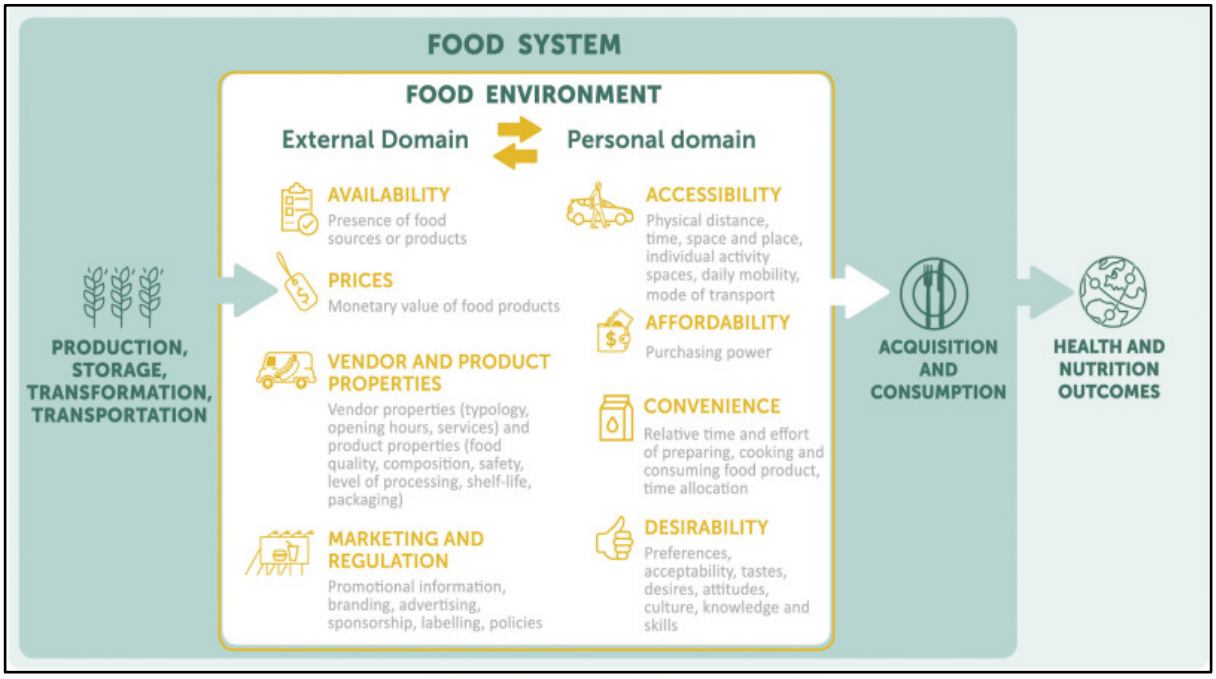

Figure 1: The Food Environment as depicted by Turner et al., (2018, p96)

Similarly to Turner's framework (Figure 1), Swinburn et al., (2019) developed a socio-ecological model called the Systems Outcomes Framework (Figure 2), where he provides additional layers to understanding the food environment. He describes that the food system can be divided into rings of five systems: the 'natural system' in the centre, is the system which everything on the planet depends on; the 'governance', which includes elections, policies, regulations and economics; the 'macro systems', which includes the food retail environment, land use, and transportation; the 'meso systems', which includes the workplace, schools, hospitals and public spaces; and lastly the 'micro systems', which includes family,

communities and social circles, which encompasses attitudes and beliefs. All these systems have an influence on human and ecological health (Swinburn et al., 2019).

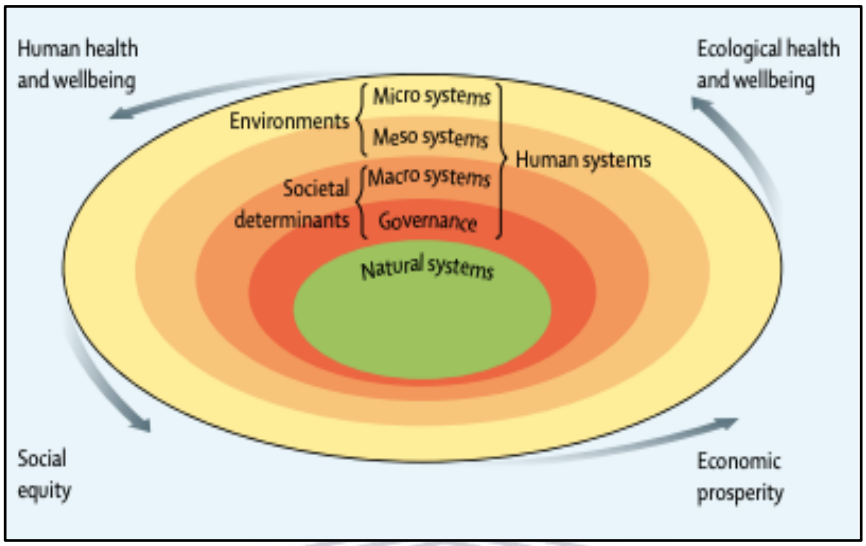

Figure 2: The Systems Outcomes Framework proposed by Swinburn et al. (2019, p799)

There is an over-supply of ultra-processed foods in South Africa. Frank et al. (2021) found that 76% of packaged foods in supermarkets were ultra-processed, which means a large number of packaged products found in supermarkets are energy dense, high in fats, sugar or salt (Dunford et al,, 2022; Monteiro et al., 2013). It is unclear which criteria consumers use when evaluating food items in grocery stores (De Vlieger et al., 2017) but Deliens et al. (2014) suggests that nutrient and health claims are able to influence perceptions and may guide decision making when it comes to what one purchases. In South Africa, it is not mandatory to provide nutrition labels. If companies choose to include nutrient and health claims (Codex Alimentarius, 2013) on product packaging, only then are they required to provide a nutritional composition table in a prescribed format to validate the claims made (South African Government, 2012).

2.4.2 Supermarkets

Both rural and urban poor communities rely heavily on formal supermarkets, small local shops and fast food outlets to purchase their food (Otterbach, Oskorouchi and Rogan, 2021). Grocery stores decide which products, the variety, amount of units to order as well as what they allow to be promoted in their stores. When there is variety, it generates more customer traffic (Briesch et al., 2009). Advertisements, special offers, branded displays and placement of food items all influence consumers purchasing behaviour. There is limited data available regarding the influence that shelf space and level of product placement have on consumer food purchases (Shaw et al., 2020). According to Curhan (1974), product display level and shelf space allocation have been shown to have significant effects on consumer purchases. He determined that increasing fruit and vegetable shelf space by 100% resulted in 29–59% greater sales. Another study by the same author determined that unit sales of food items increased by 8% in response to an increase in shelf space of 40% (Curhan, 1972). Desmet and Renaudin (1998) adds that if a product is given a large shelf space, it is likely to be visually perceived, sifted out and bought more frequently, and if more space is allocated to a product category, the products will be out of stock less often, and the total sales of the category will increase.

Many snack products are promoted weekly in supermarkets (Steenhuis et al., 2011). These promotions can be seen as a temporary price reduction or an increased volume of a product for the same price. Studies have shown that price reductions on items that have a long shelf life and store easily tend to increase purchases compared to items that expire quickly and are difficult to store (Teunter, 2005). Miller (2009), reported that shoppers purchasing decisions were often shaped by end of aisle displays, merchandising displays, store promotions, as well as cross-promotion of certain items e.g., placing coffee sachets next to biscuits to encourage consumers to purchase both when they initially wanted biscuits only (Bezawada et al., 2009).

This is a concern as marketing of unhealthy items causes increased preference towards them, resulting in the development of poor dietary patterns (Qutteina et al., 2019). Non-nutritious snack food items and sugary beverages have a presence at checkout areas of most supermarkets, making them unavoidable and increases the likelihood of unwanted impulsive purchases (Basch and Fera, 2021; Thornton et al., 2013).

Even though supermarkets are predominantly part of the external food environment domain, individuals still enter this space and experience all that it has to offer, which means choosing what, when, and how much they purchase and consume (Brug, 2008). Healthy foods are mostly viewed by customers to be costly, which has been identified as a barrier to buying healthier products (Amore et al., 2019; Steenhuis et al., 2011). Unfortunately research suggests that grocery stores located in poor areas are likely to offer more unhealthy foods (Battersby and Peyton, 2014; Cooksey-Stowers et al., 2017).

Decision making at point-of-sale is predominately an unconscious mental process. According to Martin (2008), 95% of purchases are built on habitual behaviours that have been moulded by aspects such as food preferences and budget constraints. Strong personal barriers to healthy eating is formed with a plethora of tasty options to choose from, the convenience thereof, marketing, and temptation they create (Stankevitz et al., 2017).

2.4.3 Food and beverage industry

2.4.3.1 Multinational corporations

Big Food is viewed as multinational processed food and beverage companies which have a concentrated market power in developed countries and is implicated in unhealthy eating (Hawkes, 2002; Igumbor et al., 2012). Big food has expanded globally (Lawrence, 2011;

Stuckler and Nestle, 2012) due to takeovers of domestic food companies in developing countries (Regmi and Gehlhar, 2005). Studies show that farmers and food vendors from developing countries collapse or are integrated into processed food production when they cannot compete with Big Food companies (Stuckler and Siegel, 2011).

In South Africa multinational food companies have become more widespread, accounting for majority of the market share of ultra-processed foods (Igumbor et al., 2012). The demand for products produced by Big Food companies are largely driven by extensive advertising, price promotions and other marketing techniques to generate brand loyalty (Popkin and Ng, 2021). These unhealthy commodities contain low-cost ingredients, are hyperpalatable, and are highly branded and marketed to consumers (Popkin and Ng, 2021). They are extremely profitable because of the low production cost, long shelf-life, and high retail value. These market characteristics create incentives for industries to market and increase their sales (Stuckler et al., 2012). The low and often declining cost of these ultra-processed foods is a public health issue (Headey and Alderman, 2019). With the high levels of unemployment and poverty, people are choosing to buy these items because they are tasty, affordable and will feed their families at low cost even though it may not meet the nutritional requirements of the family members.

2.4.3.2 Marketing of snack foods

Strong evidence suggests that marketing influences food purchases (Cairns et al., 2009) and it is clear that the food industry invests a great deal in marketing their unhealthy products (Cairns et al., 2009). Children and adults alike are vulnerable to marketing (Boyland and Tatlow, 2017). However, when compared to adults, children are more receptive to television advertisements of food and beverage items (Boyland et al., 2016). Marketing companies use multiple strategies

to make unhealthy food and beverage products more appealing to children. Some examples are the use of colourful packaging with the presence of animated characters, and misleading claims (e.g. when images suggest that the product may be associated with enhanced sport performance) (Letona et al., 2014; Oyero and Salawo, 2014).

Marketers use this to their advantage to increase sales of profitable unhealthy foods (Letona et al., 2014). It was found that South African children are estimated to be exposed to an average of 24 minutes of advertising daily (Van Vuuren, 2006). The most frequent TV adverts shown of food and beverage products in South Africa are desserts and sweets, fast foods, SSBs, and starchy foods (Mchiza et al., 2013). Yamoah et al. (2021) found that more than half of food and beverage related adverts on TV were of unhealthy products and that they were advertised more than three times as often as healthy foods during child viewing hours. In addition, 34% of these advertisements used power strategies, meaning they included cartoon characters, sportsmen, and celebrities to attract the attention of children. WHO (2014) states that the most advertised foods and beverages on TV are high in fat, sugar and salt and low in essential minerals, vitamins, and fibre. When exposed to marketing, there is a lasting impact on children's food knowledge, preferences and consumption, and risk of weight gain (Cairns et al., 2009; Deliens et al., 2014).

Supermarkets use different components of the marketing mix, namely price, product, place and promotion, to influence what people purchase (Swinburn, 1999). Price and promotion strategies can influence purchase and consumption rates (Steenhuis et al., 2011). Even though there are many variables that determine what people purchase, evidence shows that consumption is higher of the items bought on promotion (Powell et al., 2013; Srinivasan et al., 2004). Dibb (2005) determined that fatty and sugary foods were twice as likely to have price

reductions compared to healthy fruit and vegetables. Supermarkets are using flyers delivered door-to-door to reach customers and convey store promotions. About 70% of promotions from Dutch supermarkets were categorised as unhealthy (Ravensbergen et al., 2015). Research shows that sales have the ability to increase by 173% when flyers are combined with a 15% price cut (Teunter, 2005). Mendes et al. (2021) identified that in Brazil, store promotions were barriers to healthy eating because they include excessive amounts of advertisements of unhealthy foods and beverages. This is not only an issue in Brazil. A study by Charlton et al. (2015) revealed that supermarket promotions in most countries included a large amount of ultra-processed products, i.e. foods and beverages which promote unhealthy eating behaviours that contribute to the global obesity epidemic. Martin-Biggers et al. (2013) is in agreement that these foods being advertised do not support a healthy weight.

2.5. Snack food consumption in SA

In South Africa, the Western Cape province has the highest reported level of snacking at 82%, while Limpopo has the lowest at 46.8%. The levels are high too in other provinces such as 73.9% in the Northern Cape, 70.2% in the Free State, 68.1% in KwaZulu-Natal and 71.2% in Mpumalanga (Shisana et al., 2014). With a lack of disposable income in South Africa (National Treasury, 2019), many consumers are choosing more affordable brands, and limiting their purchases to essentials in order to save costs (Lehutso, 2022). The drive towards cheap foods results in regular consumption of ultra-processed foods (Armstrong, Lambert and Lambert, 2011; Temple and Steyn, 2011). The snacks most commonly purchased by the households of school-going children in a low socio-economic status comminity in SA are inexpensive and energy dense, enabling quick satiety (Govender et al., 2018). Shisana et al (2014) reported that majority (67.1%) of households in SA indicated that snacking occurs while people are drinking alcohol, which is concerning given that SA has the sixth highest per person alcohol intake in

the world (WHO, 2018). South African individuals with a normal BMI are more likely to purchase less food from vendors, are less likely to make purchases due to pressure from peers, are more likely to eat less fried foods and more fruit compared to those who are overweight (Gradidge and Cohen, 2018).

Röhrs and du Plessis (2021) identified that in South Africa, the snacks that people consume are peanut butter sandwiches, processed meats, peanuts, yoghurt, dried and fresh fruit, and chips, with chips and bread being the most available snack in poor communities. In the 2016 South Africa Demographic and Health Survey (SADHS, 2016), 13% of adults who participated reported daily consumption of salty snack foods, with 29% consuming it at least once weekly. Daily consumption of these foods decreased with age. This may be related to the lower dietary diversity scores often seen in elderly populations (Oldewage-Theron and Kruger, 2009). The daily consumption of snack foods are higher amongst participants in urban areas, and it generally increases with an increased household wealth (SADHS, 2016). Twenty percent of respondents from the Western Cape and nine percent from KwaZulu-Natal consumed salty snacks on a daily basis (SADHS, 2016). The sale of savoury snacks, such as popcorn, chips, nuts, seeds, and meaty snacks has grown over the years, with chips being the highest contributor to market share (Mordor Intelligence, 2022). Govender et al. (2018) identified chips as being a popular snack eaten in the homes of school-going children in a low socio-economic status community in South Africa. In the SADHS (2016) it was found that 18% of children aged six to eight months old consumed salty snacks, and so did 64% of children aged 18-23 months. In a South African study by Peer et al. (2018), approximately half of the participants (n= 3855) consumed foods high in fat and salt regularly, which is likely to contribute to the development of hypertension and obesity.

Consumers appreciate value for money, and this is no different when purchasing snacks (Atmar et al., 2020). Private labels (i.e. store brand) products have been known to offer more value for money (Nenycz-Thiel and Romaniuk, 2012). More attention has been drawn to sweet biscuits and fruit snacks as private label manufacturers are constantly involved in creating new products (Euromonitor, 2021a). Biscuit consumption has largely grown from 1999-2012 (Ronquest-Ross et al., 2015). Sweet biscuits have become popular with low-income individuals because of their affordability, whereas savoury biscuits are purchased more among high-income individuals who entertain guests (Euromonitor, 2013; Ronquest-Ross et al., 2015; Solomon, 2011).

In South Africa there has also been an increase in consumption of confectionaries over the decades as a result of more chocolate consumption, which grew 12.5% from 1999-2012 (Ronquest-Ross et al., 2015). South Africa's confectionery industry comprises of the chocolate market, valued at approximately R6.4 billion and sugar confectionery, which is valued between R12.5 billion and R13.5 billion (Research and Markets, 2019). Slabs are the most frequenly bought chocolate product and takes over 50% of the market share (Ronquest-Ross et al., 2015). Customers prefer milk chocolate, however dark chocolate is increasing in popularity due to the supposed health benefits (Euromonitor, 2013). Govender et al. (2018) identified sweets as being a popular snack eaten in the homes of school-going children in a low socio-economic status community in South Africa. Pastilles, gums, jellies and chews is set to be the largest category of sugar confectionery in South Africa in 2022, with estimated value sales of ZAR3817.5m. While toffees, caramels, and nougat are set to be the second largest category at a value of ZAR1716.9m, followed by boiled sweets (ZAR1671.6m) in third place (WESGRO, 2022).

South Africans are increasing their consumption of soft drinks, especially in urban areas, but due to better education and awareness, consumers shift towards selecting low-calorie carbonated drinks (Igumbor et al., 2012; Mukherjee et al., 2021; Steyn et al., 2003; Steyn et al., 2011). Carbonated beverages are also the most frequently purchased item from street vendors, besides fruit (Steyn et al., 2011). In 2015, Madiba et al. (2017) conducted a study at a South African university which reported that 33% of students drink around two to twenty-two tablespoons of sugar every day. What is alarming is that two tablespoons of which comes from sugary drinks alone. Faber et al. (2016) suggest that in South Africa nearly 20% of children aged 12 months and older consume carbonated beverages at least once a week. In the SADHS (2016) it was reported that 4% of children aged six to eight months consumed sugary drinks, 18% of children aged 6-23 months, and 33% of children aged 18-23 months, respectively. Carbonated beverages are responsible for majority of the ultra-processed beverage sales globally. In Africa carbonated beverage sales accelerated over recent years, from around 12 litres per capita in 2006 to 26 litres per capita in 2019 (Baker et al., 2020). As an attempt to reduce sugary beverage intake in South Africa, the Health Promotion Levy on sugary beverages (SARS, 2021) was introduced on 1 April 2018, which was shown to be successful in decreasing the intake of sugar, calories, and volume of taxed beverages (Essman et al., 2021).

South Africa's economic recession worsened right before the COVID-19 outbreak (Sheefeni, 2022). Unemployment rates soared during the strict lockdown periods in 2020 and disposable incomes fell as many employees were forced to take pay cuts, whilst some did not receive any income. This placed many people under greater financial stress and food insecurity (van der Berg et al., 2022). During the COVID-19 pandemic, periods of national lockdown caused South Africans to increase their consumption of ultra-processed snacks. (Sobba et al., 2021).

The high food insecurity rate has not changed much since June 2020 (van der Berg et al., 2022). The financial pressure that many South Africans are under implies that people will continue to buy what is affordable, which might not always be the healthy option.

Post the COVID-19 national lockdown, people have returned to work and were allowed to gather, which suggests a busier lifestyle compared to 2020 (South African Government, 2022). With many consumers having less time to prepare meals or sit down to eat meals, snacking may become more frequent. South African schools have also allowed all pupils to return post lockdown which will grow the demand for school snacks (Bhengu, 2022). Many still face concern related to food and nutrition post COVID-19 because the pandemic has made consumers aware of how food impacts health. This suggests that healthy snacks may play a more important role moving forward (Li et al., 2021).

2.6. Conclusion

This review highlights many concerns regarding the potential of unhealthy snacking. Snacking contributes to the decreased nutrient density of diets as well as excess energy intake and obesity, increasing the risk of developing NCDs (Sturm, 2005). There is a gap in research addressing snack food consumption specific to South Africa. Most research which addresses this topic is conducted in America and Europe. Improving the quality of food environment research is critical to the design of feasible, appropriate, and effective interventions to improve public health nutrition in LMIC (Turner et al., 2020). Thornton et al. (2013) is in agreement, noting that efforts to improve diet and reduce obesity, along with chronic diseases, are more successful when supported by strategies that aim to create healthier food environments. In order for positive dietary change to occur, the availability and variety of snack foods in supermarkets should be altered (Brug, 2008). Supermarkets are considered influential in determining dietary

behaviours and health outcomes (Feng et al., 2010). Glanz et al. (2012) adds that supermarkets are becoming increasingly recognised as potential intervention points for limiting snack food exposure in order to improve public health. Interventions which identify healthy and unhealthy options at POS can result in healthier customer purchasing behaviour, with promising evidence for nutrition labelling systems (Chan et al., 2021). Expanding our understanding of the food environment is crucial for policy development and contributing towards the Sustainable Development Goal (target 2) to end all forms of malnutrition (United Nations, 2015).

3. Methodology

This mixed-methods study examined the marketing, placement and nutritional composition of packaged snack products from eight grocery stores in both middle- and low-income areas around Cape Town, South Africa. An observational checklist was used to guide primary data collection on marketing and product placement and secondary nutritional composition data was extracted from the ROFE project. Descriptive statistics were used to express frequencies of the presence of snack categories and sub-categories at stores as well as the central tendencies of the nutritional composition of each snack category and sub-category for total energy, protein, total fat, saturated fat, sugar, free sugar, fibre and sodium. These values were then evaluated using the South African Nutrient Profiling Model (SANPM) (Frank et al., 2021) to identify products high in nutrients of concern. The non-nutritive sweetener criteria from the SANPM was not used for assessment as this paper only addresses total sugar, saturated fat, and sodium. Interviews were conducted with the store managers to collect information about product placement and marketing. The qualitative data from the store managers interviews were analysed thematically by reading through the responses for all questions and grouping themes together.

3.1 Aim and Objectives

This study aimed to describe the nutritional composition and variety of snack items available in grocery stores in Cape Town, South Africa and describe the in-store placement and marketing of these items.

The objectives of this study were:

1. To assess and describe the types, variety and nutritional composition of snack items available in major grocery stores in Cape Town, South Africa.

2. To identify categories and sub-categories that are high in total sugar, saturated fat, and sodium (nutrients of concern).

3. To describe the in-store placement and marketing of snack items in major grocery stores in Cape Town, South Africa.

4. To determine the reasoning behind how these snack items are marketed and placed in-store.

3.2 Study design

This was an observational cross-sectional, mixed-method study. Observational studies involve observing and measuring the variable of interest without attempting to intervene (Song and Chung, 2010). This methodology is helpful in providing insight and understanding of real life situations where little is known; such is the case with the snack food landscape in South African supermarkets. A cross-sectional method was chosen because it provides a snapshot of a situation at a particular point in time (Levin, 2006). They are generally quick, inexpensive and less resource intensive to conduct compared to other study designs as no follow-up is required (Lu, 2009). Quantitative research methods are characterised by objectively collecting information that can be analysed numerically and the sample sizes are generally larger than qualitative samples (Palmer, 2019). This was a suitable study design for the purposes of this investigation due to access to a large nutritional facts panel dataset on snack items that could

be analysed numerically. There was also a qualitative aspect to this study which called for engaging in socially organised settings with open-ended interviews to obtain additional information on snack placement and marketing in supermarkets which could not be collected via observation alone. Conducting interviews are relatively inexpensive and provides in-depth material (Miller and Dingwall, 1997).

3.3 Population and sampling

In South Africa, data on snacks available at supermarkets in 2019 was extracted from the secondary data base of the "Researching the Obesogenic Food Environment in South Africa and Ghana (ROFE)" ethics number BM17/08/20 (Appendix 1) with permission from the primary investigator (Appendix 2). This data was sourced from six major supermarket chains located within three different areas in Cape Town, Western Cape Province. In total, eight stores from both middle- and low- socio-economic areas were used. Half (n=4) were from a middle socio-economic area and the rest (n=4) from low-socio-economic areas. Both middle- and low-socio-economic areas were included in the event that products differed due to the area the store was located in. Including the major supermarket chains in one of South Africa's eight metropolitan municipalities provides a reasonable representation of the variety of snack foods available to the public. The same eight supermarkets, and the managers thereof, were selected again in 2021 to collect additional primary data regarding the marketing, variety and placement of snack items.

3.4 Data collection

The secondary data was originally collected by systematically photographing all information available on the front- and back-of-pack of food and beverage items in store. Photographs of packaged products from the ROFE study captured information on the brand name,

manufacturer, mass, type of packaging, labelling, barcode, nutrition facts panel (NFP) and ingredient list. The ROFE dataset captured all packaged food and beverage products in the supermarkets, not only snack products, thus data on snacks were extracted for this study.

As a universal definition of a snack does not exist (Ciurzyńska, et al., 2019; Johnson and Anderson, 2010), a modification of the guide by Thornton et al. (2013) was used (Table 1) to identify appropriate snack items for extraction. Using Microsoft excel, ten categories of data, consisting of 7965 products, were screened to identify products eligible for inclusion. There was a removal of 3708 products because they were not considered to be snack items according to the guidelines by Thornton et al. (2013) summarised in Table 1.

Table 1: List of snack items (adapted from Thornton et al., 2013)

Included	**Excluded**
Only packaged & ready to eat items	All packaged and unpackaged foods
Ready-to-drink dairy drinks	Ready-made mixed dishes (frozen, refrigerated, shelf stable)
Ready-to-drink smoothies	Frozen, canned or fresh fruit
Yoghurt	Frozen, canned or fresh vegetables
Sports drinks, energy drinks	Raw, marinated or processed meat, fish, seafood or poultry
Carbonated drinks, juice	Tofu, tempeh, soya mince, meat substitutes
Sorbet, ice creams and frozen yoghurt	Legumes (dried or canned)
Dips and spreads: guacamole, hummus	Unflavoured milk, mageu, condensed milk, cream
Savoury biscuits, crackers, rice and corn cakes	Oils, butter, cheese
All chips: potato, corn, vegetable, tortilla, legume, rice	Eggs
Ready-to-eat Popcorn	Baking ingredients
Pretzels	Sweeteners, Chewing gum
Nuts	Sugars (white, brown, icing)
Seeds	Breakfast cereals: sweet cereals, mealie meal, muesli, granola, porridge
Trail mix	Condiments
Dried fruit	Salad dressings
Hard candies	Spices
Gummy sweets, marshmallows	Sauces
Turkish delight	Water, Alcohol
Nougat	Tea, coffee
Ready-to-eat sweet baked goods: cakes, brownies, muffins, pastries, rusks, biscuits	Infant and paediatric feed and food
Breakfast bars, energy bars	Ready to eat finger foods: cocktail meatballs, sausage rolls, cheese puffs
Chocolate	Nut butters, chocolate/nut spreads, fish paste, liver spread, jam, pate

After removing the inappropriate products, there were 4257 products remaining which were included in this study. The final products were then grouped by similarities to create 10 new snack categories. The flow diagram of product elimination is shown in Figure 3.

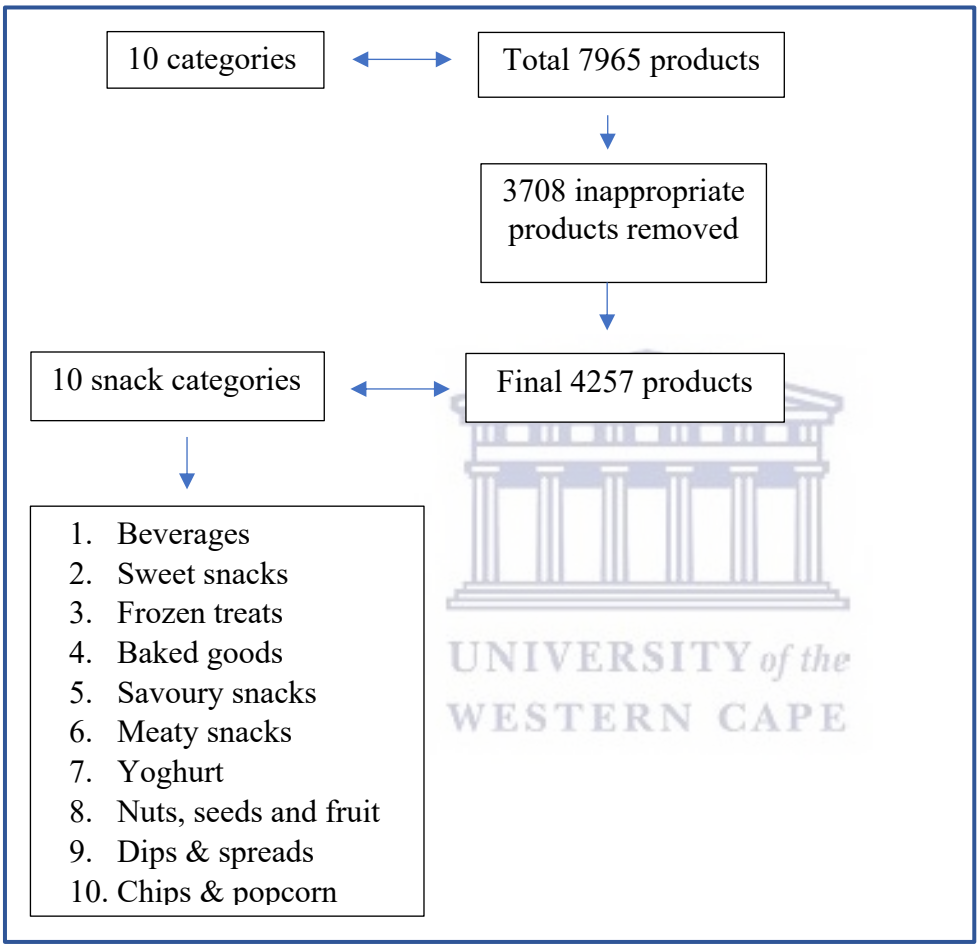

Figure 3: Product elimination flow chart

An observational checklist (Appendix 3), adapted from the Supermarket Snack Food Audit Tool developed by Thornton et al. (2013) and the International Network for Food and Obesity / non-communicable Diseases Research, Monitoring and Action Support (INFORMAS) (Mhurchu, 2017) protocol for Food Availability in Supermarkets guided the primary data collection to obtain information on the in-store marketing of snacks in 2021. The checklist was organized to include observations of the in-store placement of snack products, variety of snacks available at POS, special offers, combo deals, end of aisle displays, branded displays and aisle lengths. After completing the checklist, face to face interviews (Appendix 4) were conducted with the store managers, or representatives, to obtain additional information that could not be collected via observation alone such as details regarding snack placement strategies, marketing, shelf space allocations, promotions, and responsible parties for these decisions. The participants responses were recorded by the interviewer below each question (Appendix 4). Both checklist and interview schedule was reviewed by two colleagues with experience in food environment research for face-validity.

3.5 Data extraction and data entry

The observational checklist (Appendix 3) information from each store visited was captured into Microsoft Excel (version 16.54) and the responses from interviews (Appendix 4) with the store managers, or representatives, was captured into Microsoft Word (version 16.54).

Secondary nutritional composition data was extracted by the primary researcher. All snacks from Table 1 were extracted from the original 2019 NFP datasets, which had a total of 7965 products, to create the snack products dataset (Table 2). The dataset consisted of ten categories (Figure 3; Table 2) including sub-categories (Table 2) such as flavoured water, 100% juice, juice drinks and fruit flavoured drinks, coconut water, soft/carbonated drinks, sugar free/diet

carbonated drinks, sports drinks, energy drinks, coffee, tea, flavoured milk, dairy drinks, dairy-free flavoured milks, non-alcoholic drinks, bars, chocolate, candy, ice-creams, sorbet, sweet baked goods, savoury biscuits, dried meat, dairy yogurt, dairy-free yoghurt, dried fruits, fruit puree packs, nuts, seeds, dips and spreads, potato crisps, cheese snacks, vegetable/legume chips, tortilla/corn chips, and popcorn. Items which were not included (n=3708) were those that are generally consumed as a larger meal, or component thereof, were unpackaged, or if it required preparation prior to consumption (e.g. unpopped popcorn kernels) as it eliminates the convenience factor. Examples of excluded items are eggs, butter, cheese, meat, seafood, poultry, meat substitutes, canned fruit, canned vegetables, ready-made meals, sauces, condiments, spices, spreads, porridge, granola, sugar, baking ingredients, unflavoured milk, cream, legumes, coffee granules or tea bags. The data extraction process was duplicated by another researcher who has experience working with South African nutritional composition data. A comparison was then made to see if the initial extraction was accurate and that no inappropriate items were included in the final dataset. To limit bias, any differences found were discussed between the primary researcher and the researcher who duplicated the data extraction process and a consensus was reached. The dataset was saved as a Microsoft Excel (version 16.54) spreadsheet to be used for analysis.

Table 2: Extracted categories and sub-categories with product examples

Category	Sub-category	Examples
Beverages	Flavoured water	With or without sugar
	100% juice	100% fruit or vegetable juice
	Juice drinks & fruit flavoured drinks	Juice blend drinks (normal, diet, light)
	Coconut Water	Coconut water/juice
	Soft/carbonated drinks	Carbonated drinks containing sugar
	Sugar free/diet carbonated drinks	Carbonated drinks containing less than 4g/100ml sugar i.e. Sprite Zero, Coke Light, Pepsi Max
	Sports drinks	Isotonic beverages
	Energy drinks	Carbonated energy drinks with caffeine
	Coffee	Ready to drink coffee
	Tea	Ready to drink tea
	Flavoured milk	Ready to drink flavoured milk (full cream/low fat/fat free, amasi)
	Dairy drinks	Hot chocolate, flavoured dairy drink (e.g. Tropika)
	Dairy-free flavoured milks	Flavoured soya, almond or coconut milk
	Non-alcoholic drinks	Non-alcoholic beers, cider and gin
	Other beverages	Mageu, aloe drinks
Sweet snacks	Bars	Breakfast/energy bar with fruit, with chocolate, with nuts
	Chocolate	Chocolate slabs or bars, nuts, fruit and sweets covered in chocolate
	Candy	Hard candies, gummies, toffee, marshmallows, turkish delight, nougat
Frozen treats	Ice creams	Milk-based ice cream, ice cream bars, frozen dairy dessert, frozen yoghurt
	Sorbet	Ice lollies, fruit sherbet ice pops
Baked goods	Sweet Baked Goods	Sweet biscuits, digestive biscuits, rusks, cake, brownies, muffins, cinnamon rolls, sweet rolls, ice-cream cones, chocolate coated pretzels, pudding, custard, tarts
Savoury snacks	Savoury biscuits	Plain crackers/salty crackers, rice crackers, corn cakes, cheddar flavoured biscuits, pretzels, croutons, matzo
Meaty snacks	Dried meat	Biltong, salami sticks, droewors, chilli bites
Yoghurt	Dairy yogurt	Plain yogurt, flavoured yoghurt, yogurt with fruit/granola, drinkable yogurt
	Dairy-free yoghurt	Soya and coconut yoghurt
Nuts, seeds and fruit	Dried Fruits	Dried mango, dates, cranberries etc
	Fruit puree packs	On the go fruit puree pouches
	Nuts	Raw nuts, roasted nuts, flavoured/salted nuts
	Seeds	Raw seeds, roasted seeds
	Other nut & seed products	Trail mix, nut and dried fruit mix, nut brittle and seed bars
Dips and spreads	Dips and spreads	Hummus, normal and creamy dips, tzatziki
Crisps and popcorn	Potato Crisps	All potato crisps
	Cheese Snacks	Cheese flavoured maize snacks and chips
	Vegetable/legume chips	All vegetable and legume chips
	Tortilla/Corn Chips	All tortilla/corn chips
	Popcorn	Sweet and savoury ready to eat popcorn
	Other crisp like snacks	Chevra, corn, onion rings, puffed prawn chips, rice cake chips

3.6 Data analysis

The remaining items formed the complete dataset comprising of 4257 packaged ready-to-eat snack items that was used for analysis in IBM Statistical Package for Social Sciences (SPSS) version 28 software. Descriptive statistics were used to express frequencies of the presence of snack categories and sub-categories at stores as well as the central tendencies of the nutritional composition of each category and sub-category for total energy, protein, total fat, saturated fat, sugar, free sugar, fibre and sodium. Certain nutrient values were then evaluated using the SANPM developed by Frank et al. (2021) to identify products high in nutrients of concern. Non-nutritive sweetener was excluded from evaluation as this study only addresses total sugar, saturated fat, and sodium. The information from the observational checklist (Appendix 3) was analysed in Microsoft Excel (version 16.54). Total shelf space allocated to each snack category was calculated and percentages were determined. Thematical analysis was done with the qualitative data from the store managers interviews (Appendix 4), which involved reading through the responses for all questions (n=8) and looking for patterns to identify themes and grouping them together (Braun and Clarke, 2021) in Microsoft Word (version 16.54). This was done for all six questions.

3.7 Validity and Reliability

The eight stores included in this study were all located in Cape Town, South Africa. Although there may be differences to different geographic areas in the country, it provides a reasonable indication of what snack foods might be available to consumers in grocery stores across the country as they include South Africa's six major supermarket chains. Quality of the nutritional composition data from the ROFE study had been assured, the method of which has been described by Frank et al. (2022) and included daily quality checks by a single data supervisor, followed by a structured quality assurance process. The data extraction process was duplicated

by a second reviewer to ensure that the initial extraction was done accurately prior to data analysis. There were only six questions for each store manager and the responses were entered into Microsoft Word (version 16.54). Any errors found in the dataset was easily identified and corrected by the primary researcher.

3.8 Ethics considerations

Ethics approval to conduct the study was granted by the Humanities and Social Sciences Research Ethics Committee of the University of the Western Cape, ethics number HS 20/4/38 (Appendix 5). The stores were given an information sheet (Appendix 6) which described the purpose of the study and the process of how the data would be collected. Although the observational checklist (Appendix 3) information is available in the public domain, consent was still obtained (as a courtesy) before proceeding with data collection. Store managers provided written consent (Appendix 7) before the interview during which they were asked six questions about the in-store marketing and placement of snack products (Appendix 4). Human participants were included in this study via interviews however there were minimal risk posed to them. The store manager's names were not recorded on the questionnaire sheet and during data entry the store names were coded, therefore making all data anonymous. The snack dataset used in this study does not identify any stores.

3.9 Data management

All data used in this study has only been handled by the primary researcher and supervisors. The original 2019 NFP datasets, along with the 2019 snack food dataset, observational checklist and store questionnaire data is securely stored on Kikapu, which is the University of the Western Capes online institutional research data repository. Kikapu is password protected by the primary researcher and access has been granted to supervisors. Once this study is

completed, the primary researcher will no longer have access to the ROFE project or the extracted data.

4. Results

This chapter describes the types, variety and nutritional composition of snack items available in major supermarkets in Cape Town, South Africa. The categories and sub-categories that are high in total sugar, saturated fat, and sodium (nutrients of concern) are highlighted and the in-store placement and marketing of snack items are described. The reasoning behind how snack items are marketed and placed in store is also discussed.

4.1 Snack food frequency

This section describes the type and variety of snack foods found at major supermarkets in Cape Town, South Africa. There were a total of 4257 snack items included in this study. Not all products were unique, due to the inclusion of identical products of different weights. The dataset comprised of 10 categories, with 37 sub-categories (Table 3). The snack categories (Figure 4) consisting of the highest number of products were beverages (26.3%, n=1121), sweet snacks (22.7% , n=968), and baked goods (13.0%, n=555) making up just over 60% of the snack dataset. Savoury snacks (4.8%, n=206), frozen treats (3.7%, n=158), meaty snacks (1.7%, n=71), and dips and spreads (1.0%, n=42) each contribute less than 5% of the total number of snack products. The snack sub-categories with the largest share of products were sweet baked goods (13%, n=555), chocolate (11.1%, n=473), dairy yoghurt (10.0%, n=426), candy (9.9%, n=423), and 100% fruit juice (7.7%, n=328).

Table 3: Number of products in each snack category and sub-category

Categories	Number of Products	Percent (%)	Sub-categories	Number of Products	Percent (%)
Baked goods	555	13.0	Sweet Baked Goods	555	13.0
Beverages	1121	26.3	Flavoured water	45	1.1
			100% juice	328	7.7
			Juice drinks & fruit flavoured drinks	146	3.4
			Coconut Water	3	0.1
			Soft/carbonated drinks	104	2.4
			Sugar free/diet carbonated drinks	111	2.6
			Sports drinks	34	0.8
			Energy drinks	50	1.2
			Coffee	15	0.4
			Tea	107	2.5
			Flavoured milk	68	1.6
			Dairy drinks	56	1.3
			Dairy-free flavoured milks	8	0.2
			Non-alcoholic drinks	18	0.4
			Other beverages	28	0.7
Crisps and popcorn	332	7.8	Potato Crisps	112	2.6
			Cheese Snacks	31	0.7
			Vegetable/legume chips	15	0.4
			Tortilla/Corn Chips	56	1.3
			Popcorn	36	0.8
			Other crisp like snacks	82	1.9
Dips and spreads	42	1.0	Dips and spreads	42	1.0
Frozen treats	158	3.7	Ice creams	133	3.1
			Sorbet	25	0.6
Meaty snacks	71	1.7	Dried meat	71	1.7
Nuts, seeds, and fruit	375	8.8	Nuts	139	3.3
			Seeds	20	0.5
			Other nut & seed products	70	1.6
			Dried Fruits	138	3.2
			Fruit puree packs	8	0.2
Savoury snacks	206	4.8	Savoury biscuits	206	4.8
Sweet snacks	968	22.7	Bars	72	1.7
			Chocolate	473	11.1
			Candy	423	9.9
Yoghurt	429	10.1	Dairy yoghurt	426	10
			Dairy-free yoghurt	3	0.1
Total	4257	100		4257	100

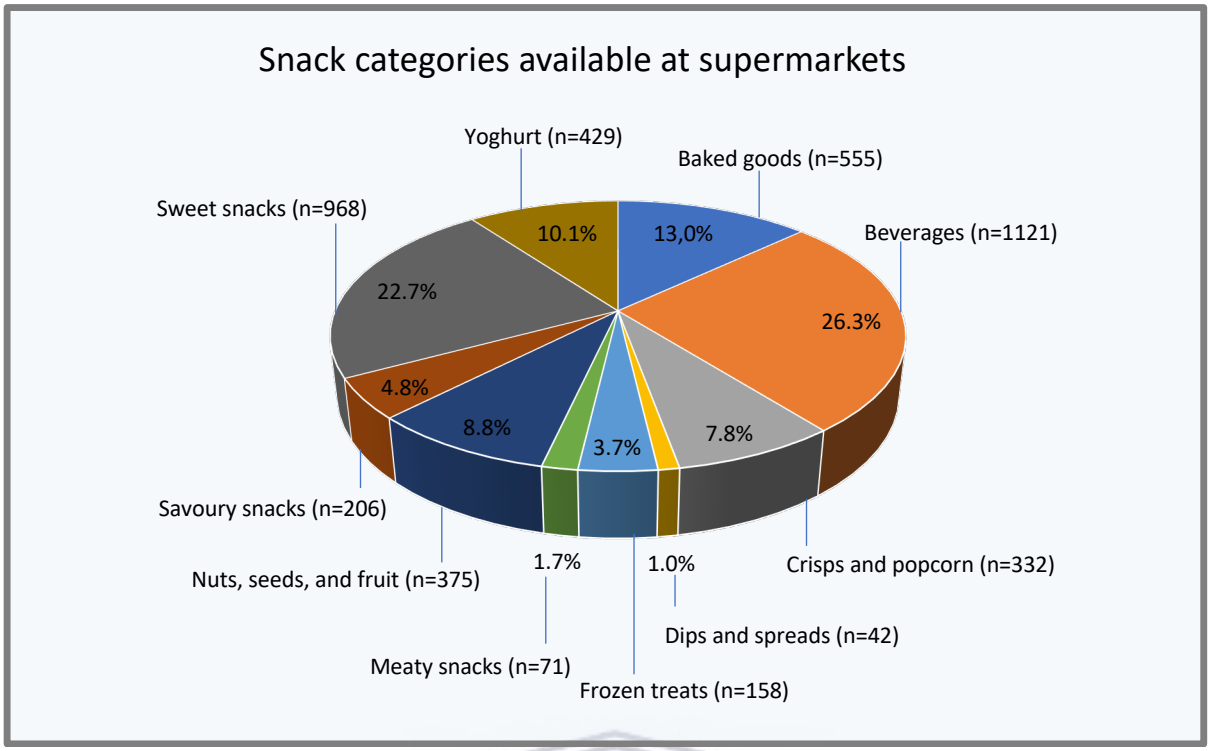

Figure 4: Proportionate distribution of snack categories available from supermarkets in Cape Town.

4.2 Nutritional composition

4.2.1 Snack food categories and sub-categories

This section addresses objective 1 and 2. It looks at the nutritional composition of each category (Table 4; Figures 5, 6 & 8) and sub-category (Table 5; Figures 5, 7 & 8) to determine whether they can be considered as healthy or unhealthy snack options for consumption. The South African Nutrient Profiling Model (SANPM) criteria developed by Frank et al. (2021) was used to identify excessive amounts of nutrients of concern that should be limited, namely total sugar, saturated fat, and sodium. Almost all categories were non-compliant with the recommended limit for these nutrients, as only the Yoghurt category met the criteria, specifically Dairy yoghurt. Other than Dairy yoghurt, the only sub-categories that met the recommended criteria was found in the beverage category. They were Flavoured water, Sugar-free/diet carbonated drinks, Sports drinks, Energy drinks, Tea, Non-alcoholic drinks, and Other beverage products. Due to most categories and sub-categories containing excessive amounts of nutrients of concern, it indicates that they are not healthy snacks for regular consumption. This section also addresses the proportion of products in each category and sub-category that are non-compliant with the SANPM criteria (Table 6).

Table 4: Nutritional composition of snack categories, per 100g

		n	Mean	Standard Deviation	Median	Minimum	Maximum	95% Confidence Interval for Mean	
								Lower bound	Upper bound
Baked goods	kJ/100g	555	1735.81	432.36	1889.00	213.00	2487.00	1653.79	1751.59
	Protein (g)	554	6.47	3.14	6.10	0.00	48.00	6.10	6.87
	Total carbohydrate (g)	323	55.40	16.06	60.00	6.10	84.00	53.18	56.80
	Total sugars (g)	547	25.60	11.16	25.30	0.00	61.00	23.29	25.73
	Free sugar (g)	547	25.60	11.16	25.30	0.00	61.00	23.29	25.73
	Total fat (g)	555	17.59	8.12	17.60	0.00	58.10	16.46	18.19
	Saturated fat (g)	546	9.68	6.23	9.30	0.00	42.50	8,61	9.92
	Fibre (g)	539	2.95	2.87	2.30	0.00	37.78	2.96	3.73
	Sodium (mg)	549	294.98	178.10	278.00	0.12	1240.00	269.92	309.55
Beverages	kJ/100g	1115	145.10	83.97	143.00	0.00	528.00	132.98	149.98
	Protein (g)	1112	0.55	0.96	0.20	0.00	8.60	0.56	0.77
	Total carbohydrate (g)	440	7.06	3.71	7.90	0.00	18.57	6,87	7,59
	Total sugars (g)	1113	6.99	3.79	7.10	0.00	15.20	6.30	7.02
	Free sugar (g)	1113	4.73	2.53	4.60	0.00	15.20	4.39	4.92
	Total fat (g)	1116	0.29	0.77	0.00	0.00	5.40	0.24	0.42
	Saturated fat (g)	1102	0.18	0.51	0.00	0.00	3.80	0.15	0.27
	Fibre (g)	1041	0.29	0.44	0.00	0.00	2.90	0.27	0.35
	Sodium (mg)	1114	19.18	47.12	7.00	0.00	797.00	2.85	17.07
Crisps & popcorn	kJ/100g	332	2048.66	240.22	2065.50	1200.00	2998.00	2070.55	2101.53
	Protein (g)	329	7.42	5.43	6.30	1.60	58.72	6.64	8.54
	Total carbohydrate (g)	211	53.36	14.39	54.00	1.00	87.60	51.50	55.46
	Total sugars (g)	316	4.85	10.50	2.10	0.00	67.00	3.62	6.80
	Free sugar (g)	316	4.85	10.50	2.10	0.00	67.00	3.62	6.80
	Total fat (g)	329	26.38	10.09	27.00	2.60	67.70	26.61	29.62
	Saturated fat (g)	316	9.87	6.57	10.80	0.00	63.80	9.02	11.17
	Fibre (g)	314	5.55	3.97	4.80	0.00	29.00	4.71	5.64
	Sodium (mg)	329	673.67	347.84	620.00	29.00	3382.00	618.56	714.23

Table 4: Nutritional composition of snack categories, per 100g (continued)

		n	Mean	Standard Deviation	Median	Minimum	Maximum	95% Confidence Interval for Mean	
								Lower bound	Upper bound
Dips and spreads	kJ/100g	42	1230.24	567.69	1079.50	290.00	2277.00	919.25	1151.41
	Protein (g)	42	3.81	2.31	3.10	0.10	9.00	2.30	5.19
	Total carbohydrate (g)	18	8.96	4.19	10.00	2.00	18.00	6.88	11.04
	Total sugars (g)	42	2.98	2.73	2.30	0.00	12.50	0.92	2.96
	Free sugar (g)	42	2.58	2.20	2.30	0.00	9.38	0.83	2.84
	Total fat (g)	42	27.45	16.03	25.10	1.00	56.50	17.59	25.20
	Saturated fat (g)	42	8.60	7.12	7.60	1.00	20.40	2.27	8.26
	Fibre (g)	42	2.16	2.55	0.65	0.10	7.50	1.77	4.71
	Sodium (mg)	42	431.00	186.48	398.00	94.00	679.00	343.77	503.79
Frozen treats	kJ/100g	158	732.75	329.21	698.50	194.00	1704.00	705.01	845.93
	Protein (g)	156	2.43	2.32	1.90	0.00	15.50	1.92	2.66
	Total carbohydrate (g)	120	22.12	6.07	24.00	9.80	42.00	20.37	22.75
	Total sugars (g)	155	16.58	6.12	18.00	2.10	29.20	15.61	17.96
	Free sugar (g)	155	16.58	6.12	18.00	2.10	29.20	15.61	17.96
	Total fat (g)	156	9.07	6.57	7.55	0.00	29.30	8.64	11.43
	Saturated fat (g)	153	6.00	4.75	4.40	0.00	20.70	5.46	7.45
	Fibre (g)	142	0.68	0.65	0.50	0.00	3.50	0.49	0.73
	Sodium (mg)	154	54.90	52.62	46.50	0.00	600.00	40.93	64.27
Meaty snacks	kJ/100g	71	1471.93	274.25	1414.00	860.00	1959.00	1324.65	1557.64
	Protein (g)	71	46.82	13.34	44.00	18.00	67.64	43.16	50.43
	Total carbohydrate (g)	35	2.64	1.62	2.50	0.00	6.00	2.09	3.20
	Total sugars (g)	71	0.90	1.11	0.80	0.00	5.60	0.44	1.31
	Free sugar (g)	71	0.90	1.11	0.80	0.00	5.60	0.44	1.31
	Total fat (g)	71	16.27	10.54	15.60	2.70	37.50	12.39	20.46
	Saturated fat (g)	71	7.37	5.06	6.70	1.02	18.30	5.53	9.50
	Fibre (g)	71	1.20	1.46	0.80	0.00	9.80	0.66	1.42
	Sodium (mg)	71	1897.45	361.47	1853.00	1261.00	3036.00	1741.02	1958.80

Table 4: Nutritional composition of snack categories, per 100g (continued)

		n	Mean	Standard Deviation	Median	Minimum	Maximum	95% Confidence Interval for Mean	
								Lower bound	Upper bound
Nuts, seeds, and fruit	kJ/100g	373	1873.20	665.58	2018.00	244.00	3200.00	1792.42	2000.63
	Protein (g)	375	11.87	8.82	11.70	0.10	36.00	10.56	13.08
	Total carbohydrate (g)	227	39.19	23.81	41.00	3.00	89.00	33.56	40.34
	Total sugars (g)	344	28.05	25.19	18.45	0.00	77.70	23.21	30.29
	Free sugar (g)	344	17.48	13.39	17.40	0.00	53.30	14.90	18.76
	Total fat (g)	373	27.06	23.98	28.50	0.00	76.10	25.10	32.27
	Saturated fat (g)	338	4.29	4.84	3.90	0.00	57.30	3.71	4.92
	Fibre (g)	361	8.47	5.60	7.70	0.30	59.30	7.34	9.04
	Sodium (mg)	356	92.22	160.35	22.50	0.00	1382.00	66.65	107.83
Savoury snacks	kJ/100g	206	1787.47	241.72	1762.50	786.00	2592.00	1731.76	1822.59
	Protein (g)	206	10.33	4.00	9.90	0.40	25.00	9.46	11.12
	Total carbohydrate (g)	109	65.20	14.97	68.00	3.00	87.00	62.21	68.22
	Total sugars (g)	202	3.61	3.41	2.80	0.00	21.80	3.17	4.71
	Free sugar (g)	202	3.61	3.41	2.80	0.00	21.80	3.17	4.71
	Total fat (g)	206	13.57	10.59	11.05	0.80	50.10	11.29	15.17
	Saturated fat (g)	205	5.41	5.61	3.50	0.00	24.30	3.94	6.06
	Fibre (g)	203	5.65	5.55	3.90	0.00	30.10	4.70	6.64
	Sodium (mg)	206	574.03	327.73	599.00	0.00	2680.00	500.29	639.11
Sweet snacks	kJ/100g	968	1821.92	392.97	1830.50	71.00	2606.00	1841.70	1901.90
	Protein (g)	965	5.44	4.35	5.20	0.00	33.00	5.35	6.02
	Total carbohydrate (g)	743	62.61	17.31	61.00	0.00	100.00	61.20	63.82
	Total sugars (g)	958	50.04	18.72	52.00	0.00	96.10	46.74	49.44
	Free sugar (g)	958	50.04	18.72	52.00	0.00	96.10	46.74	49.44
	Total fat (g)	966	16.96	14.04	16.15	0.00	52.40	18.06	20.16
	Saturated fat (g)	952	9.51	8.17	8.80	0.00	39.00	9.95	11.17
	Fibre (g)	900	2.51	3.70	1.59	0.00	34.50	2.56	3.16
	Sodium (mg)	964	95.31	97.58	70.00	0.00	840.00	89.42	104.07

Table 4: Nutritional composition of snack categories, per 100g (continued)

		n	Mean	Standard Deviation	Median	Minimum	Maximum	95% Confidence Interval for Mean	
								Lower bound	Upper bound
Yoghurt	kJ/100g	429	341.55	89.08	343.00	160.00	695.00	329.95	354.78
	Protein (g)	429	2.82	0.86	2.80	0.20	7.20	2.96	3.18
	Total carbohydrate (g)	241	11.17	3.74	12.00	3.00	23.00	10.71	11.67
	Total sugars (g)	427	8.64	3.27	9.10	0.50	20.90	7.88	8.73
	Free sugar (g)	427	4.36	1.67	4.55	0.25	11.00	3.99	4.43
	Total fat (g)	428	2.80	1.97	2.10	0.10	13.70	2.62	3.14
	Saturated fat (g)	425	1.87	1.50	1.30	0.00	13.00	1.77	2.15
	Fibre (g)	425	0.49	0.43	0.50	0.00	2.70	0.54	0.65
	Sodium (mg)	425	41.87	13.62	42.00	9.00	124.00	43.84	47.07

* South African Nutrient Profiling Model criteria (Frank et al., 2021): Solids: total sugar: 10g/100g; saturated fat: 4g/100g; sodium: 400mg/100g. Liquids: total sugar: 5g/100ml, saturated fat: 3g/100ml, sodium: 100mg/100ml.
* Beverages = per 100 ml.
* Orange = values above cut-points.
* Green = values below cut-points.

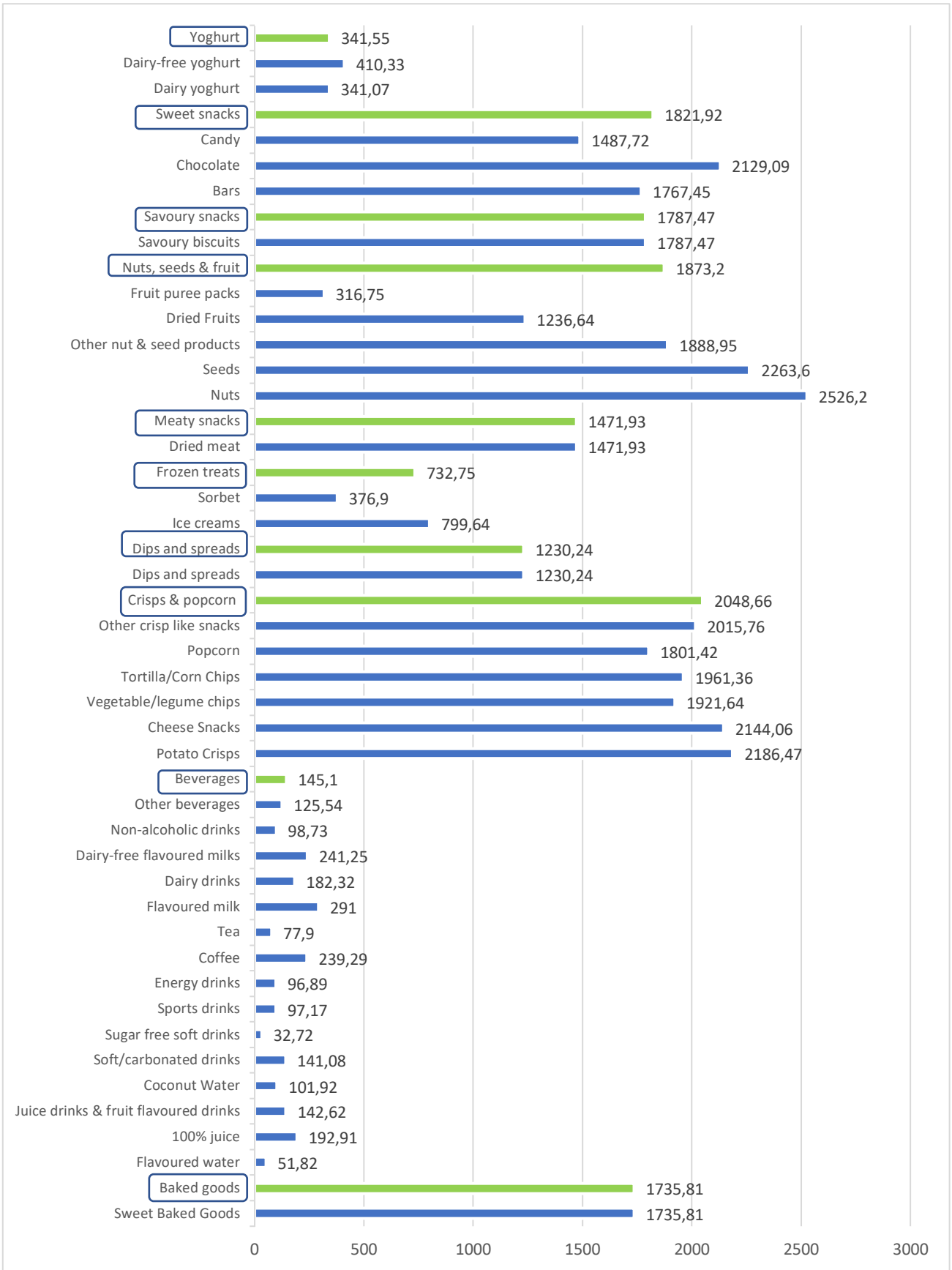

Figure 5: Mean energy (kJ) per snack category and sub-category, per 100g
* Green = categories.
* Blue = sub-categories.

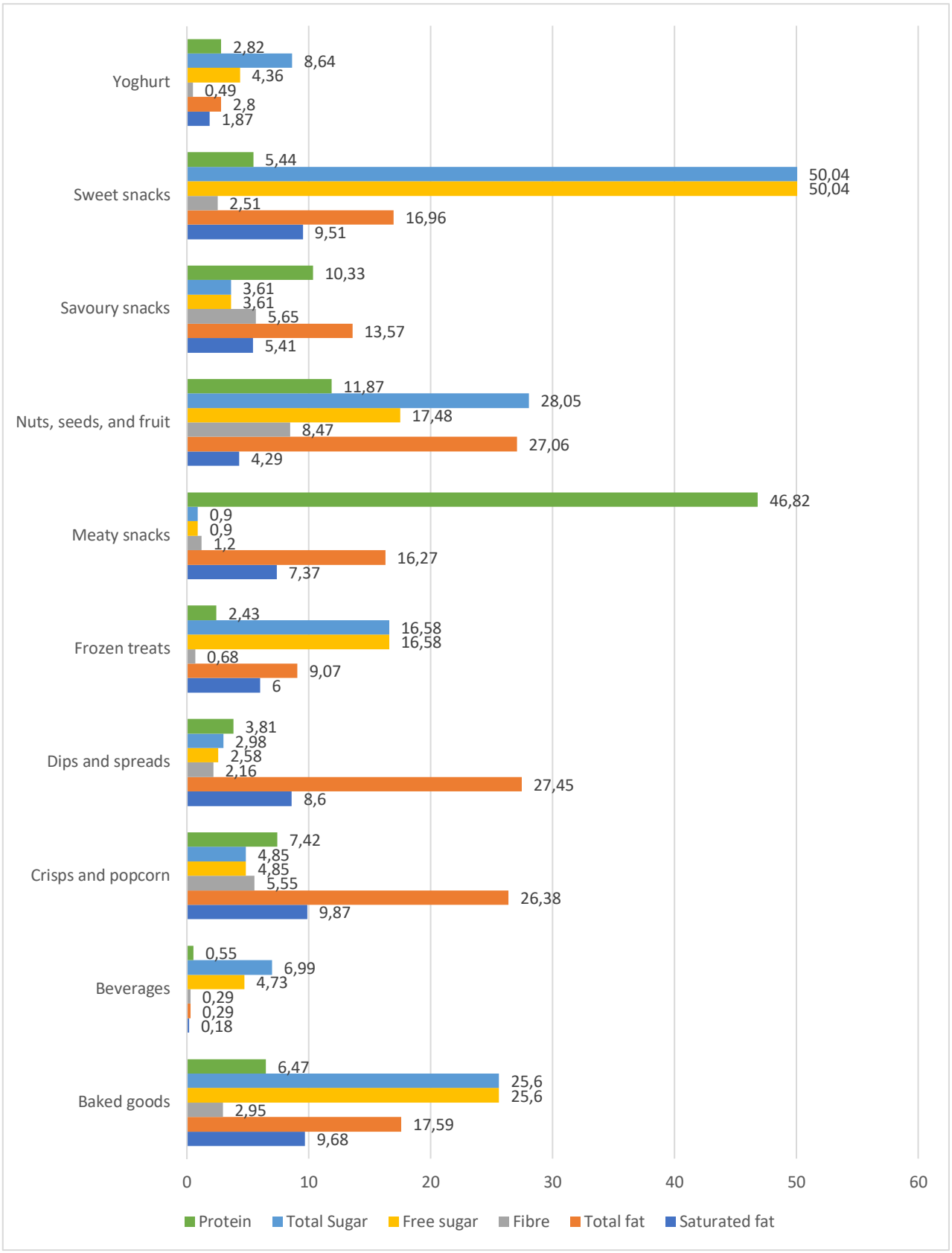

Figure 6: Mean grams of protein, sugars, fats and fibre per snack category, per 100g

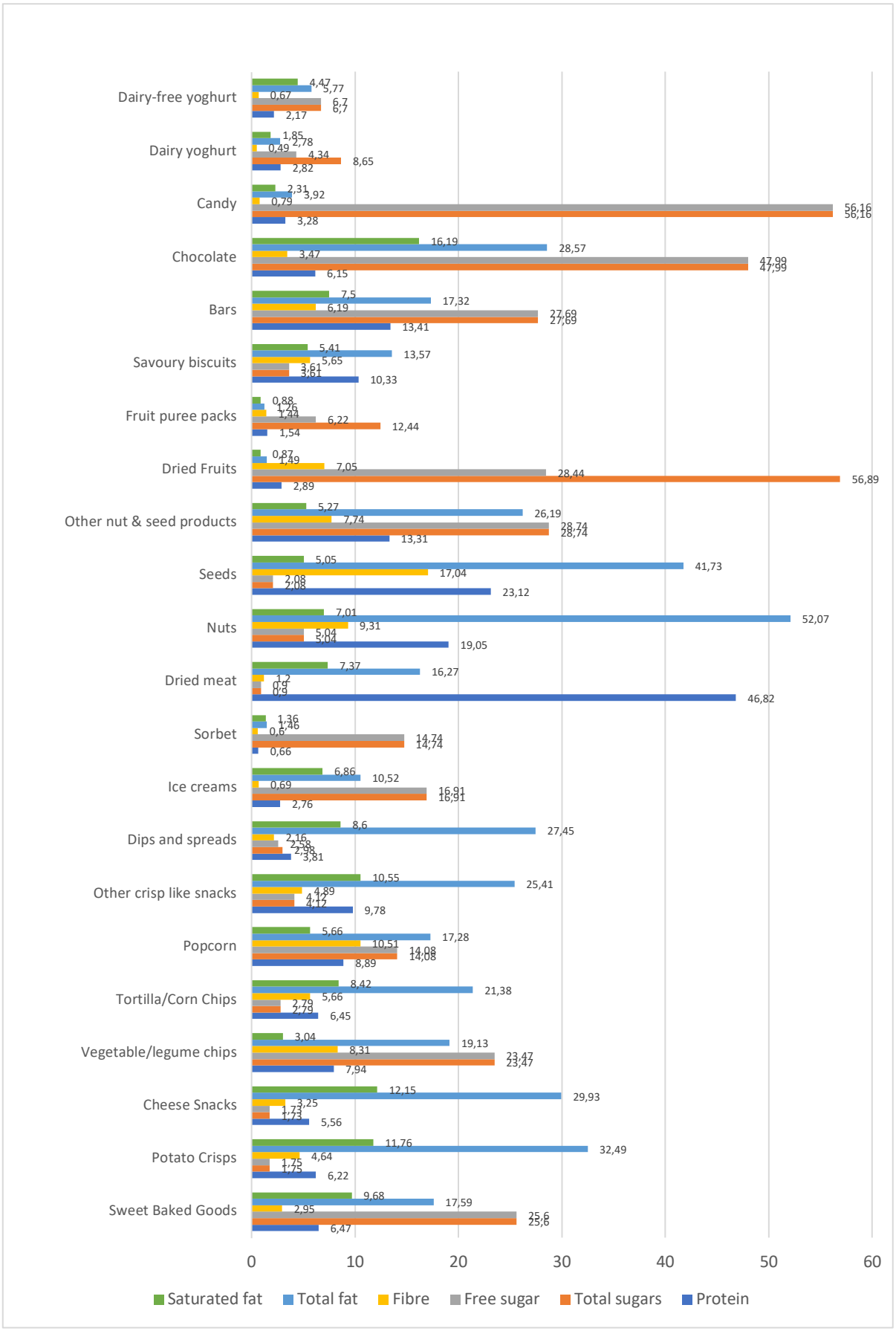

Figure 7: Mean grams of protein, sugars, fats, and fibre per snack sub-category, per 100g

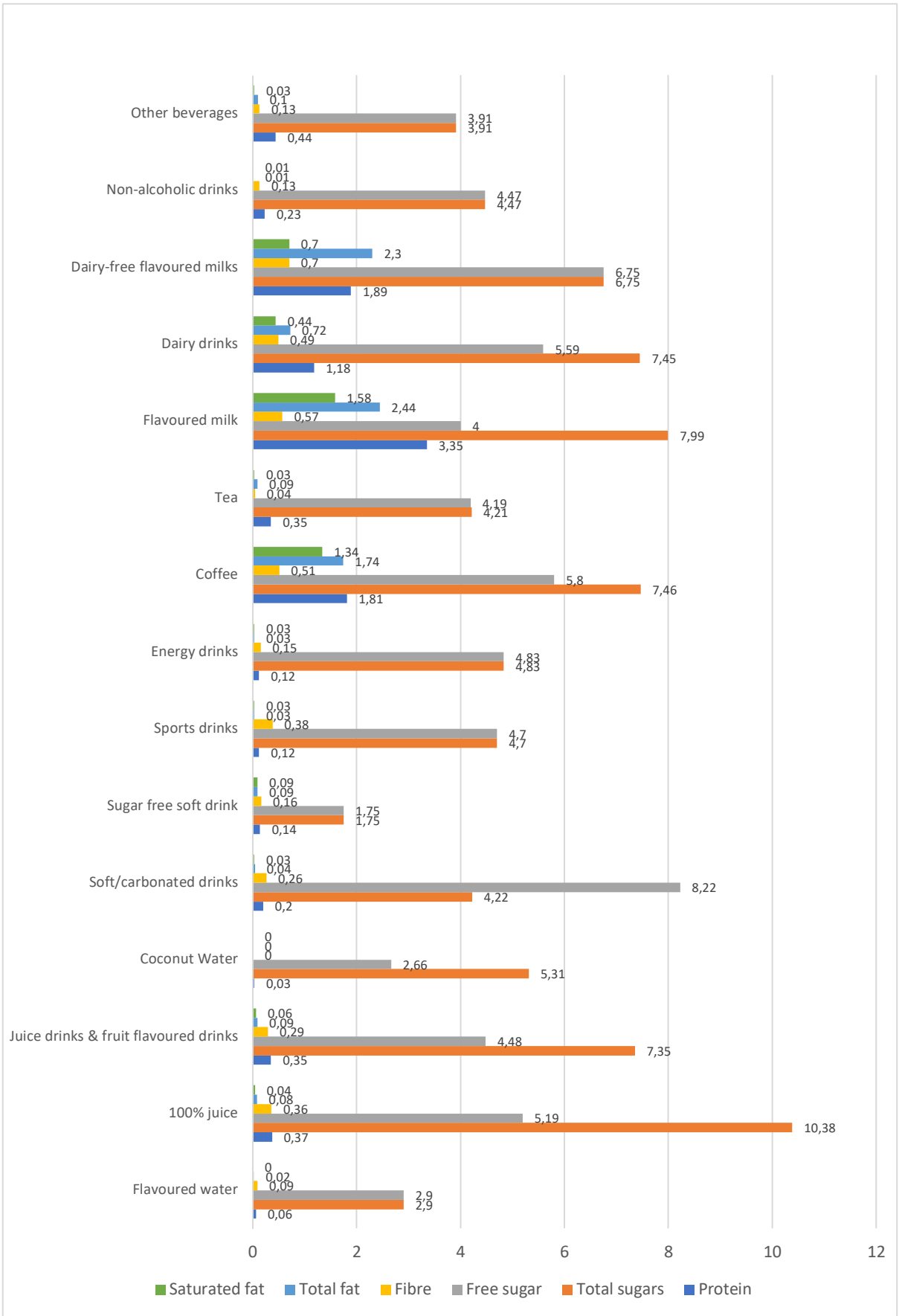

Figure 7 continued: Mean grams of protein, sugars, fats, and fibre per snack sub-category, per 100g

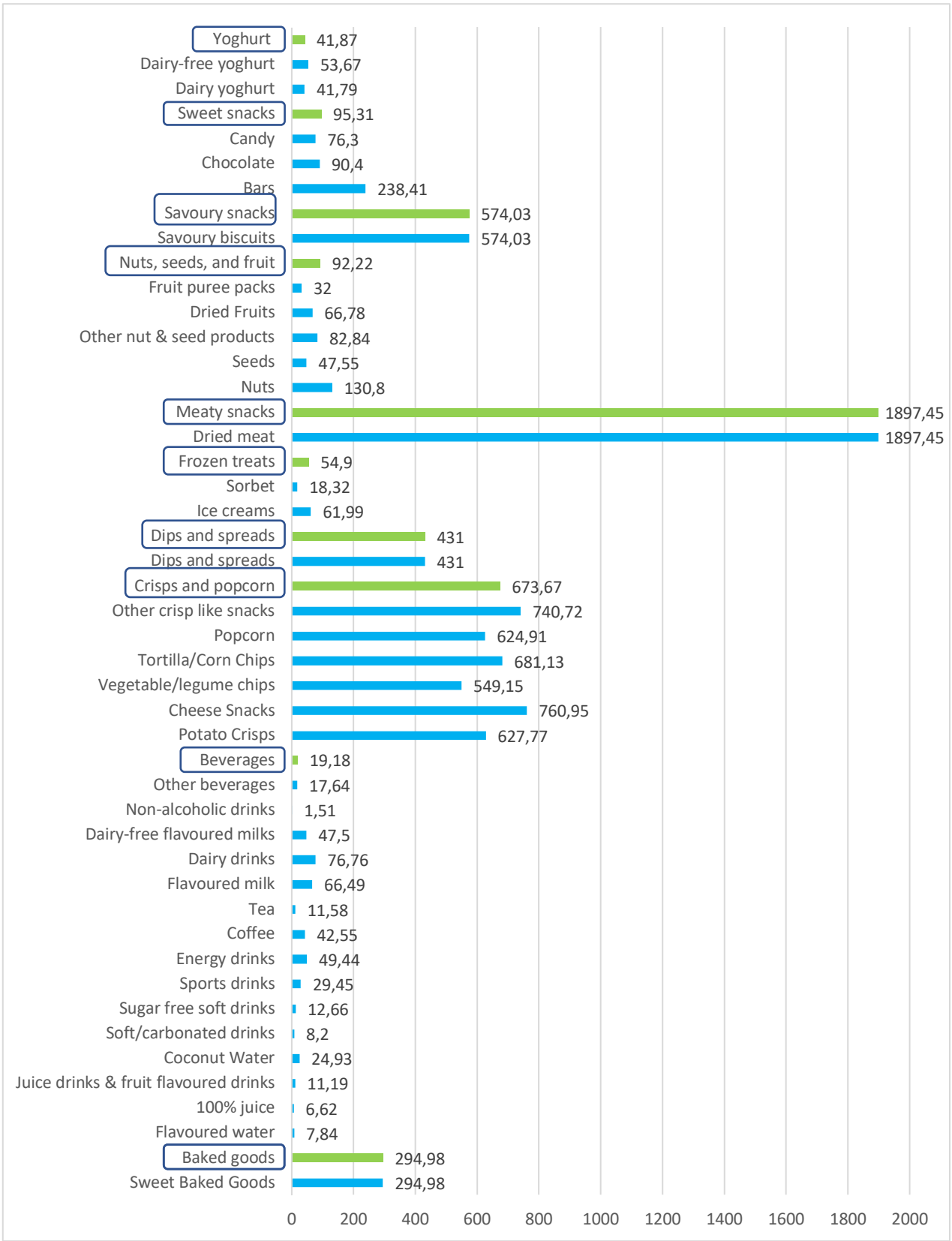

Figure 8: Mean sodium (mg) per snack category and sub-category, per 100g
* Green = categories.
* Blue = sub-categories.

Table 5: Nutritional composition of snack sub-categories, per 100g

		n	Mean	Standard Deviation	Median	Minimum	Maximum	95% Confidence Interval for Mean	
								Lower bound	Upper bound
Sweet baked goods	kJ/100g	555	1735.81	432.36	1889.00	213.00	2487.00	1653.79	1751.59
	Protein (g)	554	6.47	3.14	6.10	0.00	48.00	6.10	6.87
	Total carbohydrate (g)	323	55.40	16.06	60.00	6.10	84.00	53.18	56.80
	Total sugars (g)	547	25.60	11.16	25.30	0.00	61.00	23.29	25.73
	Free sugar (g)	547	25.60	11.16	25.30	0.00	61.00	23.29	25.73
	Total fat (g)	555	17.59	8.12	17.60	0.00	58.10	16.46	18.19
	Saturated fat (g)	546	9.68	6.23	9.30	0.00	42.50	8,61	9.92
	Fibre (g)	539	2.95	2.87	2.30	0.00	37.78	2.96	3.73
	Sodium (mg)	549	294.98	178.10	278.00	0.12	1240.00	269.92	309.55
Flavoured water	kJ/100g	44	51.82	39.04	65.50	0.00	111.00	0.00	0.00
	Protein (g)	45	0.06	0.084	0.00	0.00	0.30	0.04	0.09
	Total carbohydrate (g)	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total sugars (g)	44	2.90	2.08	3.90	0.00	6.00	2.27	3.53
	Free sugar (g)	44	2.90	2.08	3.90	0.00	6.00	2.41	3.67
	Total fat (g)	45	0.02	0.04	0.00	0.00	0.10	0.01	0.03
	Saturated fat (g)	45	0.00	0.02	0.00	0.00	0.10	0.00	0.01
	Fibre (g)	42	0.09	0.27	0.00	0.00	1.00	0.01	0.17
	Sodium (mg)	45	7.84	4.47	7.00	0.00	19.00	6.70	9.35
100% fruit juice	kJ/100g	327	192.91	35.81	193.00	73.00	308.00	173.06	187.21
	Protein (g)	327	0.37	0.43	0.20	0.00	2.70	0.53	0.72
	Total carbohydrate (g)	95	9.81	2.14	10.00	2.00	15.00	9.36	10.24
	Total sugars (g)	327	10.38	2.13	10.50	0.00	15.20	8.97	9.79
	Free sugar (g)	327	5.19	1.06	5.25	0.00	7.60	4.48	4.90
	Total fat (g)	327	0.08	0.16	0.00	0.00	1.70	0.06	0.15
	Saturated fat (g)	327	0.04	0.12	0.00	0.00	1.00	0.02	0.05
	Fibre (g)	327	0.36	0.54	0.10	0.00	2.90	0.17	0.34
	Sodium (mg)	327	6.62	9.82	4.00	0.00	75.00	4.90	10.42

Table 5: Nutritional composition of snack sub-categories, per 100g (continued)

		n	Mean	Standard Deviation	Median	Minimum	Maximum	95% Confidence Interval for Mean	
								Lower bound	Upper bound
Juice drinks & fruit flavoured drinks	kJ/100g	145	142.62	56.68	136.00	51.00	318.00	151.07	182.04
	Protein (g)	144	0.35	0.49	0.20	0.00	3.10	0.35	0.69
	Total carbohydrate (g)	55	9.16	2.94	9.00	3.00	18.57	8.07	9.53
	Total sugars (g)	144	7.35	2.87	6.50	1.00	14.60	7.33	8.77
	Free sugar (g)	144	4.48	2.23	3.70	0.50	13.40	3.97	5.25
	Total fat (g)	145	0.09	0.27	0.10	0.00	3.00	0.04	0.30
	Saturated fat (g)	143	0.06	0.26	0.00	0.00	2.80	0.02	0.26
	Fibre (g)	142	0.29	0.42	0.00	0.00	2.20	0.24	0.51
	Sodium (mg)	144	11.19	23.00	6.00	0.00	240.00	6.38	11.24
Coconut water	kJ/100g	3	101.92	14.22	100.00	88.75	117.00	66.59	137.35
	Protein (g)	3	0.03	0.06	0.00	0.00	0.10	-0.11	0.18
	Total carbohydrate (g)	3	5.95	1.08	6.00	4.85	7.00	3.27	8.62
	Total sugars (g)	3	5.31	1.78	5.80	3.33	6.80	0.88	9.74
	Free sugar (g)	3	2.66	0.89	2.90	1.67	3.40	0.44	4.87
	Total fat (g)	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Saturated fat (g)	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fibre (g)	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sodium (mg)	3	24.93	3.89	25.00	21.00	28.79	15.26	34.6
Soft/carbonated drinks	kJ/100g	104	141.08	53.96	138.50	24.00	414.00	118.16	146.16
	Protein (g)	101	0.20	0.44	0.00	0.00	2.70	0.15	0.25
	Total carbohydrate (g)	63	8.25	2.58	8.00	4.00	13.00	7.14	8.73
	Total sugars (g)	103	8.22	2.71	7.80	4.10	15.20	7.05	8.64
	Free sugar (g)	103	8.22	2.71	7.80	4.10	15.20	7.05	8.64
	Total fat (g)	103	0.04	0.07	0.00	0.00	0.50	0.03	0.06
	Saturated fat (g)	103	0.03	0.07	0.00	0.00	0.50	0.02	0.06
	Fibre (g)	81	0.26	0.32	0.10	0.00	1.00	0.26	0.48

Sodium (mg)	104	8.21	12.46	6.00	0.00	108.00	5.37	8.41

Table 5: Nutritional composition of snack sub-categories, per 100g (continued)

		n	Mean	Standard Deviation	Median	Minimum	Maximum	95% Confidence Interval for Mean	
								Lower bound	Upper bound
SF/diet carb drinks	kJ/100g	109	32.72	32.27	12.00	0.00	93.00	8.94	32.06
	Protein (g)	111	0.14	0.18	0.00	0.00	0.70	0.17	0.27
	Total carbohydrate (g)	41	1.40	1.56	1.00	0.00	5.10	1.17	2.37
	Total sugars (g)	111	1.75	1.72	0.50	0.00	4.00	0.56	1.62
	Free sugar (g)	111	1.75	1.72	0.50	0.00	4.00	0.56	1.62
	Total fat (g)	111	0.09	0.18	0.00	0.00	0.60	0.05	0.09
	Saturated fat (g)	106	0.09	0.18	0.00	0.00	0.60	0.03	0.07
	Fibre (g)	105	0.16	0.23	0.00	0.00	1.00	0.21	0.40
	Sodium (mg)	111	12.66	11.39	11.00	0.00	48.00	5.73	9.51
Sports drinks	kJ/100g	34	97.17	36.66	94.50	5.00	144.20	76.32	87.01
	Protein (g)	34	0.12	0.14	0.07	0.00	0.50	0.18	0.30
	Total carbohydrate (g)	22	4.40	1.73	5.00	0.00	6.10	4.47	5.20
	Total sugars (g)	34	4.70	2.06	4.35	0.00	8.34	3.54	4.37
	Free sugar (g)	34	4.70	2.06	4.35	0.00	8.34	3.54	4.37
	Total fat (g)	34	0.03	0.04	0.00	0.00	0.10	0.05	0.10
	Saturated fat (g)	34	0.03	0.04	0.00	0.00	0.10	0.05	0.10
	Fibre (g)	24	0.38	0.49	0.00	0.00	1.00	0.46	1.04
	Sodium (mg)	34	29.45	12.91	31.00	0.00	56.00	30.93	32.40
Energy drinks	kJ/100g	49	96.89	91.00	82.00	3.00	528.00	8.76	181.90
	Protein (g)	47	0.12	0.20	0.00	0.00	0.50	0.00	0.00
	Total carbohydrate (g)	17	5.03	4.55	4.00	0.00	12.20	-0.23	10.23
	Total sugars (g)	50	4.83	3.98	4.25	0.00	14.80	-0.22	9.95
	Free sugar (g)	50	4.83	3.98	4.25	0.00	14.80	-0.22	9.95
	Total fat (g)	49	0.03	0.06	0.00	0.00	0.30	0.00	0.00
	Saturated fat (g)	45	0.03	0.06	0.00	0.00	0.30	0.00	0.00
	Fibre (g)	39	0.15	0.24	0.00	0.00	1.00	0.00	0.00
	Sodium (mg)	50	49.44	29.82	56.50	0.00	100.00	39.29	50.71

Table 5: Nutritional composition of snack sub-categories, per 100g (continued)

		n	Mean	Standard Deviation	Median	Minimum	Maximum	95% Confidence Interval for Mean	
								Lower bound	Upper bound
Coffee	kJ/100g	15	239.29	72.84	256.00	102.00	337.00	191.53	357.59
	Protein (g)	15	1.81	1.30	1.60	0.10	4.40	0.15	2.99
	Total carbohydrate (g)	12	8.23	1.58	7.80	6.00	11.00	6.68	10.19
	Total sugars (g)	13	7.46	2.06	7.20	4.30	11.30	5.02	9.18
	Free sugar (g)	13	5.80	1.39	5.63	3.23	8.48	4.10	7.03
	Total fat (g)	15	1.74	1.48	1.500	0.00	5.40	1.19	4.64
	Saturated fat (g)	12	1.34	1.01	1.10	0.00	3.60	0.88	3.06
	Fibre (g)	9	0.51	0.47	0.50	0.00	1.20	0.41	1.12
	Sodium (mg)	11	42.55	22.57	43.00	1.00	88.00	11.83	48.51
Tea	kJ/100g	107	77.90	34.11	74.00	1.00	168.00	64.23	82.13
	Protein (g)	107	0.35	0.39	0.30	0.00	1.60	0.31	0.49
	Total carbohydrate (g)	64	4.27	2.03	4.30	0.50	9.00	3.60	4.55
	Total sugars (g)	107	4.21	1.96	4.00	0.00	9.40	3.37	4.32
	Free sugar (g)	107	4.19	1.96	4.00	0.00	9.40	3.35	4.30
	Total fat (g)	107	0.09	0.17	0.00	0.00	0.50	0.10	0.21
	Saturated fat (g)	107	0.03	0.09	0.00	0.00	0.40	0.02	0.08
	Fibre (g)	97	0.04	0.12	0.00	0.00	0.50	0.02	0.08
	Sodium (mg)	107	11.58	16.88	8.00	0.00	156.00	5.98	16.43
Flavoured milk	kJ/100g	68	291.01	58.85	281.00	129.00	418.00	246.71	314.40
	Protein (g)	68	3.35	0.87	3.20	2.80	8.60	3.00	4.50
	Total carbohydrate (g)	19	8.84	3.48	8.00	4.00	16.00	7.16	10.52
	Total sugars (g)	67	7.99	2.38	8.50	2.50	12.20	6.24	8.30
	Free sugar (g)	67	4.00	1.19	4.25	1.25	6.10	3.12	4.15
	Total fat (g)	68	2.44	0.97	2.05	0.10	3.50	1.50	2.57
	Saturated fat (g)	68	1.58	0.65	1.20	0.10	2.700	1.05	1.70
	Fibre (g)	68	0.57	0.47	0.50	0.00	1.700	0.37	0.70
	Sodium (mg)	68	66.49	70.12	61.00	3.00	616.00	53.67	73.60

Table 5: Nutritional composition of snack sub-categories, per 100g (continued)

		n	Mean	Standard Deviation	Median	Minimum	Maximum	95% Confidence Interval for Mean	
								Lower bound	Upper bound
Dairy drinks	kJ/100g	56	182.32	99.49	151.00	7.00	436.00	181.81	298.56
	Protein (g)	56	1.18	1.47	0.40	0.20	6.10	0.77	2.51
	Total carbohydrate (g)	17	9.82	1.46	9.00	7.00	13.00	9.00	10.61
	Total sugars (g)	56	7.45	2.32	7.75	0.50	11.90	8.08	9.67
	Free sugar (g)	56	5.59	1.74	5.81	0.38	8.93	6.06	7.25
	Total fat (g)	56	0.72	1.32	0.10	0.00	4.90	0.56	2.65
	Saturated fat (g)	55	0.44	0.96	0.10	0.00	3.80	0.35	1.89
	Fibre (g)	54	0.49	0.50	0.50	0.00	2.00	0.56	1.02
	Sodium (mg)	56	76.76	160.59	36.00	10.00	797.00	26.56	53.35
Dairy-free flavoured milk	kJ/100g	8	241.25	99.10	294.00	69.00	323.00	-44.41	479.74
	Protein (g)	8	1.89	1.201	2.20	0.40	3.00	-1.51	4.71
	Total carbohydrate (g)	3	7.33	6.51	7.00	1.00	14.00	-8.83	23.50
	Total sugars (g)	8	6.75	4.88	8.90	1.00	12.90	-11.79	21.92
	Free sugar (g)	8	6.75	4.88	8.90	1.00	12.90	-11.79	21.92
	Total fat (g)	8	2.30	0.75	2.35	1.30	3.80	0.59	3.14
	Saturated fat (g)	8	0.70	0.74	0.40	0.10	2.10	-1.32	3.85
	Fibre (g)	8	0.70	0.67	0.75	0.00	1.70	-0.35	2.75
	Sodium (mg)	8	47.50	20.16	57.50	21.00	65.00	1.74	103.60
Non alcoholic	kJ/100g	18	98.73	33.80	107.00	29.00	130.00	74.63	113.27
	Protein (g)	18	0.23	0.22	0.23	0.00	0.70	0.13	0.39
	Total carbohydrate (g)	18	5.66	2.56	5.70	0.00	8.30	3.86	6.75
	Total sugars (g)	18	4.47	3.03	3.10	0.00	8.00	2.45	5.78
	Free sugar (g)	18	4.47	3.03	3.10	0.00	8.00	2.45	5.78
	Total fat (g)	18	0.01	0.03	0.00	0.00	0.10	-0.01	0.03
	Saturated fat (g)	18	0.01	0.03	0.00	0.00	0.10	-0.01	0.03
	Fibre (g)	15	0.13	0.30	0.00	0.00	1.00	-0.03	0.30
	Sodium (mg)	18	1.51	1.09	2.00	0.00	4.00	1.09	1.99

Table 5: Nutritional composition of snack sub-categories, per 100g (continued)

		n	Mean	Standard Deviation	Median	Minimum	Maximum	95% Confidence Interval for Mean	
								Lower bound	Upper bound
Other beverages	kJ/100g	28	125.54	29.13	132.00	50.00	163.00	97.06	168.08
	Protein (g)	28	0.44	0.36	0.50	0.00	0.90	0.00	0.00
	Total carbohydrate (g)	8	7.84	2.06	8.20	3.000	9.40	5.77	9.89
	Total sugars (g)	28	3.91	2.81	3.15	0.00	9.10	5.68	9.72
	Free sugar (g)	28	3.91	2.81	3.15	0.00	9.10	5.68	9.72
	Total fat (g)	27	0.10	0.09	0.10	0.00	0.20	0.00	0.00
	Saturated fat (g)	28	0.03	0.05	0.00	0.00	0.10	0.00	0.00
	Fibre (g)	27	0.13	0.13	0.10	0.00	0.40	-0.04	0.10
	Sodium (mg)	28	17.64	9.93	19.50	0.00	29.00	18.08	23.07
Potato chips	kJ/100g	112	2186.47	141.95	2215.00	1625.00	2450.00	2158.11	2216.78
	Protein (g)	112	6.22	1.41	6.30	1.80	9.10	6.08	6.70
	Total carbohydrate (g)	91	50.36	7.39	48.00	37.00	77.00	48.77	51.86
	Total sugars (g)	111	1.75	1.53	1.20	0.00	7.40	1.52	2.20
	Free sugar (g)	111	1.75	1.53	1.20	0.00	7.40	1.52	2.20
	Total fat (g)	112	32.49	6.47	33.90	5.10	43.00	31.25	34.06
	Saturated fat (g)	110	11.76	4.26	13.30	0.60	18.40	10.63	12.57
	Fibre (g)	111	4.64	1.76	4.80	0.10	11.33	4.36	5.02
	Sodium (mg)	111	627.77	353.49	568.00	135.00	3382.00	564.12	670.76
Cheese snacks	kJ/100g	31	2144.06	161.76	2140.00	1764.0	2680.0	2059.28	2230.58
	Protein (g)	31	5.56	1.06	5.40	3.70	8.90	5.04	6.53
	Total carbohydrate (g)	14	56.66	6.12	56.00	50.00	74.00	53.12	60.19
	Total sugars (g)	26	1.73	1.63	1.15	0.00	5.70	0.36	2.09
	Free sugar (g)	26	1.73	1.63	1.15	0.00	5.70	0.36	2.09
	Total fat (g)	31	29.93	7.16	29.00	8.70	48.60	25.22	33.12
	Saturated fat (g)	31	12.15	4.32	12.70	1.10	22.24	8.12	13.00
	Fibre (g)	31	3.25	1.65	2.90	1.20	8.30	2.23	3.20
	Sodium (mg)	31	760.95	292.36	699.00	291.00	2011.00	634.02	1101.55

Table 5: Nutritional composition of snack sub-categories, per 100g (continued)

		n	Mean	Standard Deviation	Median	Minimum	Maximum	95% Confidence Interval for Mean	
								Lower bound	Upper bound
Veg/legume chips	kJ/100g	15	1921.64	115.06	1926.00	1717.00	2103.00	1836.25	1996.34
	Protein (g)	15	7.95	3.40	6.68	3.42	15.10	5.21	8.52
	Total carbohydrate (g)	12	61.81	6.08	60.55	55.60	77.32	57.95	65.68
	Total sugars (g)	15	23.47	19.53	33.05	0.60	46.99	17.48	40.35
	Free sugar (g)	15	23.47	19.53	33.05	0.60	46.99	17.48	40.35
	Total fat (g)	15	19.13	4.37	19.50	12.40	25.80	15.52	20.74
	Saturated fat (g)	15	3.04	3.31	1.80	0.47	11.70	1.46	2.22
	Fibre (g)	15	8.31	3.69	7.80	3.20	16.67	6.79	11.31
	Sodium (mg)	15	549.15	432.33	340.00	62.98	1159.00	181.22	627.32
Tortilla/corn chips	kJ/100g	56	1961.36	189.88	1996.00	1497.0	2282.0	1882.64	1996.61
	Protein (g)	56	6.45	1.61	6.05	3.57	10.70	6.11	7.38
	Total carbohydrate (g)	34	61.91	7.97	59.00	49.50	79.20	58.81	64.40
	Total sugars (g)	55	2.79	1.99	2.90	0.00	10.71	1.92	3.54
	Free sugar (g)	55	2.79	1.99	2.90	0.00	10.71	1.92	3.54
	Total fat (g)	56	21.38	8.29	23.60	3.40	35.20	17.21	22.73
	Saturated fat (g)	56	8.42	4.97	9.80	0.00	16.00	5.66	9.03
	Fibre (g)	56	5.66	2.84	5.40	0.00	10.90	4.75	6.99
	Sodium (mg)	56	681.13	207.53	678.00	225.00	1220.00	649.18	819.68
Popcorn	kJ/100g	36	1801.42	180.11	1799.50	1500.00	2225.00	1743.62	2024.57
	Protein (g)	36	8.89	3.83	8.50	2.40	13.70	4.81	10.93
	Total carbohydrate (g)	13	59.86	19.69	46.40	39.00	87.60	44.55	73.29
	Total sugars (g)	34	14.08	22.73	2.60	0.00	67.00	3.77	39.79
	Free sugar (g)	34	14.08	22.73	2.60	0.00	67.00	3.77	39.79
	Total fat (g)	36	17.28	9.42	18.75	2.60	33.90	11.68	26.94
	Saturated fat (g)	34	5.66	4.39	2.90	0.50	15.70	1.42	6.78
	Fibre (g)	34	10.51	5.14	12.40	1.60	19.90	4.47	10.93
	Sodium (mg)	34	624.91	280.30	717.00	31.00	1020.00	338.29	767.71

Table 5: Nutritional composition of snack sub-categories, per 100g (continued)

		n	Mean	Standard Deviation	Median	Minimum	Maximum	95% Confidence Interval for Mean	
								Lower bound	Upper bound
Other crisp like snacks	kJ/100g	82	2015.76	302.41	2008.00	1200.0	2998.0	2039.54	2286.70
	Protein (g)	79	9.78	9.98	6.70	1.60	58.72	7.51	18.72
	Total carbohydrate (g)	47	48.04	23.17	55.00	1.00	81.00	37.83	56.44
	Total sugars (g)	75	4.12	5.32	2.70	0.00	30.50	2.32	6.07
	Free sugar (g)	75	4.12	5.32	2.70	0.00	30.50	2.32	6.07
	Total fat (g)	79	25.41	11.45	23.80	2.70	67.70	24.72	35.95
	Saturated fat (g)	70	10.55	9.99	9.60	0.02	63.80	8.80	19.11
	Fibre (g)	67	4.89	5.19	3.10	0.00	29.00	2.75	6.29
	Sodium (mg)	82	740.72	425.18	621.50	29.00	2200.00	611.85	966.64
Dips and spreads	kJ/100g	42	1230.24	567.69	1079.50	290.00	2277.00	919.25	1151.41
	Protein (g)	42	3.81	2.31	3.10	0.10	9.00	2.30	5.19
	Total carbohydrate (g)	18	8.96	4.19	10.00	2.00	18.00	6.88	11.04
	Total sugars (g)	42	2.98	2.73	2.30	0.00	12.50	0.92	2.96
	Free sugar (g)	42	2.58	2.20	2.30	0.00	9.38	0.83	2.84
	Total fat (g)	42	27.45	16.03	25.10	1.00	56.50	17.59	25.20
	Saturated fat (g)	42	8.60	7.12	7.60	1.00	20.40	2.27	8.26
	Fibre (g)	42	2.16	2.55	0.65	0.10	7.50	1.77	4.71
	Sodium (mg)	42	431.00	186.48	398.00	94.00	679.00	343.77	503.79
Ice creams	kJ/100g	133	799.64	311.80	779.00	286.00	1704.00	760.13	905.41
	Protein (g)	131	2.76	2.37	2.40	0.60	15.50	2.16	2.94
	Total carbohydrate (g)	106	22.39	6.14	24.40	9.80	42.00	20.47	23.05
	Total sugars (g)	131	16.91	6.11	18.30	2.10	29.20	15.79	18.22
	Free sugar (g)	131	16.91	6.11	18.30	2.10	29.20	15.79	18.22
	Total fat (g)	131	10.52	6.11	9.00	1.00	29.30	9.99	12.75
	Saturated fat (g)	129	6.86	4.61	6.10	0.10	20.70	6.27	8.31
	Fibre (g)	118	0.69	0.70	0.50	0.00	3.50	0.50	0.76
	Sodium (mg)	129	61.99	54.27	49.50	13.00	600.00	46.05	71.69

Table 5: Nutritional composition of snack sub-categories, per 100g (continued)

		n	Mean	Standard Deviation	Median	Minimum	Maximum	95% Confidence Interval for Mean	
								Lower bound	Upper bound
Sorbets	kJ/100g	25	376.90	132.47	392.00	194.0	668.00	302.50	437.42
	Protein (g)	25	0.66	0.68	0.50	0.00	3.00	-0.02	0.96
	Total carbohydrate (g)	14	20.09	5.30	21.50	11.00	31.20	16.80	23.47
	Total sugars (g)	24	14.74	6.01	15.95	4.30	27.80	10.79	19.69
	Free sugar (g)	24	14.74	6.01	15.95	4.30	27.80	10.79	19.69
	Total fat (g)	25	1.46	2.16	0.12	0.00	7.90	-0.18	1.29
	Saturated fat (g)	24	1.36	1.97	0.05	0.00	7.00	-0.17	1.15
	Fibre (g)	24	0.60	0.37	0.50	0.00	1.00	0.23	0.74
	Sodium (mg)	25	18.32	16.70	12.00	0.00	49.00	4.85	11.72
Dried meat	kJ/100g	71	1471.93	274.25	1414.00	860.00	1959.00	1324.65	1557.64
	Protein (g)	71	46.82	13.34	44.00	18.00	67.64	43.16	50.43
	Total carbohydrate (g)	35	2.64	1.62	2.50	0.00	6.00	2.09	3.20
	Total sugars (g)	71	0.90	1.11	0.80	0.00	5.60	0.44	1.31
	Free sugar (g)	71	0.90	1.11	0.80	0.00	5.60	0.44	1.31
	Total fat (g)	71	16.27	10.54	15.60	2.70	37.50	12.39	20.46
	Saturated fat (g)	71	7.37	5.06	6.70	1.02	18.30	5.53	9.50
	Fibre (g)	71	1.20	1.46	0.80	0.00	9.80	0.66	1.42
	Sodium (mg)	71	1897.45	361.47	1853.00	1261.00	3036.00	1741.02	1958.80
Nuts	kJ/100g	139	2526.20	227.21	2494.20	1914.0	3200.00	2512.05	2614.70
	Protein (g)	139	19.05	5.38	20.40	7.60	29.00	17.73	20.16
	Total carbohydrate (g)	84	16.36	6.35	14.00	5.00	31.00	14.95	17.75
	Total sugars (g)	134	5.04	2.23	4.70	0.00	17.40	4.47	5.31
	Free sugar (g)	134	5.04	2.23	4.70	0.00	17.40	4.47	5.31
	Total fat (g)	139	52.07	9.59	50.40	18.30	76.10	51.27	55.47
	Saturated fat (g)	138	7.01	2.88	6.40	1.00	16.10	6.52	7.92
	Fibre (g)	139	9.31	4.42	8.80	2.00	25.80	8.57	10.21
	Sodium (mg)	137	130.80	189.41	25.00	0.00	749.00	74.45	154.72

Table 5: Nutritional composition of snack sub-categories, per 100g (continued)

		n	Mean	Standard Deviation	Median	Minimum	Maximum	95% Confidence Interval for Mean	
								Lower bound	Upper bound
Seeds	kJ/100g	20	2263.60	301.85	2286.50	1534.00	3014.00	1795.96	2523.71
	Protein (g)	20	23.12	6.60	20.90	13.60	36.00	14.51	30.55
	Total carbohydrate (g)	8	21.54	12.07	20.00	3.00	42.00	6.59	36.34
	Total sugars (g)	18	2.08	1.78	1.85	0.00	7.70	0.56	2.81
	Free sugar (g)	18	2.08	1.78	1.85	0.00	7.70	0.56	2.81
	Total fat (g)	20	41.73	12.37	44.70	12.00	61.20	22.45	54.98
	Saturated fat (g)	17	5.05	2.22	4.50	1.40	9.00	2.05	7.35
	Fibre (g)	20	17.04	13.91	10.95	6.00	59.30	-1.99	43.55
	Sodium (mg)	20	47.55	106.16	13.00	0.00	466.00	5.63	18.04
Other nuts and seeds	kJ/100g	69	1888.95	391.94	2004.00	815.0	2523.0	1952.33	2123.63
	Protein (g)	70	13.31	5.15	12.68	3.70	25.60	11.44	15.03
	Total carbohydrate (g)	43	42.43	13.25	46.00	15.00	67.10	37.83	46.17
	Total sugars (g)	58	28.74	11.31	27.60	1.80	53.30	25.81	34.39
	Free sugar (g)	58	28.74	11.31	27.60	1.80	53.30	25.81	34.39
	Total fat (g)	69	26.19	10.12	25.70	7.40	48.10	26.00	32.39
	Saturated fat (g)	54	5.27	2.25	5.30	0.90	11.50	4.82	6.52
	Fibre (g)	62	7.74	3.15	7.00	1.30	15.60	6.24	9.04
	Sodium (mg)	59	82.84	136.63	23.00	2.00	637.70	31.05	137.83
Dried fruit	kJ/100g	137	1236.64	246.32	1239.00	783.0	2940.0	1135.53	1246.22
	Protein (g)	138	2.89	2.07	2.50	0.10	12.60	2.30	3.29
	Total carbohydrate (g)	84	64.46	11.39	64.00	41.00	89.00	61.03	66.85
	Total sugars (g)	126	56.89	12.56	59.60	7.40	77.70	52.69	59.04
	Free sugar (g)	126	28.44	6.28	29.80	3.70	38.85	26.34	29.52
	Total fat (g)	137	1.49	6.15	0.50	0.00	64.50	0.03	1.79
	Saturated fat (g)	121	0.87	5.65	0.10	0.00	57.30	-0.23	1.30
	Fibre (g)	132	7.05	3.97	7.10	0.30	24.20	5.64	7.67
	Sodium (mg)	132	66.78	140.55	19.00	0.00	1382.00	45.26	92.87

Table 5: Nutritional composition of snack sub-categories, per 100g (continued)

		n	Mean	Standard Deviation	Median	Minimum	Maximum	95% Confidence Interval for Mean	
								Lower bound	Upper bound
Fruit puree packs	kJ/100g	8	316.75	41.52	336.50	244.0	358.0	282.04	351.46
	Protein (g)	8	1.54	1.15	1.05	0.40	3.10	0.58	2.50
	Total carbohydrate (g)	8	13.75	2.76	13.00	11.00	18.00	11.44	16.06
	Total sugars (g)	8	12.44	3.47	11.10	9.10	18.20	9.54	15.34
	Free sugar (g)	8	6.22	1.74	5.55	4.55	9.10	4.77	7.67
	Total fat (g)	8	1.26	0.50	1.30	0.70	2.00	0.85	1.68
	Saturated fat (g)	8	0.88	0.59	1.00	0.10	1.70	0.38	1.37
	Fibre (g)	8	1.44	0.75	1.25	0.60	2.80	0.81	2.07
	Sodium (mg)	8	32.00	9.35	32.50	15.00	43.00	24.18	39.82
Savoury biscuits	kJ/100g	206	1787.47	241.72	1762.50	786.00	2592.00	1731.76	1822.59
	Protein (g)	206	10.33	4.00	9.90	0.40	25.00	9.46	11.12
	Total carbohydrate (g)	109	65.20	14.97	68.00	3.00	87.00	62.21	68.22
	Total sugars (g)	202	3.61	3.41	2.80	0.00	21.80	3.17	4.71
	Free sugar (g)	202	3.61	3.41	2.80	0.00	21.80	3.17	4.71
	Total fat (g)	206	13.57	10.59	11.05	0.80	50.10	11.29	15.17
	Saturated fat (g)	205	5.41	5.61	3.50	0.00	24.30	3.94	6.06
	Fibre (g)	203	5.65	5.55	3.90	0.00	30.10	4.70	6.64
	Sodium (mg)	206	574.03	327.73	599.00	0.00	2680.00	500.29	639.11
Bars	kJ/100g	72	1767.45	202.45	1749.00	1323.00	2241.00	1762.09	1865.38
	Protein (g)	72	13.41	8.47	9.00	3.60	33.00	12.33	17.70
	Total carbohydrate (g)	49	48.94	17.75	58.00	8.00	71.80	43.35	53.58
	Total sugars (g)	72	27.69	9.78	28.40	4.80	49.30	23.11	27.91
	Free sugar (g)	72	27.69	9.78	28.40	4.80	49.30	23.11	27.91
	Total fat (g)	72	17.32	8.77	15.90	3.40	50.00	16.13	21.08
	Saturated fat (g)	72	7.50	4.02	6.90	0.60	25.20	5.85	8.04
	Fibre (g)	71	6.19	3.85	6.00	0.30	25.40	5.91	7.69
	Sodium (mg)	72	238.41	105.08	237.50	15.00	445.00	204.32	273.10

Table 5: Nutritional composition of snack sub-categories, per 100g (continued)

		n	Mean	Standard Deviation	Median	Minimum	Maximum	95% Confidence Interval for Mean	
								Lower bound	Upper bound
Chocolate	kJ/100g	473	2129.09	220.23	2175.00	1334.0	2606.0	2110.45	2154.77
	Protein (g)	472	6.15	2.10	6.15	0.00	15.00	5.97	6.38
	Total carbohydrate (g)	425	55.79	11.25	57.00	8.00	90.00	55.03	57.31
	Total sugars (g)	467	47.99	13.23	50.50	0.20	73.40	46.12	48.85
	Free sugar (g)	467	47.99	13.23	50.50	0.20	73.40	46.12	48.85
	Total fat (g)	472	28.57	8.74	29.85	3.50	52.40	27.70	29.46
	Saturated fat (g)	467	16.19	5.57	16.80	2.00	39.00	15.53	16.62
	Fibre (g)	435	3.47	4.26	2.20	0.00	34.50	3.16	4.06
	Sodium (mg)	472	90.40	73.00	80.00	0.00	649.00	83.23	97.14
Candy	kJ/100g	423	1487.72	272.96	1490.00	71.0	2183.0	1433.09	1506.65
	Protein (g)	421	3.28	3.21	2.60	0.00	25.00	2.72	3.35
	Total carbohydrate (g)	269	75.86	17.00	79.00	0.00	100.00	73.20	77.59
	Total sugars (g)	419	56.16	21.50	58.30	0.00	96.10	50.91	56.27
	Free sugar (g)	419	56.16	21.50	58.30	0.00	96.10	50.91	56.27
	Total fat (g)	422	3.92	5.63	1.10	0.00	29.00	3.47	4.93
	Saturated fat (g)	413	2.31	3.58	0.90	0.00	21.10	2.04	3.05
	Fibre (g)	394	0.79	1.46	0.30	0.00	13.30	0.68	1.06
	Sodium (mg)	420	76.30	100.58	44.00	0.00	840.00	65.19	92.07
Dairy yoghurt	kJ/100g	426	341.07	88.32	345.00	160.00	695.00	329.15	353.83
	Protein (g)	426	2.82	0.85	2.80	0.30	7.20	2.98	3.19
	Total carbohydrate (g)	238	11.19	3.75	12.00	3.00	23.00	10.72	11.69
	Total sugars (g)	424	8.65	3.26	9.10	0.50	20.90	7.90	8.75
	Free sugar (g)	424	4.34	1.63	4.55	0.25	10.45	3.97	4.39
	Total fat (g)	425	2.78	1.90	2.10	0.10	9.90	2.59	3.09
	Saturated fat (g)	422	1.85	1.39	1.30	0.00	7.00	1.76	2.10
	Fibre (g)	422	0.49	0.43	0.50	0.00	2.70	0.54	0.65
	Sodium (mg)	422	41.79	13.42	42.00	9.00	124.00	43.77	46.93

Table 5: Nutritional composition of snack sub-categories, per 100g (continued)

		n	Mean	Standard Deviation	Median	Minimum	Maximum	95% Confidence Interval for Mean	
								Lower bound	Upper bound
Dairy-free yoghurt	kJ/100g	3	410.33	182.72	333.00	279.00	619.00	-43.56	864.23
	Protein (g)	3	2.17	1.70	3.10	0.20	3.20	-2.07	6.40
	Total carbohydrate (g)	3	9.67	3.06	9.00	7.00	13.00	2.08	17.26
	Total sugars (g)	3	6.70	4.75	7.50	1.60	11.00	-5.10	18.50
	Free sugar (g)	3	6.70	4.75	7.50	1.60	11.00	-5.10	18.50
	Total fat (g)	3	5.77	6.87	1.80	1.80	13.70	-11.30	22.83
	Saturated fat (g)	3	4.47	7.39	0.20	0.20	13.00	-13.89	22.82
	Fibre (g)	3	0.67	0.29	0.50	0.50	1.00	-0.05	1.38
	Sodium (mg)	3	53.67	34.36	73.00	14.00	74.00	-31.68	139.01

* South African Nutrient Profiling Model criteria (Frank et al., 2021): Solids: total sugar: 10g/100g; saturated fat: 4g/100g; sodium: 400mg/100g. Liquids: total sugar: 5g/100ml, saturated fat: 3g/100ml, sodium: 100mg/100ml.
* SF = Sugar Free
* Beverages = per 100 ml.
* Orange = values above cut-points.
* Green = values below cut-points.

Table 6: Proportion of products within snack categories and sub-categories that are excessive in nutrients of concern to limit

Solids										
Category	Sub-category	Sugar			Saturated fat			Sodium		
		> 10g/100g	% above cut-point	≤ 10g/100g	>4g/100g	% above cut-point	≤ 4g/100g	>400mg/100g	% above cut-point	≤ 400mg/100g
Baked goods	Sweet baked goods	502	91.77%	45	435	79.67%	111	122	22.22%	427
Crisps & popcorn	Potato crisps	0	0.00%	111	95	86.36%	15	96	86.49%	15
	Cheese snacks	0	0.00%	26	29	93.55%	2	30	96.77%	1
	Vegetable/legume chips	8	53.33%	7	2	13.33%	13	6	40%	9
	Tortilla	3	5.45%	52	42	75.00%	14	53	94.64%	3
	popcorn	8	23.53%	26	13	38.24%	21	27	79.41%	7
	Other crisps & popcorn	6	8.00%	69	61	87.14%	9	66	80.49%	16
Dips & spreads	Dips and spreads	1	2.38%	41	23	54.76%	19	21	50.00%	21
Frozen treats	Ice cream	110	83.97%	21	77	59.69%	52	1	0.78%	128
	sorbet	17	70.83%	7	3	12.50%	21	0	0.00%	25
Meaty snacks	Dried meat	0	0.00%	71	41	57.75%	30	71	100.00%	0
Nuts, seeds, and fruit	Nuts	3	2.24%	131	107	78.10%	31	16	11.68%	121
	Seeds	0	0.00%	18	11	64.71%	6	1	5.00%	19
	Other nut % seed products	55	94.83%	3	39	72.22%	15	4	6.78%	55
	Dried fruit	125	99.20%	1	2	1.65%	119	2	1.52%	130
	Fruit puree packs	6	75.00%	2	0	0.00%	8	0	0.00%	8
Savoury snacks	Savoury biscuits	9	4.46%	193	98	47.80%	107	148	71.84%	58
Sweet snacks	Bars	67	93.06%	5	57	79.17%	15	2	2.78%	70
	Chocolate	453	97.00%	14	459	98.29%	8	1	0.17%	571
	Candy	385	91.89%	34	81	19.61%	332	9	2.14%	411
Yoghurt	Dairy yoghurt	138	32,55%	286	38	9.00%	384	0	0.00%	422
	Dairy-free yoghurt	1	33.33%	2	1	33.33%	2	0	0.00%	3

Table 6: Proportion of products within snack categories and sub-categories that are excessive in nutrients of concern to limit (continued).

Liquids										
Category	Sub-category	Sugar			Saturated fat			Sodium		
		>5g/100g	% above cut-point	≤ 5g/100g	>3g/100g	% above cut-point	≤3g/100g	>100mg/100g	% above cut-point	≤100mg/100g
Beverages	Flavoured water	2	4.55%	42	0	0.00%	45	0	0.00%	45
	100% fruit juice	323	98.78%	4	0	0.00%	327	0	0.00%	327
	Juice drinks	118	81.94%	26	0	0.00%	143	1	0.69%	143
	Coconut water	2	66.67%	1	0	0.00%	3	0	0.00%	3
	Soft/carbonated drinks	86	83.50%	17	0	0.00%	103	1	0.96%	103
	Sugar free carbonated drinks	0	0.00%	111	0	0.00%	106	0	0.00%	111
	Sports drinks	12	35.29%	22	0	0.00%	34	0	0.00%	34
	Energy drinks	20	40.00%	30	0	0.00%	45	0	0.00%	50
	Coffee	11	84.62%	2	1	8.33%	11	0	0.00%	11
	Tea	30	28.04%	77	0	0.00%	107	1	0.93%	106
	Flavoured milk	58	86.57%	9	0	0.00%	68	3	4.41%	65
	Dairy drinks	52	92.86%	4	4	7.27%	51	4	7.14%	52
	Dairy-free flavoured milk	5	62.50%	3	0	0.00%	8	0	0.00%	8
	Non-alcoholic drinks	7	38.89%	11	0	0.00%	18	0	0.00%	18
	Other beverages	7	25.00%	21	0	0.00%	28	0	0.00%	28

Baked goods:

The nutrient composition information (Table 4 and Table 5) of the Baked goods category displayed that this category is high in mean total sugar (25.60g/100g) and saturated fat (9.68g/100g) when evaluated against the SANPM criteria (Frank et al., 2021), as they exceeded the cut-off of 10g/100g for total sugar and 4g/100g for saturated fat. In contrast, the sodium value (294.98mg/100g) was not of concern as it was below 400mg/100g. The proportion of products exceeding these nutrient limits (Table 6) were high for total sugar and saturated fat at 91.77% and 79.67%, respectively, whereas only 22.22% of products exceeded the cut-off for sodium.

Beverages:

The beverage category contained the lowest mean energy (145.10kJ/100mL), fibre (0.29g/100mL), total fat (0.29g/100mL), saturated fat (0.18g/100mL), and sodium (19.18mg/100mL) out of all categories. The mean total sugar (6.99g/100mL) was the only high nutrient of concern in the beverage category (Table 4). The beverage sub-categories (Table 5) that are compliant with the SANPM criteria (Frank et al., 2021) for meant total sugar, saturated fat, and sodium are Flavoured water, Sugar-free/diet carbonated drinks, Sports drinks, Energy drinks, Tea, Non-alcoholic drinks, and Other beverage products. All sub-categories were within the 100mg/100mL sodium and 3g/100mL saturated fat limit. More than half of the products in the 100% Fruit juice (98.78%), Juice drinks (81.94%), Coconut water (66.67%), Soft/carbonated drinks (83.50%), Coffee (84.62%), Flavoured milk (86.57%), Dairy drinks (92.86%), and Dairy-free milks (62.50%) were above the recommended 5g/100mL total sugar limit (Table 6).

Crisps and popcorn:

This was the category highest in mean energy (2048.66kJ/100g) due to Potato chips (2186.47kJ), Cheese snacks (2144.06kJ) and Other crisp like snacks (2015.76kJ) being energy dense (Figure 5). The Crisps and popcorn category (Table 4) is high in mean saturated fat (9.87g/100g) and mean sodium (673.67mg/100g), whereas mean total sugar was not of concern as it was below the limit at 4.85g/100g. When looking at the sub-categories (Table 5), all were high in mean sodium, and all, besides the Vegetable/legume chips sub-category, were high in mean saturated fat. Even though the saturated fat content of vegetable/legume chips were not of concern, they are however high in mean total sugar (23.47g/100g) along with the popcorn sub-category (14.08g/100g). More than 79.41% of products in each sub-category (Table 6), excluding vegetable/legume chips, were high in sodium. Similar is seen with the proportion of products exceeding the sodium limit, being more than 75.00% of each category besides Vegetable/legume chips and Popcorn. The proportion of products exceeding total sugar limits was much lower than saturated fat and sodium, with most being less than 10% in each sub-category. With this information, none of the categories or sub-categories are suitable for regular consumption.

Dips and spreads:

Dips and spreads had a relatively low mean energy value (1230.24kJ/100g) when compared to other snack categories but contained the fourth highest in sodium value (431mg/100g). Similarly to the Crisps and popcorn category, Dips and spreads (Table 5) are high in mean saturated fat (8.60g/100g) and mean sodium (431.00mg/100g) when evaluated using the SANPM (Frank et al., 2021). The mean sugar value (2.98g/100g) is within the normal range. More than half of the products in this category exceeded saturated fat and sodium limits (Table 6). Only one product (2.38%) exceeded the limit for sodium however this category is not

considered to contain health promoting products due to the high mean saturated fat and sodium content (Table 6).

Frozen treats:

Frozen treats are relatively low in mean energy (732.75kJ/100g) compared to other categories and is high in mean total sugar (16.58g/100g) and mean saturated fat (6.00g/100g) (Table 4). Both ice cream (16.91g/100g) and sorbet (14.74g/100g) are high in mean total sugar but only ice cream (6.86g/100g) contains excessive amounts of saturated fat (Figure 7). When it comes to proportion of nutrients exceeding limits (Table 6), over 70% of ice cream and sorbet products are high in total sugar. Nearly 60% of ice cream products were high in saturated fat compared to only 12.50% of sorbet products. Seeing that both sub-categories contain high amounts of sugar they are not considered to be healthy snacks for regular consumption.

Meaty snacks:

Meaty snacks (dried meat) contained the highest mean protein (46.82g/100g) and had the highest mean sodium content (1897.45g/100g) out of all categories and sub-categories. The nutrient profile of meaty snacks in Table 4 and Table 5 shows that it contains excessive amounts of saturated fat (7.37g/100g) and sodium (1897.45mg/100g) when evaluated using the South African Nutrient Profiling Model (Frank et al., 2021). All dried meat products were high in sodium and more than half were high in saturated fat (Table 6). The mean total sugar content of meaty snacks is not of concern as it only 0.90g/100g and no products from this category was high in sugar.

Nuts, seeds, and fruit:

This category has the highest mean fibre (8.47g/100g), which came from the seeds sub-category (17.04g/100g), and second highest total fat (27.06g/100g) content compared to all categories (Table 4). Nuts (2526.20kJ/100g) and seeds (2263.60kJ/100g) were the highest in energy and protein out of all sub-categories at 19.05g/100g and 23.12g/100g, respectively (Table 5). The Nuts, seeds, and fruit category is high in mean total sugar (28.05g/100g) and mean saturated fat (4.29g/100g), and low in sodium (92.22mg/100g) when evaluated using the South African Nutrient Profiling Model criteria (Frank et al., 2021) (Table 5). Table 5 displays how Nuts and Seeds were the only sub-categories compliant to recommended the sugar limit of 10g/100g. When looking at sub-categories (Table 5), the only two which were compliant to the recommended saturated fat limit of 4g/100g was Dried fruit (0.87g/100g) and Fruit puree packs (0.88g/100g). All sub-categories were below the recommended 400mg/100g limit for sodium (Figure 8). Dried fruit (99.20%), Fruit puree packs (75.00%), and Other nut and seed products (94.83%) have the highest proportion of products that are high in total sugar (Table 6). The proportion of Nuts (78.10%), Seeds (64.71%), and Other nut and seed products (72.22%) which are high in saturated fat is also high. Most products in each sub-category was within the sodium limit.

Savoury snacks:

Savoury snacks has the second highest fibre content, at 5.65g/100g, out of all categories and contains a fair amount of protein (10.33g/100g). Savoury snacks (Savoury biscuits) has mean saturated fat (5.41g/100g) and mean sodium (574.03mg/100g) values of concern as they were both higher than the South African Nutrient Profiling Model criteria (Frank et al., 2021) (Table 4). Almost half (47.80%) of the products in this sub-category is not compliant with the 4g/100g

limit of saturated fat, and even more products (71.84%) exceeding the 400mg/100g limit for sodium (Table 6).

Sweet snacks:

Sweet snacks was the category third highest in mean energy (1821.92kJ/100g), following crisps and popcorn, and Nuts, seeds and fruit. Sweet snacks is high in mean total sugar (50.04g/100g) and mean saturated fat (9.51g/100g) (Table 4). Only mean sodium (95.31mg/100g) was compliant with the South African Nutrient Profiling Model criteria (Frank et al., 2021). All sub-categories (Table 5) have an excessive amount of mean total sugar, with Bars (27.69g/100g) being the lowest and highest being Candy (56.16g/100g). Candy (2.31g/100g) was the only sub-category that was under the 5g/100g limit for mean saturated fat and all sub-categories were low in mean sodium. Over 90% of products from all sub-categories are high in sugar (Table 6). Bars (79.17%) and chocolate (98.29%) also have a large proportion of products containing excessive amounts of saturated fat.

Yoghurt:

The yoghurt category contained the second lowest amount in mean energy (341.55kJ/100g), fibre (0.49g/100g), total fat (2.80g/100g), saturated fat (1.87g/100g) and sodium (41.87mg/100g) out of all categories. This category (Table 4) was within the recommended total sugar, saturated fat, and sodium limits from the South African NPM criteria (Frank et al., 2021). Table 5 shows that there are not great differences in the nutritional composition for Dairy and Dairy-free yoghurt besides the mean saturated fat being much higher in the Dairy-free yoghurt (4.47g/100g), exceeding the 4g/100g saturated fat limit. Sodium in both sub-categories were not of concern as they are within the recommended limit. The proportion of

Dairy and Dairy-free yoghurt products not compliant to the NPM criteria for total sugar is around 33% (Table 6).

4. Marketing and product placement

This section describes the in-store placement and marketing of snack items and the reasoning behind how snack items are marketed and placed in-store.

4.3.1 Snacks available at point of sale

Snacks were available at the POS in all eight stores that were assessed. At the POS, three stores had a snake system leading up to the cash register and the remaining five had multiple lines.

The three snack categories found at POS in all eight stores were Beverages, Sweet snacks, Crisps and popcorn (Table 7; Figure 9). Nuts, seeds, and fruit as well as Baked goods were present at seven and six of the stores respectively. The most frequent snack sub-categories observed at POS were Potato chips, Chocolate, and Bars, seen at all eight stores. The other sub-categories which were present at most stores POS were Nuts, Dried fruit, Candy, Regular and diet carbonated beverages, Sport and energy drinks, and Sweet baked goods as displayed in Figure 9.

Based on the nutritional content of snack categories and sub-categories (Table 4 and Table 5), majority of the snacks found at POS are either high in total sugar, saturated fat, or sodium.

Table 7: Number of stores at which snack categories and sub-categories were found at point of sale with mean nutrient composition.

Category	n	Sub-category	n	kJ	Sugar (g)	Saturated fat (g)	Sodium (mg)
Beverages	8	Regular carbonated drinks	7	141.08	8.22	0.03	8.21
		Diet carbonated drinks	7	32.72	1.75	0.09	12.66
		Juice	3	192.91	10.38	0.04	6.62
		Sports & energy drinks	6	96.89	4.83	0.03	49.44
		Dairy drinks	0	182.32	7.45	0.44	76.76
Nuts, seeds & fruit	7	Dried fruit	7	1236.64	56.89	0.87	66.78
		Nuts	7	2526.20	5.04	7.01	130.80
		Seeds	3	2263.60	2.08	5.05	47.55
Crisps & popcorn	8	Potato crisps	8	2186.47	1.75	11.76	627.77
		Popcorn	2	1801.42	14.08	5.66	624.91
Frozen treats	4	Ice-cream	4	799.64	16.91	6.86	61.99
Dips & spreads	0	Dips & spreads	0	1230.24	2.98	8.60	431.00
Yoghurt	0	Dairy yoghurt	0	341.07	8.65	1.85	41.79
		Dairy free yoghurt	0	410.33	6.70	4.47	53.67
Meaty snacks	4	Dried meat	4	1471.93	0.90	7.37	1897.45
Sweet snacks	8	Bars	8	1767.45	27.69	7.50	238.41
		Chocolate	8	2129.09	47.99	16.19	90.40
		Candy	7	1487.72	56.16	2.31	76.30
Baked goods	6	Sweet baked goods	6	1735.81	25.60	9.68	294.98
Savoury snacks	4	Savoury biscuits	4	1787.47	3.61	5.41	574.03

* South African Nutrient Profiling Model criteria (Frank et al., 2021): Solids: total sugar: 10g/100g; saturated fat: 4g/100g; sodium: 400mg/100g. Liquids: total sugar: 5g/100ml, saturated fat: 3g/100ml, sodium: 100mg/100ml.
* Orange = values above cut-points.
* Green = values below cut-points.

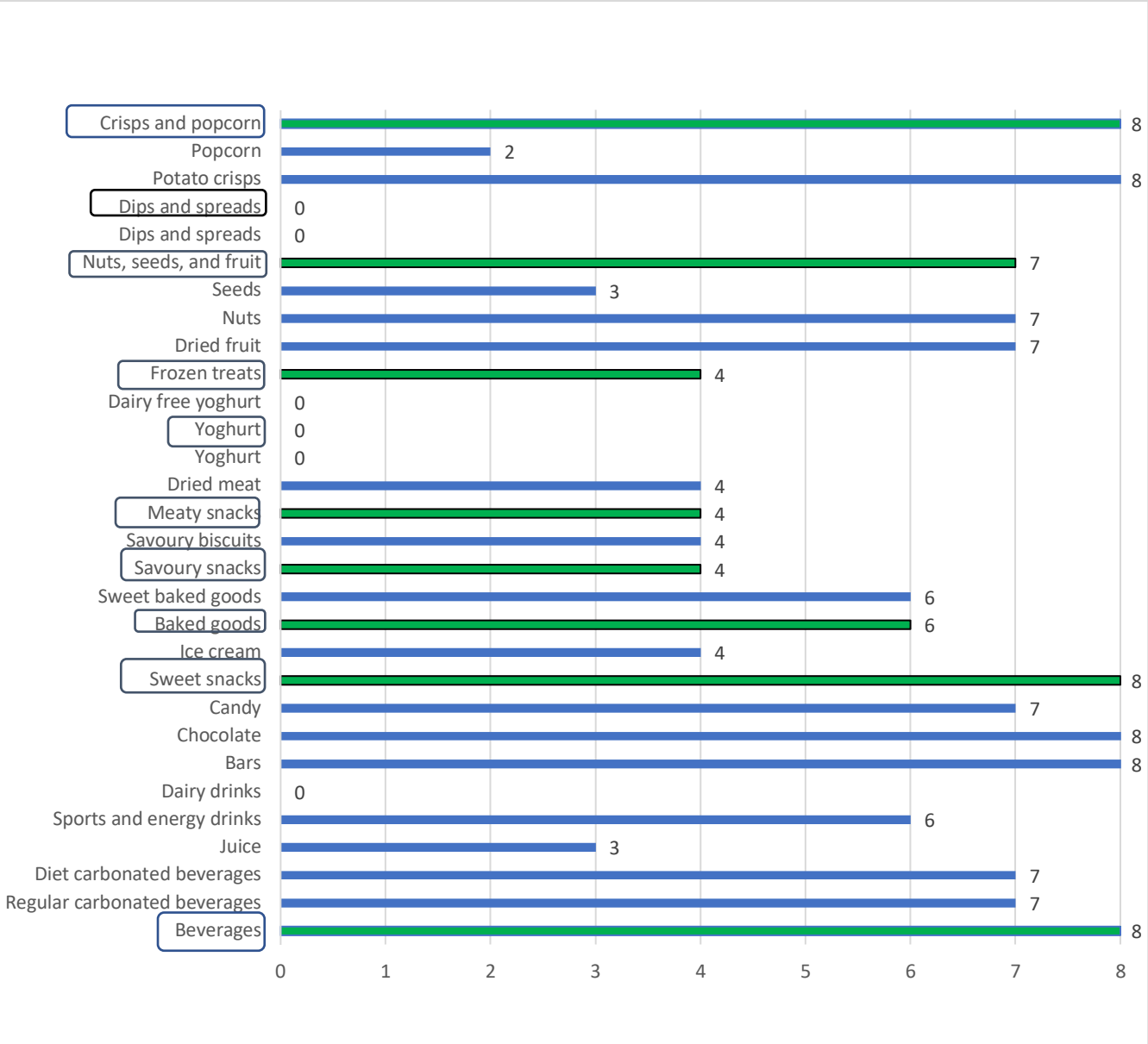

Figure 9: Number of stores at which snack categories and sub-categories were found at point of sale.
* green = categories.
* dark blue = sub-categories.

4.3.2 Marketing and branding of snack food items

Numerous snack product marketing strategies were visible in the stores. Specials and combo deals were offered to consumers at all (n=8) stores. Examples of the deals offered to customers is displayed in Table 8. One store manager added that "*they sell better than their healthy products*". In many stores, food industry companies had a brand marketing presence, as seen in Table 9 and Figure 10. Branded display cabinets were present at most (n=7) stores and branded temporary display units (pop-up holders and shelves) were observed at three stores. Branded notice boards of snack foods in the aisles were observed in five of the stores, and all stores (n=8) had brand specific specials of snack items. The in-store marketing observed was exclusively packaged, ready-to-eat snacks i.e., sweet baked goods, chips, chocolate, and SSBs. As previously noted, these items contain high amounts of energy, sugar, saturated fat, and sodium and therefore should not be consumed regularly. Examples of in-store branded marketing observed are displayed in Figures 11 – 13 below.

Table 8: Examples of combo and special deals available from stores

Deals offered
“Any 3 Pringles assorted 100g for R60”
“Buy any 3 Tortilla Chips for R45, save R14.97”
“Buy any 4 gums and jellies for R70, save R17.96”
“Buy any 3 Fanta, Sprite or Stoney for R57, save R7.47”
“Buy 4x4 per pack muffins all variants & get a 5th free!”
“Buy any 2x Bar-one/black forest/vanilla cake & save 10%”
“Save R11 - buy any 5xCadbury P.S. Duo/Lunch Bar Max for R49”
“Save R11 - buy any 4x45g M&M's chocolate/peanut sweets for R49”
“Save R17 - buy any 6x250g Danone Yogi Sip Drinking Yoghurt All Variants for R49”
“1x Black Forest cake + 1x Coca-Cola original taste cold drink 2L both for R80, save R18”
“Bakers EET-SUM-MOR biscuits all variants 200g R17.99 – save R7”
“Coca-Cola cold drink all variants 6x300ml per pack R49.99, save R9”

Table 9: In-store branded marketing of snacks at grocery stores.

Branded marketing	Stores	Percentage
Branded display cabinets	7	87.5%
Branded temporary display units	3	37.5%
Branded notice boards	5	62.5%
Brand specific specials	8	100%

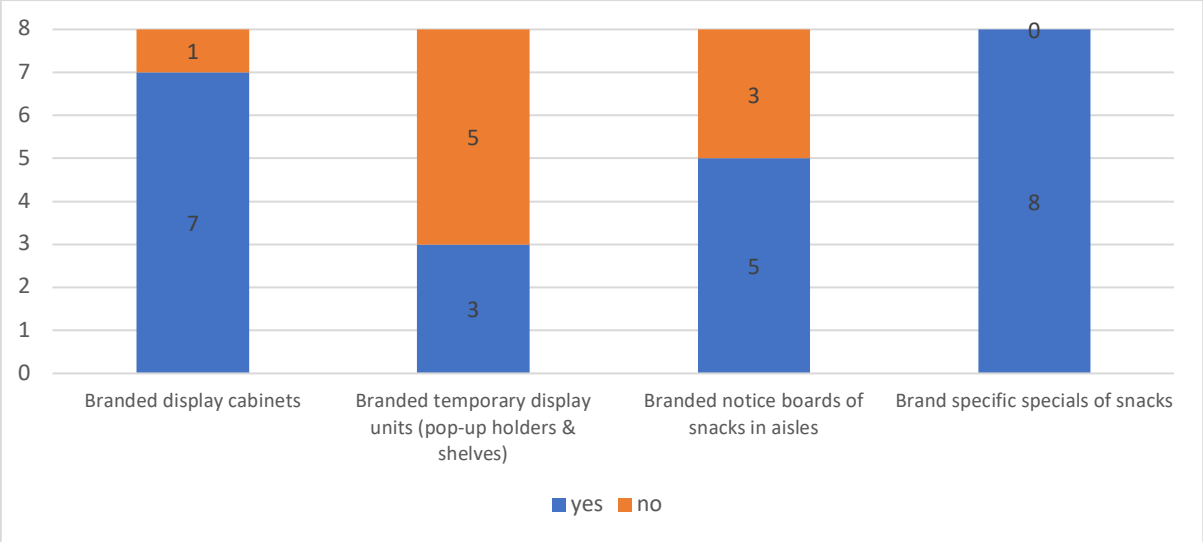

Figure 10: In-store branded marketing of snacks

Figure 11: Branded temporary display units

Figure 12: Branded display cabinets

Figure 13: Branded notice board pop out in aisle

4.3.3 Shelf space allocated to snacks

There were snacks present on all shelves at all supermarkets. The distribution of shelf space as a proportion of total snack food shelf space allocated to snack categories and sub-categories are presented in Table 10 and Figure 14. Sweet baked goods accounted for the largest proportion of snack shelf space (22.44%), followed by Crisps (14.04%), Carbonated drinks (12.65%), Juice (10.90%), Confectionary (7.39%), and Chocolate, breakfast and energy bars (6.94%). Less than 10% of the snack shelf space was used by Pretzels (0.69%), Popcorn (1.28%), Nuts, seeds and dried fruit (4.77%).

Table 10: Shelf space allocated to snacks

Snacks	Shelf space (m)	Percentage (%) of total snack shelf space
Chocolate, breakfast and energy bars	45.07	6.94
Confectionary	47.97	7.39
Sweet baked goods	145.70	22.44
Savoury baked goods	22.92	3.53
Crisps	91.04	14.02
Popcorn	8.28	1.28
Pretzels	4.48	0.69
Nuts, seeds, and dried fruit	30.97	4.77
Carbonated drinks	82.14	12.65
Dairy drinks	38.18	5.88
Juice	70.69	10.90
Sports/energy drinks	26.93	4.15
Ice creams, lollies, sorbet	34.79	5.36
Total	649.16	100

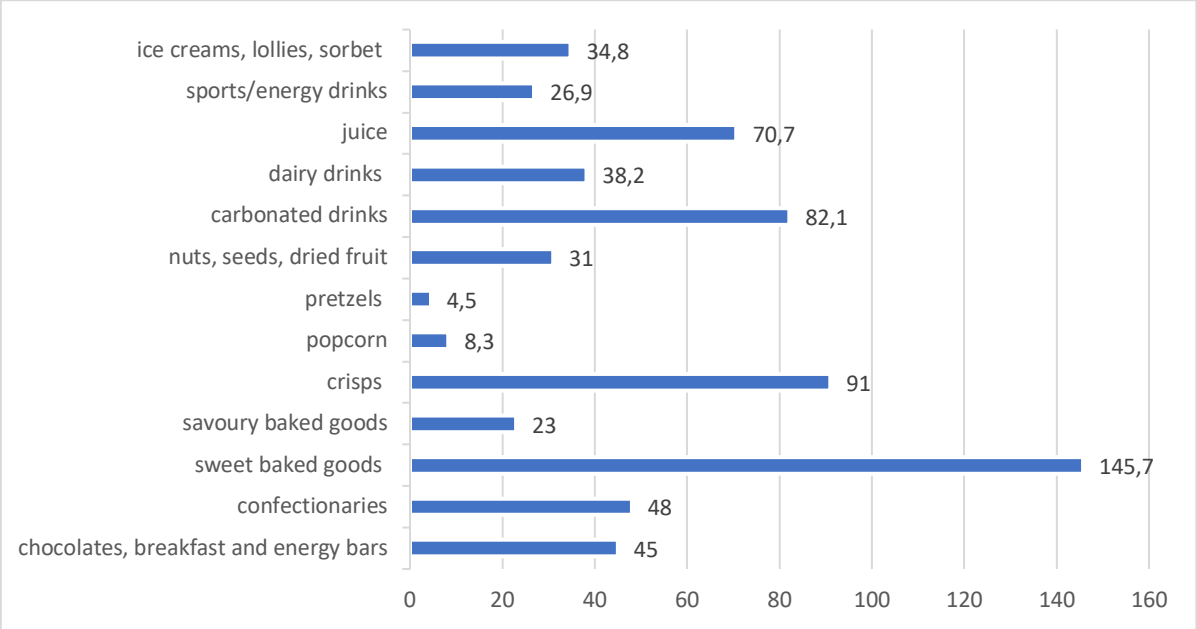

Figure 14: Total shelf space (m) allocated to snacks

4.4 Store managers insight on marketing and placement of snack foods

This section discusses the reasoning behind how snack items are marketed and placed in-store.

4.4.1 Store promotions

Results were mixed regarding whether stores decided on which promotions to run themselves, or if decisions regarding promotions were made elsewhere. Half of the stores (n=4) do not decide which products are part of promotional deals. The buyers, merchandising and marketing team at head office decide on promotion items well in advance and the store implements these promotions. In the other four stores, both head office and the store decide which products are placed on promotion. These stores have two types of promotions: national promotions and store based/managers/indoor promotions. Decisions on which products to promote, at both the store and head office level, are based on sales history reports and observing what sells well. New products may be promoted or showcased to stimulate interest and promote sales. Seasonal preferences and what sells best during certain periods of the year and in specific areas also

inform choices e.g. in winter, sweet sales are higher than other seasons. One store in particular, targeting an affluent demographic, said their decision is based on their "image strategy" e.g. to promote a certain lifestyle or healthy eating. Another store in a lower socio-economic area mentioned that their in-house specials are based on what the competitors in their area have on offer. Some stores that run their own in-house specials might put products on special if they have a large amount of stock that they want to get rid of. The frequency of promotions varies from weekly to monthly catalogues from the different retailers. One store has bi-monthly catalogues to accommodate for month end. It is worth noting that marketing is not only limited to catalogues and in-store advertisements, stores also attempt to catch the shoppers' attention via temporary promotional boards outside of the store, social media, applications, and the short message service platform for promotions which reaches regular customers. Some stores offer customers reward card discounts on certain items.

4.4.2 High volume areas and product placement

All stores report having "high volume" areas that catch the attention of shoppers, thus supporting more sales. These areas are at the end of aisles, in the fresh sections, i.e. fruit and vegetables, which is usually located at the entrance, as well as the butchery, bakery and at POS. "Gondola ends" (products placed at the end of an aisle), or "champion end displays", and "euro stands" (stands displaying imported products) are popular areas as well as square or round bins located near the POS because, as reported by one manager, when the payment lines are long, there are impulsive purchases that occur while the customers wait to check out. One store that has a lot of imported products said that they keep these imported products in round bins because they will bring in more money.

There is a standard blueprint, or planogram, for store layout for all supermarkets and most stores stated that the head office will provide instructions on where items are to be placed. They indicated that it is best for the store layout to start with fresh items (fruit and vegetables) and also end off fresh (butchery). The control over where certain products are placed varies between stores. A few stores said that they have little influence over where to place certain items as it cannot deviate from the store's planogram. For example, the regional manager will decide on the aisle layout i.e. what product categories get placed in each aisle and the flow of products, "*the (house brand) will always be at eye level (M2 & M8)*", said two store managers. A few of the other stores are slightly more flexible, where the branch manager oversees the whole store and decides where to place certain items, while staying within the standard store blueprint. This blueprint is based on what sells well, to create exposure to new products, and to promote those selling poorly. Some managers said that they decide independently on where some products are placed. However, they also receive instructions from head office on what to place at gondola ends, and if a company pays to have their products at the POS, it cannot be removed e.g. in one store, Kinder Joy pays to have their product at every second POS. Some stores that have control over product placement said that it is done strategically to increase sales e.g. placing certain products at eye level. One store stated that the manager and a category management team evaluate the store and, depending on sales, they determine shelf space for certain products whilst ensuring compliance with head office store guidelines.

A store from a low socio-economic status (SES) community uses a term called "cart chasing", a strategy where the store places open cardboard boxes filled with fast selling products on the floor in front of shelves, to attract customers and increase sales. The "high volume" areas are often reserved for items on promotion. Cross merchandising of snack foods is apparent, where they place snacks throughout the store e.g. a box of energy bars hung next to infant formula –

the products are not related but is a subtle way to get consumers to buy more. Snack foods have the advantage of being small enough to be hung anywhere. One manager, from the store that targets an affluent demographic, reported using product placement to place products in the same category together in order to create a flow and allow for an easy shopping experience. Their product placement is also aimed to encourage people to purchase additional items e.g. having tea placed near rusks and cakes to suggest they be consumed together.

4.4.3 Industry compensation

All stores (n=8) stated that head office receives some sort of payment from suppliers for prioritising the display or marketing of their food items in the high volume areas mentioned above (gondola end of aisle displays, POS). It is either in the form of a cash payment or free stock. At most of the stores located in low SES areas, they stated that they do not receive money at store level, but rather free stock from the manufacturers. Some stores receive free product in return for specific placement and for putting up branded displays, whereas others will receive free product but the supplier does not have placement power, the store decides on placement. One particular store, targeting an affluent demographic, predominately stocks their house brand, and does not carry a large variety of other brands. Even though the brand supplier negotiates with the store's buying department, they do not pay for shelf level placement or specific placement since this store places their own house products at eye level, and other branded products on the bottom shelves. One store identifies as a "family business" and do certain things independently. They liaise with both the supplier and head office when arranging deals in order to comply with head office rules. They receive payment from both head office and suppliers.

4.4.4 Stores perception of their influence

Most stores (n=7) reported that their marketing and placement of snacks encourages customers to make healthy decisions. Each store's reasoning for this statement varied. One store explained that their deli recently introduced a bin of "healthy" items (chocolate, breakfast/energy bars, dried fruit, nuts and seeds) in front of the cooked food so customers could have that as an option. Another manager stated that their product placement and store layout encourages healthy shopping because the first thing customers are exposed to upon store entry is fresh fruit and vegetables. This manager mentioned that they promote a healthy lifestyle and give customers what they want, which is healthy options. The products available at this store has also been reformulated over time to make them healthier (i.e. less fat and baked not fried), and they now have a policy to ensure more healthy snacks are positioned at the points of sale. One store stated they have an aisle dedicated to health products, which makes it easier for consumers to find. Another franchise said they carry the full range of healthy products the chain has to offer and have fresh produce available. This store has a recipe book using their own produce, which the manager believes encourages consumers to cook healthy meals and it also advertises the store brand healthy product range. The manager would like to think their store promotes customers to make healthy decisions, however, their branch caters to a low SES community and the marketing and placement unfortunately depends on store location. He mentioned that there is more encouragement to purchase healthy foods from the stores targeting the affluent demographic.

Managers from different stores located in low SES areas indicated that choosing healthier options was the consumer's responsibility, with one stating that "*at the store level we try to make it healthy. We try our best to promote health but at the end of the day consumers make the final decision (M5)*". One store manager stated that "*it is the individual's decision when*

purchasing, not the stores. It is a consumer based store meaning we give consumers what they want, which happens to be NikNaks, chips, and chocolates, but we would not say that the store does not encourage healthy shopping (M5)" and another "*everything is visible to the customers, there are healthy options available and therefore it is the consumers choice whether they select the healthy or unhealthy (M7)*". One manager from a store located in a low SES area shared that consumer demands shift towards ultra-processed items but the store does not disregard their social responsibility to promote health. He stated that they have a different target market to stores that target affluent customers. Only one manager thought that his store did not encourage customers to make healthy decisions. He stated that "*Snacks are luxuries. They will always be in the store. It is placed in the high traffic areas because it will always sell, even if they are moved. Why must we tell them to not buy it if it is being sold in the store?(M8)*". An interesting statement was made by a manager, from the store targeting an affluent demographic, he said "*when customers shop unhealthy at our store, it is better quality unhealthy compared to other shops, especially in low SES areas. Our store listens to the consumers behaviour, and what the consumers want, we will provide. Our consumers want healthy so that is why there are so many healthy options in the store (M2)*".

5. Discussion

5.1. The nutritional composition of snack items

In South Africa there is an over-supply of ultra-processed foods, which make up 76% of packaged foods in supermarkets (Frank et al., 2021). The findings on nutritional composition data are in line with other studies, which found packaged ultra-processed foods to be energy dense, high in fats, sugar, and sodium (Dunford et al., 2022; Monteiro et al., 2013).

The highest mean energy content was seen in nuts, seeds, potato crisps, cheese snacks, and chocolate. In South Africa the most commonly consumed snacks, according to literature, are sweets (Govender et al., 2018; Ronquest-Ross et al., 2015), chips (Euromonitor, 2021b; Faber et al., 2016; SADHS, 2016), nuts, sweet and savoury biscuits/crackers, chocolate, carbonated beverages (Igumbor et al., 2012; Ronquest-Ross et al., 2015; Senekal and Steyn, 2003; Steyn et al., 2011), and fruit juice (Ronquest-Ross et al., 2015). In terms of mean energy, these snack food items range from 1487.72kJ/100g - 2526.20kJ/100g. When compared to healthier options i.e., an apple (215kJ/100g) or unsweetened yoghurt (341.07kJ/100g) it is fair to say that the snacks commonly consumed in South Africa are high in energy. The implication of regularly consuming energy dense snacks is that it easily leads to over-consumption of energy, which contributes to obesity and the development of non-communicable diseases (Johnson et al., 2017).

All beverages had a relatively low mean energy value when compared to other sub-categories, which might be due to minimal fat present and the use of NNS replacing sugar since the introduction of the Health Promotion Levy on sugary beverages which took effect on 1 April 2018 (SARS, 2021). Research has shown that sugar-sweetened beverage tax has incentivised the food industry to reformulate and replace sugar with NSS, instead of reformulating products

to be less sweet (Reyes et al., 2020; Vyth et al., 2010). In 2018, 55.6% of carbonated drinks and 29.6% of all packaged beverages in SA already contained NSS, which was prior to the sugar-sweetened beverage tax implementation (Frank et al., 2021). If the NNS criteria (Frank et al., 2021) was to be used to assess beverages in this study, they would most likely not be compliant with the SANPM.

5.2. Snacks excessive in nutrients of concern

The snacks which had a mean sugar content above the SANPM criteria were sweet baked goods, 100% fruit juice, juice drinks, coconut water, soft/carbonated drinks, coffee, flavoured milk, dairy drinks, dairy-free drinks, vegetable/legume chips, popcorn, all frozen treats, other nuts and seeds products, dried fruit, fruit puree packs, and all sweet snacks (bars, candy, chocolate). The highest mean total sugar per food sub-category was observed in dried fruit (56.89g/100g) and candy (56.16g/100g) but it is worth noting that even though dried fruit and candy contain almost the same mean total sugar, dried fruit has a low to moderate glycaemic index (GI) value, is high in fibre, and has a high proportion of fructose which suggests a favourable post-prandial glucose and insulin response (Esfahani et al., 2014; Sadler et al., 2019). Sadler et al. (2019) also suggests that polyphenols found in dried fruit is beneficial on modulating sugar absorption and metabolism. Dried fruit is commonly perceived to be a healthy snack, however many consumers do not realise it is a more concentrated source of sugar compared to fresh fruit. Additionally, dried fruit lacks natural water content, making it easier to over-consume without feeling full in comparison to fresh fruit. Therefore for those with diabetes, it may not be advantageous. The same goes for candy and chocolate.

The only snacks below the cut-points for sugar was savoury biscuits, nuts, seeds, dried meat, other crisps and popcorn products, tortilla chips, cheese snacks, potato crisps, flavoured water,

sugar-free/diet carbonated drinks, sports drinks, energy drinks, tea, non-alcoholic drinks and all yoghurt sub-categories. On the other hand, most of these low-sugar options are high in sodium and/or saturated fat and therefore cannot be viewed as healthy.

Sweet baked goods, all crisps and popcorn sub-categories (except vegetable/legume chips), dips and spreads, ice-cream, dried meat, nuts, seeds, other nut and seed products, savoury biscuits, bars, chocolate, and dairy-free yoghurt all contain excessive amounts of mean saturated fat according to the SANPM criteria (Frank et al., 2021). Chocolate had the highest grams of saturated fat out of all sub-categories (16.19g/100g), followed by cheese snacks (12.5g/100g) and potato crisps (11.76g/100g). Saturated fat intake has been known to increase LDL cholesterol (Siri-Tarino et al., 2010) which has been strongly associated with the development of atherosclerotic cardiovascular disease and intake thereof should be limited (Hooper et al., 2020; Krauss, 2010).

All crisps and popcorn sub-categories, dried meat, savoury biscuits, and dips and spreads exceeded the recommended limit of 400mg/100g (Frank et al., 2021). The dried meat sub-category was exceptionally high (1897.45mg/100g) possibly because it is dehydrated and salt is commonly used as a method of preservation (Jones et al., 2016). Diets consisting of high amounts of sodium are problematic in South Africa as they contribute to the development of hypertension (Peer et al., 2018) where nationally almost one third of adults are already hypertensive (Shisana et al., 2014) and ultimately places a great burden on the health care system.

Of course, the mean values per category and sub-category were analyzed and do not reflect each individual product. Therefore, consumer nutrition literacy is essential to evaluate products

and select those which have fewer negative implications on one's health. Front-of-pack labelling has been identified for several years by WHO and the Organization for Economic Co-operation and Development as an important strategy to tackle nutrition related diseases, because it helps consumers make informed decisions on the healthiness of their purchases (OECD, 2008; Sonnenberg et al., 2013) and drives healthier product formulation, and reformulation by the food industry (Mhurchu et al., 2017; Reyes et al., 2020). Even though it is important for consumers to be nutrition literate, the government has a duty to ensure an enabling food environment that prioritises healthy options for all the people of its country. Front-of-package nutrition labelling systems could be used to underpin policies that restrict the marketing of unhealthy snacks and what is allowed to be sold to children in schools (Taillie et al., 2021).

5.3. The in-store snack placement and marketing strategies used

Even though most store managers believe that their store encourages a healthy shopping environment for customers, the findings are not in line with this notion. There is clearly a theme of the profit-driven food industry strategically driving consumers to purchase more unhealthy products. Manufacturers work closely with supermarkets to ensure that unhealthy snacks are strategically placed in the high volume areas to support more sales. All stores receive incentives from suppliers for prioritising the display or marketing their products in the high volume areas or POS. Consumers are steered towards ultra-processed snacks through eye-catching packaging and the branded marketing presence seen in all stores i.e., notice boards, display cabinets, and temporary display units. Stores are also using cross merchandising placement strategies to encourage an increase in purchases of snack items, many of which are high in nutrients of concern to limit. For many reasons it is extremely difficult for customers to practice healthy purchasing behaviours. Reduced prices of ultra-processed snacks (specials and combo

deals) were offered at all stores, making them even more affordable. In South Africa many opt for budget friendly brands and products due to a lack of disposable income since unemployment rates are as high as 34.4%, making even more households food insecure (Reuters, 2021).

The largest proportion of snack shelf space in stores were allocated to sweet baked goods, crisps, and carbonated drinks which was mostly high in mean energy, total sugar, saturated fat, or sodium which contributes to the development of NCD's (Johnson et al., 2017). This is a problem as a larger share of shelf space is likely to be visually perceived, sought out and bought more frequently. Additionally there is an extremely large variety of unhealthy pre-packaged snacks for consumers to choose from in supermarkets, making healthier options such as fresh fruits and vegetables, which receives less marketing attention, less appealing to customers.

The snack products at POS were unavoidable in all stores and the options were mostly high in mean energy, total sugar, saturated fat, and sodium. This is unfortunate because ultra-processed foods are increasingly recognised to have addictive qualities (Gearhardt and Hebebrand, 2021; Moss, 2021) and, as stated by a store manager, it increases temptation while customers wait to check out and results in impulsive purchases. One particular supermarket chain, included in this study, has made public statements about removing sweets and chocolates from POS to create a healthier shopping experience (Woolworths, 2015). Despite this commendable effort, the store still has ultra-processed items at POS (e.g. energy bars, rusks, sweet and savoury biscuits, sugar-coated dried fruit bites, carbonated beverages, and crisps) which are energy dense, high in sugar, saturated fat, and sodium thus contradicting their aim of creating an environment where consumers are encouraged to shop healthier. There might be a

misunderstanding amongst store owners/head office regarding what constitutes healthy, since nutrition is not their primary scope of practice.

Overall, there appears to be a lack of social responsibility from manufacturers, supermarkets, and government to protect public health. Store managers indicated that the responsibility to purchase healthy snacks, or food in general, should come entirely from the customer. The current food environment, as assessed in this study, does not enable consumers to easily make healthy purchasing decisions. Ultra-processed foods have addictive qualities and consumers, without choice, are being subjected to aggressive advertisements and marketing from the food industry which jeopardizes consumers' freedom of choice (Schmitt et al., 2007).

We must also consider the misinformation, contradictory and false information regarding nutrition, especially through social media (Al-Jawaldeh et al., 2021). The nutrition literacy level of South Africa is not understood well enough to suggest that consumers are capable of interpreting information available in the nutritional facts panel in order to assess healthiness of products. Some studies that have assessed nutrition literacy in South Africa stated that consumers do read nutrition information on food labels to some extent (Van der Merwe et al., 2013). However, some were unsure of their understanding of the information provided (Kempen et al., 2012) and others simply do not read labels due to a lack of interest, time, habitual purchasing, and price concerns (Van der Merwe et al., 2013). The difficulties experienced by consumers when using nutrition labels include the font size of the label, as well as the terminology used (Jacobs et al., 2011).

This findings of the study provides insight on the retail food environment in the Western Cape. There is a need for strict legislation on the marketing and the promotion of unhealthy snack

products. Policymakers will be able to use this information to improve the availability of healthy food options at supermarkets and transform store layout and marketing strategies to reduce the purchasing of unhealthy items. Supermarkets are potential intervention points for limiting exposure of unhealthy products (Glanz et al., 2012). Therefore, in order for the government to implement strategies regarding in-store marketing, mandatory regulations would be necessary. There should be a restriction of ultra-processed snack foods at POS, no reduced prices of these items (specials and combo deals), and banning of branded marketing strategies in-store, which will enable consumers to purchase healthier options (Adams, 2022; Huitink et al., 2020). Mandatory front-of-package nutrient specific warning labels will be able to assist consumers with identifying unhealthy options in-store (Bopape et al., 2022) and incentivises the food industry to reformulate their products (Chan et al., 2021; Reyes et al., 2020). Along with front-of-package nutrition labelling systems, implementing an added tax to snack items with excessive amounts of nutrients of concern has proven to be effective in creating a healthier food environment (Reyes et al., 2020; Vyth et al., 2010). The ultra-processed food industry will be affected as changing packaging and reformulating products could become a big expense, and changes in marketing strategies and store layout might reduce sales. However, these changes are necessary to create a healthier shopping environments to improve consumer health outcomes.

5. 4 Limitations

This study limited snack items to commercially available pre-packaged items and excluded home prepared snacks as well as those freshly prepared at commercial outlets. Another limitation is that the stores used for data collection are in only one city in South Africa. Even though they are major supermarkets, this is not representative of the entire snack product supply for the country as a whole as it excludes small retailers, especially those in the informal

sector. Store managers, but not management at company headquarters, were interviewed. Certain marketing and sales information is kept at company headquarters, and store managers did not have knowledge regarding all of the marketing practices and decision making. Therefore, responses across stores reflect store managers opinions and practices, but might not comprehensively reflect broader company policies.

In-store data was collected in 2021, and nutritional composition data was collected in 2019. An assumption was made that the nutritional content of packaged snacks in 2021 had a similar nutritional composition to that of 2019. This study did not comprehensively assess compliance of snack products to the SANPM (Frank et al., 2021), as it excluded the assessment of non-nutritive sweeteners. It did however assess nutrients of concern to limit. This study assessed how many of the snack products available in supermarkets are energy dense and high in sugar, saturated fat, and sodium. It is important to note that predominately "unhealthy" snacks were assessed as no fresh and unpackaged fruit or vegetables were included in the dataset. Therefore, the findings on the nutritional composition of snacks available in supermarkets could perhaps be misleading as not all snack products available to consumers were included. However, this was only relevant to the nutritional analysis component of this study, which was conducted by category in order to minimise bias. The in-store assessment of product placement and marketing evaluated all snack products.

6. Conclusion

6.1 Conclusion

This study has highlighted that packaged snacks found in supermarkets are high in energy, sugar, saturated fat, and sodium, and consumption thereof should be limited. These snacks are widely available at all POS and there is a large food industry brand marketing presence in stores. Snack products were marketed at all stores and there were different strategies in place to attract consumers to these products. The findings suggest that supermarkets create an enabling environment that encourages the purchases of ultra-processed snack products. It is concerning as excessive consumption increases the risk of obesity and developing NCDs, which ultimately places a great burden on the country's health care system. There is a large responsibility placed on consumers to make healthy choices when grocery shopping. However, the supermarket environment, perhaps coupled with poor consumer nutrition literacy, does not enable them to do so. There seems to be a lack of social responsibility from the food industry to protect consumers and promote public health. Additionally, there is a need for national government to take charge in policy development, implementation, and monitoring to ensure a healthier food environment for all citizens. Strategies to prevent obesity and NCD's should be targeted at regulations around what is allowed to be sold to the public, reducing marketing and advertisements at store level, removing promotions of ultra-processed food items and limiting the presence of these snacks at POS. The implementation of front-of-package nutrition labelling systems (e.g. warning labels, Health Star Ratings, Nutri-Score and Traffic light labelling) will be able to guide consumers towards healthier products and drive manufacturers to reformulate, making products lower in nutrients which should be limited, thus increasing the variety of heathy packaged food and beverage options available in grocery store settings.

6.2 Recommendations

Decisions regarding the food one buys, and consumes, is heavily influenced by the food industry and government policies. Supermarkets should be considered as an intervention point for reducing exposure to marketing of ultra-processed snacks. Strategies to prevent obesity and NCD's should be targeted at regulations around what is allowed to be sold to the public, reducing marketing and advertisements at store level and removing promotions of ultra-processed unhealthy products so that consumers are not negatively influenced while purchasing groceries. Points of sale should limit ultra-processed snacks on display as it further encourages consumers to purchase them. Taxation has also proven to be effective in reducing purchases of ultra-processed products, with results being even greater when combined with nutrition warning labels as it reduces social inequities between high- and low-income groups (Langellier, 2021). In South Africa, front-of-package nutrient specific warning labels has shown to have a greater potential, compared to the Guideline Dietary Amounts (GDA) and multiple traffic lights, in assisting consumers to identify products high in nutrients of concern and discourage purchasing of unhealthy products (Bopape et al., 2022). Nutrition labelling systems assist customers with comparing their options as well as drive manufactures towards product reformulation. Without reformulation, consumers will continue to have few healthy packaged food and beverage choices in the supermarket food supply. This study did not include the collection of local snack consumption data which would have painted a greater picture as to how the nutritional composition of snacks relates to the quantity and frequency of what is actually consumed. Further research is needed on this topic as snacking prevalence in South Africa is high and constitutes a fifth of total daily energy intakes, which is concerning as it has the potential to negatively impact health outcomes. Continuous monitoring of the food environment is also essential as it will strengthen the systems needed to help reduce the burden of NCDs.

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Appendices

Appendix 1: Ethical clearance letter: ROFE

Researching the obesogenic food environment in South Africa and Ghana study (ethics number is BM17/08/20).

UNIVERSITY of the WESTERN CAPE

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30 October 2018

Prof D Sanders
School of Public Health
Faculty of Community and Health Sciences

Ethics Reference Number: BM18/7/20

Project Title: Researching the obesogenic food environment, its drivers and potential policy levers in South Africa and Ghana.

Approval Period: 19 October 2018 – 19 October 2019

I hereby certify that the Biomedical Science Research Ethics Committee of the University of the Western Cape approved the scientific methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report in good time for annual renewal.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

PROVISIONAL REC NUMBER -130416-050

FROM HOPE TO ACTION THROUGH KNOWLEDGE.

Appendix 2: Permission letter for secondary data analysis

UNIVERSITY of the
WESTERN CAPE

FACULTY OF COMMUNITY AND HEALTH SCIENCES DEPARTMENT OF DIETETICS AND NUTRITION

2 March 2020

The Chairperson
Higher Degrees Committee
Faculty of Community and Health Sciences University of the Western Cape
Robert Sobukwe Road
BELLVILLE
7535

Dear Sir

PERMISSION TO DO SECONDARY DATA ANALYSES ON EXISTING DATA

I am the PI on the research project "Researching the obesogenic food environment, its drivers and potential policy levers in South Africa and Ghana" (BMREC 17/8/20).

Hereby I grant permission to Sharna Solomon (student number 3452949) to use selected photographic data generated by this survey for the characterization of the local food environments, towards her mini-thesis for the Masters in Public Health Nutrition. She will have access to anonymized data only.

Kind regards

RINA SWART
Supervisor
PI: Researching the obesogenic food environment, its drivers and potential policy levers in South Africa and Ghana

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A place of quality,
a place to grow, from hope
to action through knowledge

Appendix 3: Observational checklist

Observational checklist (adapted from Thornton et al, 2013):

Name of Grocery store:_____

Date of data collection: _____

1. **Does the store have snack foods located at pay points?**
   Details:

Y | N

2. **If yes, record the variety of snack food items at each cash register display.**
   Product: (a) regular carbonated beverage (b) diet carbonated beverage (c) dairy drinks (d) juice (e) sports drinks/energy drinks (f) chocolate (g) breakfast bars/ energy bars (h) ice-cream (i) confectionery (j) sweet baked goods (k) savoury baked goods (l) popcorn (m) crisps (n) pretzels (o) nuts (p) seeds (q) dried fruit (r) no snack food (s) other (specify)

Cash register display	Product	Cash register display	Product
1		12	
2		13	
3		14	
4		15	
5		16	
6		17	
7		18	
8		19	
9		20	
10		21	
11		22	

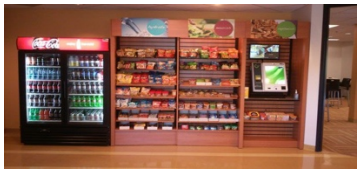
Y | N

3. **Are there snack food items (from list 1) on special?**

Y | N

4. **Are snack food combos being offered in the store?**
   I.e. pie and coke or "buy 3x80g Cadbury chocolates for R35"

5. **Does store have: (tick = yes)**

	Y	N
Branded display cabinets of snack foods 		
Branded temporary display units (pop-up holders and shelves)  		
Branded notice boards of snacks in aisles  		
Branded specific specials of the snack foods.  		
Notes:		

6. Snack foods are placed on the Top ☐ middle ☐ or low ☐ level of shelves.

7. Shelf space:

Snacks	**Length of aisle containing snack (metres)**
Chocolates, breakfast bars and energy bars	
Confectioneries	
Sweet baked goods	
Savoury baked goods	
Crisps	
Popcorn	
Pretzels	
Nuts, seeds, dried fruit	
Carbonated drinks (regular and diet)	
Dairy drinks	
Juice	
Sports/energy drinks	
Ice-creams, ice lollies and sorbets	

Appendix 4: Marketing and placements of snack foods questionnaire

Questionnaire to be completed with store manager/representative/merchandiser:

1. **Does the store decide which products are on special/part of promotional deals?** Y | N
Please provide detail of who decides and how that decision is reached:

2. **Are there popular "high volume" areas in the store that catch the attention of shoppers thus supporting more sales?** Y | N
If yes, who decides what products are placed there:

3. **Does the store receive any payment from companies for prioritising display or marketing of their food items? E.g. branded displays, larger shelf space, end of aisle displays.** Y | N
Provide detail:

4. **Is there control by the store over where certain products are placed?** Y | N
E.g. Can the store decide to remove all snacks away from pay-points, have healthy snacks mixing with unhealthy in the same aisle (nuts and fruits next to the chocolates or biscuits)
Comments:

5. **Do you think the in-store marketing and placement of snack foods, in this store, encourages the shopper to make healthy decisions?** Y | N
Comment on why and possible ways to improve this (only if "no" was selected):

6. **Is there any in-store marketing related information of snack foods that you think is relevant and that you may want to add?**

Y | N

Appendix 5: Ethical approval HSSREC

Ethical clearance from the Human and Social Sciences Research Ethics Committee of the University of the Western Cape.

UNIVERSITY of the WESTERN CAPE

60 YEARS of hope, action & knowledge

17 June 2020

Ms S Solomon
Dietetics and Nutrition
Faculty of Community and Health Sciences

Ethics Reference Number:	HS20/4/38
Project Title:	A comparison of the nutritional composition of snack goods available at grocery stores in South Africa and Norway: A cross sectional observational study.
Approval Period:	17 June 2020 – 17 June 2023

I hereby certify that the Humanities and Social Science Research Ethics Committee of the University of the Western Cape approved the methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report by 30 November each year for the duration of the project.

The permission to conduct the study must be submitted to HSSREC for record keeping purposes.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

Director: Research Development
University of the Western Cape
Private Bag X 17
Bellville 7535
Republic of South Africa
Tel: +27 21 959 4111
Email: research-ethics@uwc.ac.za

NHREC Registration Number: HSSREC-130416-049

FROM HOPE TO ACTION THROUGH KNOWLEDGE.

Appendix 6: Information sheet

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INFORMATION SHEET

The nutritional composition of snack foods available at grocery stores in South Africa: a cross-sectional observational study.

This is a research project being conducted by Sharna Solomon at the University of the Western Cape as part of her Masters in Public Health Nutrition. Your grocery store is invited to participate in this research project because it represents the variety of snack foods that are available to the general public in South Africa. The purpose of this research project is to describe the nutritional information and in-store placement of these snack foods.

If your store is used for this study, a researcher will complete an observational checklist of the in-store placement of these snack foods and ask the manager, or representative, a few questions pertaining to product placement.

This research is not designed to help anybody personally, but the results may help the investigator learn more about the food environment in a developing country such as South Africa. The findings of this study will be used for research purposes only. We hope that, in the future, other people might benefit from this study through better understanding of how snack foods are presented and marketed in-store. The findings of this study could also guide decisions toward obesity prevention strategies.

No identifying information of the store will be used in this study and your stores participation in this research is completely voluntary. You may choose not to take part. If you agree for your store to be included in this study, you may stop participating at any time.

If you have any questions about the research study itself, please contact the student Sharna Solomon at: 0827061326 or sharnaleesolomon@gmail.com. If you wish to report any problems you have experienced related to the study, please contact:

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This research has been approved by the University of the Western Cape's Humanities and Social Sciences Research Ethics Committee.

Humanities and Social Science Research Ethics Committee
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Appendix 7: Participation consent form

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CONSENT FORM

The nutritional composition of snack foods available at grocery stores in South Africa: a cross-sectional observational study.

The study has been described to me in language that I understand. My questions about the study have been answered. I understand what my participation will involve and I agree to participate of my own choice and free will. I understand that my identity will not be disclosed to anyone. I understand that I may withdraw from the study at any time without giving a reason and without fear of negative consequences or loss of benefits.

Y / N This conversation will NOT be recorded.

Y / N The researcher may take pictures of particular in-store marketing, but may not take pictures that identify the store or workers in the store.

Y / N The researcher MAY NOT take pictures of in-store marketing, the store, or workers in the store.

Participants name .....

Participants signature .....

Date .....

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