DURBAN UNIVERSITY OF TECHNOLOGY

THE NUTRIENT QUALITY, SODIUM CONTENT AND COMPLIANCE OF SAVOURY SNACKS AND POTATO CRISPS IN DURBAN

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APRIL 2023

THE NUTRIENT QUALITY, SODIUM CONTENT AND COMPLIANCE OF SAVOURY SNACKS AND POTATO CRISPS IN DURBAN

Submitted in fulfilment of the requirements of the

degree of Master of Management Sciences

Specialising in

Quality Management

in the

Faculty of Management Sciences

at the Durban University of Technology

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APRIL 2023

APPROVED FOR EXAMINATION

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Declaration

I hereby declare that this submission is my own and to the best of my knowledge, it neither contains material previously published nor written by another person, nor material that to a major extent has been accepted for the award of any other degree at Durban University of Technology or any other educational institution. I also declare that the intellectual content of this thesis is a product of my work. Any contribution made to the research by others especially in the use of equipment for sample analysis has been explicitly acknowledged in the dissertation.

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Nomcebo Zama

Date : 13.04.2023

Dedication

I would like to dedicate this study to my loving family. It has been through your support that I was able to see this study through. I would also like to thank my friends and family who have always motivated me to reach for greater heights without your love this wouldn’t have been possible.

I also dedicate this thesis to my late grandmother uMahadebe. I know that you would have been proud of this great achievement. I will forever be grateful for the love that you embedded in us as a family. This study is also dedicated to my late brother Masiya, I know for a fact that you would have thrown a big party for me to celebrate this wonderful achievement.

Acknowledgements

I would like to acknowledge my supervisor Professor Ramdass Kemlall without your support and encouragement I would have not been able to complete my study. I am grateful for the advice and assistance and for ensuring that I was able to complete my thesis on time. I would forever be grateful.

I would also like to thank my co-supervisor Kgabo Mokgohloa for the continued support.

I would also like to thank Abisha Kampira from Afregarde Editlink for their professionalism in editing my work.

The staff at the faculty of Management Sciences - thank you for all your assistance.

Abstract

South Africans consume a significantly high amount of sodium from salty snacks. The study aimed to evaluate salty snack manufacturers' compliance with the June 2016 and 2019 target date for sodium reduction as set out by the Department of Health in Regulation 214. It also aimed to assess low sodium claims made on selected products and determine if the sodium claim is compliant with the labelling legislation.

The study focuses on flavoured potato chips, flavoured ready-to-eat savoury snacks and salt and vinegar-only potato chips and savoury snacks. The study applied an observational descriptive research design. The aspects under observation were nutrition labels from the above items. The products were sampled from five major retailers in Durban using convenience sampling methods. A total sample of 90 products belonging to the above categories was considered. Sodium content information was collected from the selected product packages. The study also applied the Association of Official Analytical Chemists' (AOAC) official method 984.27 in laboratory tests to verify low sodium claims on the sampled products.

In terms of compliance, the study showed that out of the 90 selected snacks, 26% of the snacks did not meet their 2019 targets, while 4% did not meet their 2016 targets. Fisher's exact tests showed that no snack category had a better inclination towards meeting 2019 tests than others. In the flavoured ready-to-eat savoury snack category, 7.5% of the 40 varieties did not meet their 2016 target of 800mg Na/100g, while 27.5% did not meet their 700mg Na/100g target for 2019. In the flavoured potato chips group, all 40 varieties met their 2016 target of 650mg/100 while 20% did not meet their 2019 target. In the salt and vinegar chips category, 9 varieties or 90% met their 2016 target of 1000mg Na/100g, while 40% of the 10 varieties did not meet their 2019 target of 850mg Na/100g. Generally, most snacks met their 2016 and 2019 targets, but a concerning proportion failed to do so.

The laboratory tests showed that 4.4% of the products made a compliant low sodium nutrient claim (sodium levels below 120mg Na/100g). The findings from laboratory tests show that 4 of these were indeed low sodium content products, although their claimed sodium content was slightly higher than reported from independent laboratory tests. The findings also show that 1 product had a label indicating low sodium content,

although it had sodium content far above the low sodium limit. The findings show the potential errors and misrepresentations in sodium content labelling in savoury snacks.

Among other things, the study recommended increased product compliance monitoring and evaluation, using standardised, rigorous sodium testing and measuring systems, using more consumer-friendly labels and consumer education on sodium labelling.

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List of Abbreviations

AOAC:	Association of Official Analytical Chemists
BP:	Blood Pressure
DoH:	Department of Health
EU:	European Union
FHD:	Food and Health Dialogue
G (g):	grammes
Mg (mg):	milligrams
Na:	Sodium
NaCl:	Sodium Chloride
NIHI:	National Institute of Health Innovation
NZ:	New Zealand
RTE:	Ready-to-eat
SA:	South Africa
SPSS:	Statistical Package for the Social Sciences
DUT:	Durban University of Technology
WHO:	World Health Organisation

Keywords

Sodium content

Salt

Compliance

Regulation 214

Product labelling

Durban

South Africa

CHAPTER 1: BACKGROUND OF THE STUDY

1.1 Introduction

Salt is a common everyday ingredient used to flavour and preserves food in households and commercial entities. Over the years, there has been increasing concern about the quantity of salt consumed by societies, including processed salty snacks (Heart Foundation South Africa, 2020). Excessive amounts of salt in both its discretionary and non-discretionary forms are linked to many health problems, especially cardiovascular problems (Department of Health, South Africa, 2022). Hypertension is a global problem that increases the risk of heart attack, stroke, kidney failure, and blindness (World Health Organisation, 2019). It has been reported that 1.13 billion people have been diagnosed with hypertension (World Health Organisation 2019). High salt intake was identified as one of the contributing factors to hypertension.

Non-discretionary salt comes in processed foods and consumers do not have immediate control over it except to reduce taking such foodstuffs (Heart Foundation South Africa, 2020). Such processed foods constitute a significant element of modern diets and lifestyles and replacing them is not always a preferable choice for consumers. Supranational, international, and local entities continuously endeavour to reduce foods' salt or sodium content. In this vein, South Africa implemented the *Regulations Relating to the Reduction of Sodium in Certain Foodstuffs and Related Matters* (Regulation 214) of the *Foodstuffs, Cosmetics and Disinfectant Act, 1972,* published in the Government Gazette by the Department of Health (Department of Health 2016). These regulations targeted the reduction of non-discretionary salt in 13 food categories. This study looks at three product classes that fall into two categories regulated for sodium reduction by 2016 and 2019 to ascertain the degree of success in meeting these two targets. The study looks at *"Ready-to-eat savoury snacks, excluding salt-and-vinegar",* "*Flavoured potato crisps, excluding salt and vinegar"* and *"Flavoured, ready-to-eat, savoury snacks and potato crisps – salt-and-vinegar only".* Collectively, in this study, these are referred to as salty snacks or salty, savoury snacks.

1.2 Background

Salty snacks are a popular treat among people of all ages. Several global research reports published by independent research agencies highlight continuous growth trends in salty snack volumes and revenues. For instance, Grand View Research, a US research firm, reports that in 2021, the global salty snacks industry realised total revenue of US$250 billion and on top of that, is expected to continue on a growth trajectory until 2030. The reports point to this growth rate as "urbanisation and hectic lifestyles" that have seen some individuals and households even substituting traditionally cooked meals for snacks (Grand View Research, 2021). A different agency also projected significant revenue growth for salty snacks. Another report by Markets and Markets (2022) projected the global salty snacks industry revenue to rise to US$263 billion by 2027 and this report attributes this positive growth to changing lifestyles. Wyatt (2022) asserts that the impact of COVID-19, especially the "stay-at-home" options and restrictions significantly increased the volume of snacking in developed countries. At the same time, constrained supply chains forced price increases and constrained demand, yet the industry recorded significant positive performance (Wyatt, 2022).

The salty snack market is broad and diverse in South Africa. Research and Markets (2021) estimates that South Africa's salty snack revenue for 2020 amounted to US$ 1,348.93 million and was projected to grow by 3.94% between 2021 and 2026. The same report cites another study by Knorr, a well-known vegetable flavour brand, which states that 70% of SA consumers snacked on salty snacks with potato chips being the most popular snacks (Markets and Markets, 2021). IPSOS (2021) reports that the consumption of snacks increased by 43% between 2020 and 2021. As of the second quarter of 2021, salty snacks held a 23% market share of all snacks purchased and consumed in South Africa (IPSOS, 2021). This declined to 16.1% in the second quarter of 2021 (IPSOS, 2021). In addition to sales volumes, revenue and market share growth related to salty snacks, the IPSOS (2021) reports that five major retailers dominate this market: Shoprite, Pick n; Pay, Spar, Checkers and Woolworths. As of the second quarter of 2021, 31% of all salty snacks were distributed via Shoprite, followed by 19% through Pick n' Pay, 10.8% via Spar and 16.3% through Checkers and 1.4% via Woolworths (IPSOS, 2021). Generally, statistics point to an ever-increasing consumption of salty snacks – a trend that is not expected to down any time soon.

In this environment characterised by increasing snacking, some studies and reports talk of significant increases in high sodium-related diseases and conditions (Chen et al. (2021). Chen et al. (2021) note that between 2009 and 2019, the death burden and disability risks associated with increased sodium intake increased in both the developed and developing world. The World Health Organization (WHO) reports that globally 4.1 million people die because of sodium-related deaths. The same report castigates poor dietary choices that include snacking on high-sodium foodstuffs as severe sodium-related death risk factors. In South Africa, sodium-connected deaths are rising roundabout the same time snacking on sodium-rich foodstuffs is increasing. WHO also reports a considerable prevalence of people worldwide dying from cardiovascular diseases. In 2016, 17.9 million people died from cardiovascular diseases (WHO, 2016).

In response to such problematic situations, the South African government implemented regulatory measures to limit sodium content in selected foodstuffs. The South African Department of Health released the regulation in March 2013 for implementation in June 2016 and June 2019 (Department of Health 2013). The foodstuffs included in the regulation are presented in Table 1.1. The regulations have been amended two times, and government notice 1071/2017 included updates on specific definitions, the method of testing for sodium analysis and updated food categories (Department of Health 2017). The last amendment regulation, Government notice 812/2019, was published in 2019 and included updated food categories for processed and raw meat sausages (Department of Health 2019).

Table 1.1: Reduction of total sodium content (Na) of certain foodstuffs (Source: Department of Health,2013)

Food category	2016 target (Na/100mg)	2019 target (Na/100mg)
Bread	400	380
All breakfast cereals	500	400
All fat and butter spreads	550	450
Savoury snack, excluding salt-and-vinegar flavoured	800	700
Flavoured potato crisps excluding sal and vinegar	650	550

Flavoured RTE savoury snacks and potato crisp, salt-and - vinegar only	1000	850
Processed meat - uncured	1300	1150
Processed meat - cured	850	650
Raw processed meat sausages	800	600
Dry soup powder (not instant type)	5500	3500
Dry gravy powder and dry instant savoury sauces	3500	1500
Dry savoury powders with dry instant noodles to be mixed with liquid	1500	800
Stock cubes, powder, granules, emulsions, paste or jellies	18000	13000

The main objective of the regulations was to decrease the salt level in certain foodstuffs. The National Department of Health established this regulation to monitor consumers' use of non-discretionary salt in South Africa (Department of Health 2013). Salt Watch noted that effective coordinated marketing strategies to communicate to South Africans regarding the use of discretionary salt could aid in empowering consumers (Wentzel-Viljoen et al., 2017). Therefore, food manufacturers must comply with the levels set out by the government. Peters et al. (2017) recommend that consistent monitoring of food products in South Africa is vital to ensure industry compliance and evaluate the impact of reduced sodium in the diet. Before these regulations. Spires et al. (2016) attest that South Africa lacked a harmonised policy for regulating sodium.

1.3 Research problem

The study's research problem is located at the confluence of three critical trends highlighted in the background. These are increasing consumption of sodium-containing salty snacks, increasing sodium-related disease burden and deaths and attempts to regulate sodium intake through regulation as a response.

Various factors may affect compliance with salt reduction regulations. Salt has been used as a food preservative that limits the growth of harmful bacteria. The increased sodium intake has researchers suggesting it may pose health risks to human beings (Doyle & Glass 2010). The problem faced by the government and food producers has been to identify what measures need to be taken to reduce salt intake while still maintaining various functions in a recipe (Kilcast & Angus, 2007). When manufacturers need to decide whether to decrease sodium content in food, different factors need to be analysed, including foodborne pathogens, food safety, stability, quality, and cost. Salt reduction without the necessary quality mitigation factors may shorten shelf life and result in quicker spoilage and food waste (Taylor et al., 2018).

In addition to complying with sodium content limits in foodstuffs, food manufacturers must comply with labelling regulations that inform consumers of sodium content in what they consume and whether these meet health requirements. *Regulations Relating to the Reduction of Sodium in Certain Foodstuffs and Related Matters:* Amendment, No. R989 of the Foodstuffs, Cosmetics and Disinfectant Act, 1972, was published in the Government Gazette by the Department of Health (Department of Health 2016). The sodium value should be at or under the prescribed sodium target in products where a claim is made. In South Africa, the conditions food producers need to meet to make a claim are regulated by Regulations Relating to the Labelling and Advertising of Foodstuffs, No. R146 of the Foodstuffs, Cosmetics and Disinfectant Act, 1972 (Department of Health 2010). The regulations were implemented to protect consumers and prevent manufacturers from making misleading claims on packaging.

To verify if food manufacturers comply, it is therefore vital to review the sodium content as per regulation R214 and the claims made on the label as per labelling regulation R146. There is a gap in measuring regulatory compliance in South Africa as there is not enough research to verify if food products comply with the legislation set out by the South African government. To reiterate, this problem occurs at a time when the consumption of salty snacks that are considered significant contributors to sodium intake is increasing.

1.4 Aim of the study

The study aims to evaluate salty snack manufacturers' compliance with the June 2016 and 2019 target date for sodium reduction as set out by the Department of Health. Pulker et al. (2017) Articulated that it is essential for the government to have a robust monitoring and surveillance system in place for ultra-processed foods and to ensure they are consequences for manufacturers who do not comply with regulations. Self-regulation in the food industry can lead to an inefficient health system when companies do not fully participate when the legislation lacks scientific research, and if there are no evaluations done to monitor compliance and the impact of the legislation (Sharma, Teret & Bronwell 2010). Such views motivate the researcher to conduct an evaluation that can assist in determining the levels of compliance with sodium reduction targets and nutrient content claim labelling in Durban.

1.5 Study objectives

The study was intended to meet the following objectives:

- To assess and describe sodium content in selected savoury snacks
- To Investigate the selected savoury snack's compliance with Regulation 214 (R.214) on 2016 and 2019 sodium content targets
- To assess low sodium claims made on selected products and determine if the sodium claim is compliant with the labelling legislation

These objectives related to *"Ready-to-eat savoury snacks, excluding salt-and-vinegar", "Flavoured potato crisps, excluding salt and vinegar" and "Flavoured, ready-to-eat, savoury snacks and potato crisps – salt-and-vinegar only"* as classified in South African health regulations, specifically R.214.

1.6 Research questions

The following research questions were designed to meet the above objectives:

- What is the sodium content in selected savoury snacks?
- What is the selected savoury snack's level of compliance with Regulation 214 (R.214) on 2016 and 2019 sodium content targets?
- Are low sodium claims made on selected products compliant with South African labelling legislation?

The research questions also applied to selected, sampled savoury snacks like the objectives.

1.7 Plan of research activities

The study had five significant milestones from the research proposal development stage up to the final submission of the dissertation stage. These are highlighted below:

1. Research proposal submission and obtaining ethics clearance from DUT
2. Data collection by purchasing products in retail shops, coding data, and submitting samples to the lab for sodium verification.
3. Data analysis and interpretation of results using Microsoft Excel and SPSS

4. Write up the final report
5. Submission of the final dissertation

The study successfully went through all the above stages as planned.

1.8 Delimitations of this study

The sodium regulations of interest to this have 13 food categories. Only the following three categories were analysed: *"Ready-to-eat savoury snacks, excluding salt-and-vinegar",* "*Flavoured potato crisps, excluding salt and vinegar"* and *"Flavoured, ready-to-eat, savoury snacks and potato crisps – salt-and-vinegar only".* The food products bought for label review were from Durban and included Shoprite, Pick n' Pay, Spar, Checkers and Woolworths. This selection criterion excludes salty snacks from other retail outlets. Also, the study concentrates on factory-produced snacks distributed via formal retail channels.

1.9 Validity and reliability/trustworthiness

The study ensured the validity and reliability of its outcomes in various ways. To ensure validity, the research cross-checked data collected on labels, measured and recorded each sample twice to control data input errors and carefully categorised products as per the regulations. The researcher also followed and recorded observational descriptive research methods recommended and discussed by other published researchers. This included the use of proper ICP-AES procedure per the Association of Official Analytical Chemists (AOAC) official method 984.27 for testing sodium levels in solid foodstuffs. To ensure the reliability of the findings, the researcher documented the processes applied, the product categories used, and the settings from which they were extracted (Creswell & Creswell, 2018). The study also relied on research methods generally considered appropriate for an observational study, specifically the careful observation, recording and cross-checking of procedurally sampled and categorised data.

1.10 Ethical consideration

The research was guided by fundamental research ethics as discussed by several scholars, among them Creswell and Creswell (2018), Kumar (2018) and Suresh (2018). This included ensuring the confidentiality and anonymity of recorded samples by using code names instead of product brand names. Ethical clearance was also sought and granted by the Durban University of Technology. All the raw data collected for this study will be destroyed after five years. Only the researcher and supervisor will have access to the information.

1.11 Overview of research methodology and study design

This study was carried out as an observational descriptive cross-sectional quantitative study. Data was collected using recording and measurement processes and was analysed using Statistical Package for the Social Sciences (SPSS) alongside Microsoft Excel. The study used a convenience sampling procedure where data was collected from five major retail stores in Durban. The researcher collected the first 90 samples from across the five retailers to give a total sample of 90. This was justified by other related sizes that used sample sizes close to 90. A chemical analysis of the food products using inductively coupled plasma was done to test if the sodium content claims on foodstuffs that made such claims were valid. The inductively coupled plasma method recommended by the Department of Health was used for this process (Department of Health, 2017).

1.12 Important terms

This study's key terms were salt/sodium, excess salt and salty snacks. In this study, these terms were defined as follows:

1.12.1 Sodium/salt

Elias et al. (2019) explain that salt is also referred to as table salt or sodium chloride, and the chemical formula is NaCl. Salt or sodium chloride is a nutrient source for sodium and is needed by the body in small amounts. Salt comprises sodium and chloride, containing 40% of the particle (Durack et al, 2008).

1.12.2 Excess salt

To quantify salt intake, the World Health Organization puts any salt intake above 5 grams per day as excessive, while any intake of 3 grams and below is considered too little. The goal has been to reduce daily salt intake in adults to between 3g and 5g per day (WHO, 2019).

1.12.3 Salty snacks

Unless indicated, these are *“Ready-to-eat savoury snacks, excluding salt-and-vinegar”,* “*Flavoured potato crisps, excluding salt and vinegar” and “Flavoured, ready-to-eat, savoury snacks and potato crisps – salt-and-vinegar only".* In this study, these are considered salty snacks classified under the Regulations Relating to the Reduction of Sodium in Certain Foodstuffs and Related Matters: Amendment, No. R989 of the Foodstuffs, Cosmetics and Disinfectant Act, 1972.

1.12.4 Nutrition content claim

According to R1055 of the Foodstuffs, Cosmetics and Disinfectants Act 54 of 1972, a nutrient content claim is defined as "a claim that describes the level of nutrient contained in a foodstuff".

1.13 Structure of the study

The final research report produced from the study's efforts was a six-chaptered thesis report. These chapters are outlined below:

1.13.1 Chapter 1- Background to the Study

The first chapter introduced the study and gave its background. It also explained the research problem the study was set to resolve and its objectives. It also delimited the research and defined vital concepts and terms as applied in this study.

1.13.2 Chapter 2- Literature Review

This was mainly a discussion of research by different authors on topics related to hypertension, cardiovascular disease and the benefits of consuming diets low in salt, the impact of food reformulation, food labels and their effect on consumer purchasing and the different types of food claims used in South Africa and internationally.

1.13.3 Chapter 3- Research Design and Methodology

In this chapter, the research philosophy design and methods that guided the study were discussed in detail. It also highlighted how data was collected and analysed and how reliability and validity as research quality indicators were managed. The chapter ended with a discussion of the ethical considerations that guided the study.

1.13.4 Chapter 4- Results and Findings

In this chapter, the results of the analysed data were presented and discussed. The discussion mostly involved comparing and contrasting the study's findings with other sources.

1.13.5 Chapter 5 – Discussion of Results

In this chapter, the study's results are discussed.

1.13.6 Chapter 6- Conclusion and Recommendations

This chapter concluded the study by summarising key findings and giving recommendations based on the results made. It also recommended areas for future studies.

1.14 Conclusion

This chapter introduced this study as descriptive observational research to evaluate food manufacturers' compliance with the June 2016 and 2019 target date for sodium reduction as set out by the Department of Health, specifically Regulation R214 on sodium reduction and regulation R146 on product labelling. The study was considered essential for assessing the levels with which sodium content had been reduced in an environment where salt intake through salty snacks was increasing while cardiovascular diseases and other sodium intake-related diseases and conditions were also growing. The study focused on Durban, a metropolitan area whose extensive urbanity is viewed as driving snacking lifestyles IPSOS (2021). The next chapter reviews the literature relating to the study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter reviews the literature on various topics and concepts discussed in the study. The chapter starts with a discussion of salty savoury snacks and their connection with salt and sodium intake, as well as the health hazards associated with excess salt intake. This chapter uses the terms salt and sodium intake interchangeably, noting that salt consists of 40% sodium and 60% chloride (Heartfoundation SA, 2020). Also, a teaspoon of salt is quantified as 5 grammes of salt and 2000 mg of sodium (Heartfoundation SA, 2020), and a high salt intake refers to any intake above a teaspoon a day or above 2000mg for an adult. The chapter includes an overview of current sodium management strategies implemented internationally, regionally and locally.

2.2 Salty savoury snacks and sodium content

In many studies, snack foods are not well-defined, although researchers seem to describe them well (Pries et al.,2019). Snacks can be classified either as sweet or savoury, while savoury ones can be further classified into salty snacks and spicy snacks (Abeywickrema et al., 2022). The common components of savoury snacks were the use of a starchy or vegetable base, fat/oils and salt and spices rather than sugar as main flavourants (Pries et al., 2019; Abeywickrema et al., 2022). Salty, savoury snacks use salt as the main flavourant and are classified under different names. They include potato chips or crisps, rice chips, tortillas chips, corn chips, and popcorn (Farrand, 2020). Potato crisps are made from potatoes, while ready-to-eat extruded salty snacks are usually made from starches like flour and corn as main ingredients. While potato chips can be made through frying and baking, extruded snacks are made through the extrusion process (Hashempour-Baltork, 2017). These snacks can come out with a puffy or crunchy texture depending on the ingredient, temperature and pressure combination (Korkerd et al., 2016).

Salt is made up of almost equal parts of chloride and plays various important roles In the savoury snack manufacturing processes (Elias et al., 2019). According to Cargill (2010) and Elias et al. (2019), these are:

- Texture enhancement – salt can be manipulated to give the desired snack texture when combined with water, fats, starches and other substances. It helps with a firm texture that is required in most savoury snacks.
- Flavourant – salt enhances the taste of snacks. Many snacks apply it as their primary flavour rather than as an additive (for example, salt and vinegar-flavoured chips).
- Flavourant enhancer – salts also enhance how other flavours in a savoury snack can come out. They suppress bitterness while reducing sweetness, making flavours like vinegar more testable.
- Nutrient source - as the body requires sodium as a nutrient, salt in savoury snacks also serves this purpose.
- Emulsifying agent – salt helps to bind protein with other substances to avoid product crumbling or disintegration.
- Preservative – salt reduces water content in snacks, limiting microbial activity and making products last longer on shelves.

Salt plays a significant role in savoury snack production and human food consumption experience (Elias et al., 2019). In humans, sodium, a key component of salt, is essential for regulating body water, the optimal functioning of the neurological system and muscle contraction, among others (Puri & Lee, 2021). It is, however, required in often smaller-than-consumed functions (World Health Organisation - WHO, 2012). This imbalance between optimum salt and actual intake is a globally significant health risk (WHO, 2012).

Savoury, salty snacks are a major daily sodium contributor to the human body (Govender et al., 2020). The reasons for the popularity of salty snacks are their ease of accessibility, affordability and storability (Hymes et al., 2020). These appeal to both the manufacturer and the consumer. An adult eats an average of 40 grammes of savoury snacks in the United States daily. Ronquest-Ross et al. (2015) attribute the increasing consumption of savoury snacks to dietary shifts as societies move away from traditional, more stable diets toward highly processed, sugary and savoury diets. These shifts have seen a phenomenal global increase in savoury snack consumption of 66.7% between 1999 and 2012 (Ronquest-Ross et al., 2015).

A common aspect of salty, savoury snacks is their affordability to the rich and the poor, making them a socially cross-cutting foodstuff (Hymes et al., 2020). One of the demographic groups considered major salty snack consumers was school children (Karimiet et al., 2015; Govender et al., 2020). Karimiet et al. (2015) further list potato chips as the commonest of such snacks. The effect of affordability and convenience of snacks for the school environment combined with limited knowledge of health risks, pressure from colleagues and family experiences make school children highly vulnerable to the adverse effects of high sodium in savoury snacks (Bastami et al., 2019).

2.3 Sodium intake and its relation to health

It is reported that many people die from cardiovascular disease worldwide (World Health Organisation 2016). In South Africa, many people are killed by heart disease and stroke, and more than 17.3 million people are internationally dying from cardiovascular diseases (The Heart and Stroke Foundation 2016). A diet high in sodium can also negatively affect the body's organs and result in blood pressure-independent problems, as shown in Figure 2.1 (Farquhar et al., 2015).

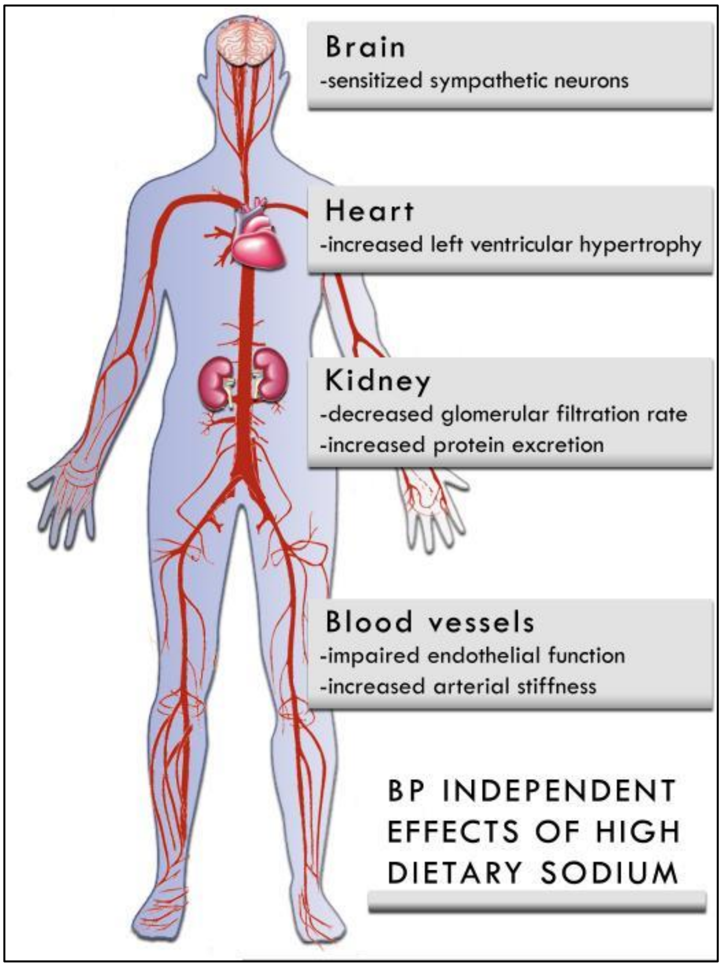


Figure 2.1: BP independent effects of high dietary sodium

Source: Farquhar et al. (2015)

The above chart links excessive sodium consumption to endothelial and arterial problems causing stiffness in the latter. It can result in renal challenges like decreased glomerular filtration rates and increased protein secretion (Farquhar et al.,2015). It is also associated with increased sensitised sympathetic neurons in the brain (Farquhar et al., 2015). For the above and many other reasons, Betram et al. (2012) articulate that decreasing the sodium content of food will positively affect the health system. In a comparative study of South Africa and Ghana, whose aim was to assess salt use behaviour, it was found that 80% of the population added discretionary salt to their food (Menyanu et al., 2017). It was further concluded that there was a need to increase consumer awareness of salt intake and discretionary salt intake as one of the ways of managing excessive, health-hazarding sodium (Menyanu et al., 2017). In a study on 102 216 adults across 18 countries, it was reported that 43.5% of the population in the study had sodium extraction of 5g and more per day. This projected sodium excretion was higher for people residing in rural areas (Mente et al.,2014). Excessive sodium intake was not only a South African problem but a global one.

2.3.1 Actual versus optimum sodium consumption

The determination of the actual salt intake that is healthy for the body is a regular discussion. Mente et al. (2021) argue that currently, available data indicates that many countries encourage adults to consume about 3 to 5g per day of dietary salt and that this is associated with low levels of cardiovascular disease risk. Cardiovascular disease risk can increase when dietary salt intake is over 5g per day and below 3g /day.

This is the WHO (2013) recommended daily intake that enables people to benefit from the positive effects of sodium while minimising health risks (WHO, 2013). At too low levels, there is a risk of missing out on the benefits like enhanced functioning of the neurological system and muscle contraction that come with sodium intake (Puri & Lee, 2021). This low level is depicted as anything below 3g per day in the chart below. Anything above 5g is considered too high (Mente et al., 2021).

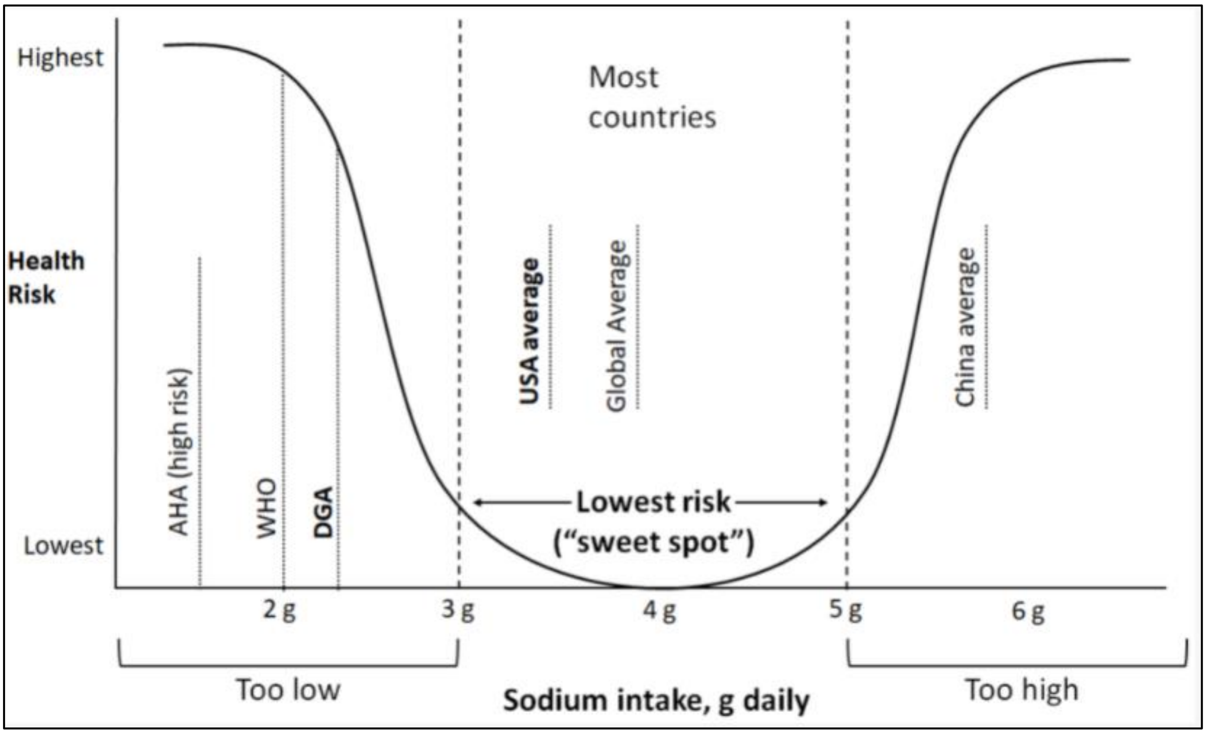


Figure 2.2: Conceptual diagram highlighting health risk based on current data

Source: Mente et al.(2021)

The Heart Foundation SA (2020) states that 5g of salt is equivalent to 1 teaspoon, making 2000mg of sodium. Thus there was an urge not to surpass one teaspoon of salt per day for adults. South Africans, however, were consuming 2 to 3 times the recommended daily salt intake, meaning that they were getting over 4000 to 6000 mg of salt per day (Eksteen & Mungal-Singh, 2015; Haertfoundation SA, 2020). This was through discretionary salt, which is added at home and processed or non-discretionary salt consumed in processed foods (Eksteen and Mungal-Singh, 2015). While Webster et al. (2017) put nondiscretionary salt at 41% of the country's total salt consumption, Koen et al. (2021) believe it is above 50%.

Mancia et al. (2021) recommend that low sodium intake curb hypertension prevalence, especially among at-risk population groups. A reduction of sodium and potassium diet intake for a population, reformulation by food producers, and vigorous regulations and monitoring by government authorities are vital to decreasing hypertension and cardiovascular diseases (Singh & Chandokar, 2018). Mello et al. (2019) suggest that there is a need for health policies which will aid in promoting the correct use of sodium and the use of discretionary salt when preparing food at home and this needs to form part of a public awareness campaign.

Similarly, Soto et al. (2018) discuss that laws and policies, coupled with increased awareness of discretionary salt use at home and the dangers of consuming ultra-processed foods, should be implemented to guide and protect consumer health. Stamler et al. (2018) recommend that sodium reduction strategies and policies be introduced in the food supply chain to curb prehypertension and post-hypertension. This included food production and, most importantly, the manufacturing and processing stages. The following section discusses various countries' strategies and policies for reducing salt and sodium intake.

2.3.2 Benefits of sodium reduction to health

There are various cardiovascular-related benefits of reduced sodium intake in humans. He and McGregor (2003) point out that reducing salt to less than 3g per day will positively affect blood pressure and cardiovascular diseases and that a 3g salt intake should thus become the target worldwide. Grillo et al.(2019) point out that a diet low in sodium can positively affect the cardiovascular system, assisting in stable blood pressure values in hypertensive patients and can assist in vascular functioning.

Another longitudinal study, the Dietary Approaches to Stop Hypertension (DASH), started in 1994 with a total of 412 study participants, shows lower systolic and diastolic blood pressure levels among low sodium consumers (Sacks et al.,2001).

With the need to reduce sodium-related health risks and harness the benefits of low sodium content, WHO and its member states have agreed to reduce salt intake with a global target of 30% by 2025 as represented in figure 2.3.

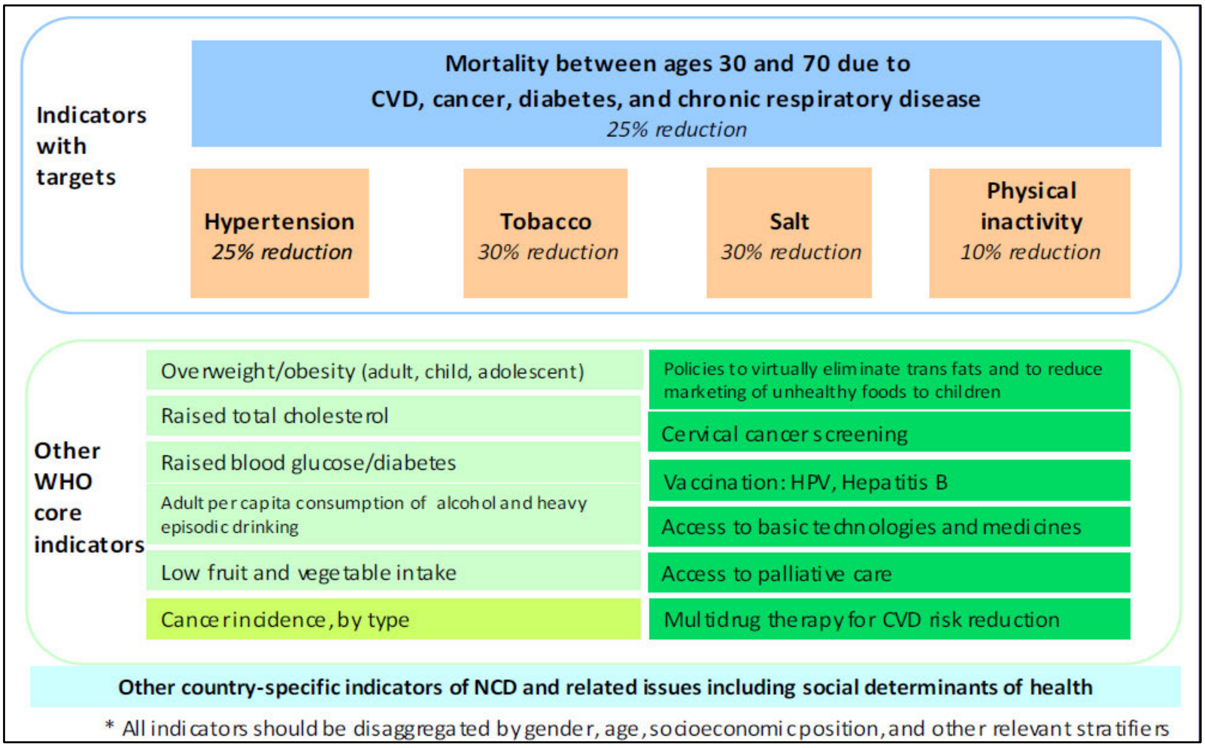


Figure 2.3: Indicators and targets for 2025 for the global monitoring programme

Source: Mente, O'Donell and Yusuf (2021)

The reduction of sodium as captured above is estimated to result in a 25% decrease in the mortality rates of people between the ages of 30 and 50. The reduction of salt in food is a significant milestone toward the attainment of the above (Mente et al., 2021).

Some studies have, however, produced less convincing results on the relationship between sodium intake and hypertension. An INTERSALT study with a sample of 10 078 people investigated the association between sodium intake and blood pressure. The study included men and women aged 20-59 from 39 countries with the highest sodium intake and a higher risk of hypertension. The study concluded that they were a weak relationship between dietary sodium intake and BP in 33 of the 52 sampled centres and this relationship was statistically significant in 8 centres only (Intersalt Cooperative Research Group 1988: 325).

In Scotland, a 24-hour urine samples study with a sample of 7354 adults aged from 40 to 59 years old showed a weak association between sodium intake and blood pressure (Smith et al., 1988). Two Trials of Hypertension Prevention (TOHP) studies conducted between 1987-1995, however, show results that contradict findings that there was a weak relationship between sodium and hypertension. In follow-up observational trials carried out after 10 -15 years, participants from the sodium reduction group experienced a lower risk (25%-30%) of cardiovascular-related diseases (Cook et al.,2007).

2.4 International salt reduction strategies

WHO has published the SHAKE package as part of its strategy to assist its member states in how they can achieve salt reduction (WHO, 2016). The technical package has policies and interventions that the member states can use as part of their salt reduction strategy. SHAKE is an acronym for the five focus areas that must be implemented to ensure salt reduction, as referred to in Table 2.1 (WHO, 2016).

Table 2.1: WHO's Shake package (World Health Organisation, 2016)

S	Surveillance	Measure and monitor salt use
H	Harness industry	Promote food reformulation to contain less salt
A	Adopt labelling and marketing standards	Implement effective standards for accurate labelling and marketing
K	Knowledge	Educate society to consume less salt
E	Environment	Support the promotion of health eating

WHO's SHAKE package emphasises the need to monitor the sodium content environment, particularly at all food production value chain levels. It also encourages supporting industries to meet sodium reduction targets through foodstuff reformulation. Thirdly WHO members are encouraged to adopt food labelling standards that effectively guide consumers of all groups in making healthy, low-sodium decisions. Empowering citizens through knowledge is also considered a critical strategy in reducing sodium intake and promoting healthy eating across society (WHO, 2016).

Many countries worldwide have formulated and implemented policies, strategies and programmes to reduce sodium intake among their citizens. In the United States of America (USA), the Food and Drug Agency (FDA) issued a voluntary guidance document for sodium reduction with 163 subcategories which has sodium targets outlined (Voluntary Sodium Reduction Goal – VSRG, 2021). The guidance document outlines restaurants, food manufacturers and service operators' targets. The plan is to reduce daily average sodium intake by 12% in 2.5 years, from 3 400 mg to 3 000 mg (VSRG, 2021). Figure 2.3 below shows the American population which exceeds the recommended sodium limits.

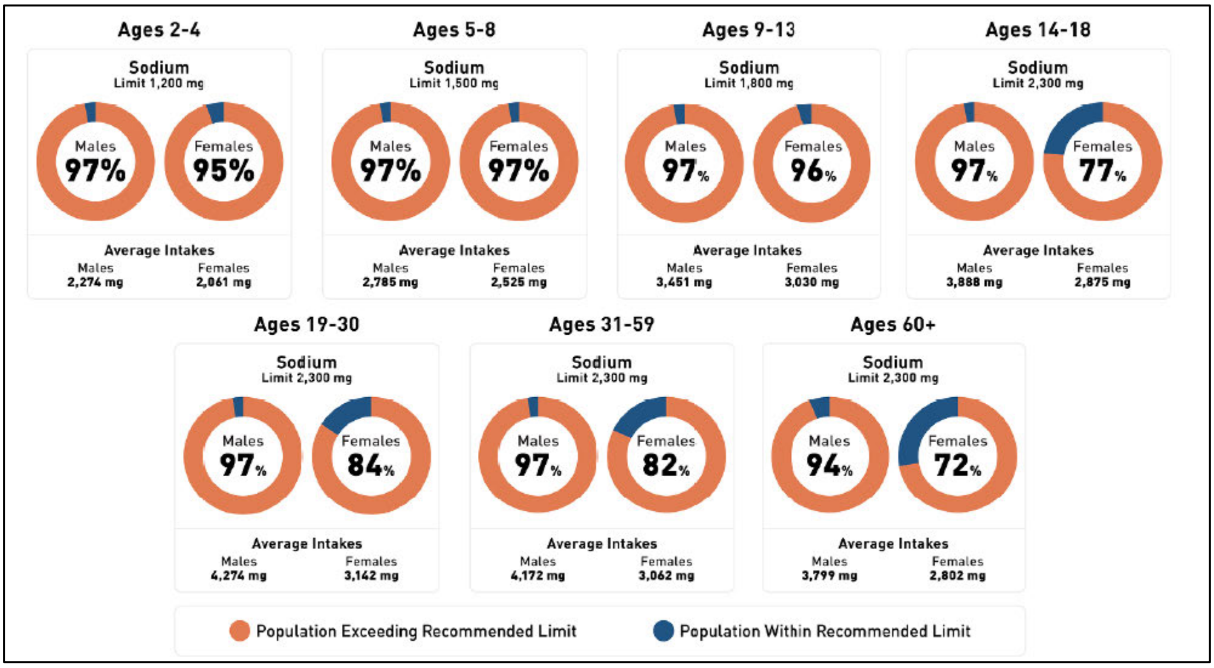


Figure 2.4: Population exceeding recommended sodium limit

Source: Voluntary Sodium Reduction Goal (2021)

The above data shows excess sodium intake as a major problem within the American population and across all age groups. For instance, 97% of males between the ages of 2 to 4 exceeded the daily recommended sodium intake. Also, 94% of all males aged 60 and above exceeded their recommended daily sodium intake. Comparatively, females in that country had a lower, albeit still above, daily recommended intake of sodium. The smallest sodium-exceeding group was that of females aged 60 and above

(VSRG, 2021). In its attempt to counter and correct the above situation, the FDA sodium reduction strategy has four pillars, and these are:

- Establishing sodium reduction targets
- Monitoring the food supply for sodium levels
- Evaluating the progress made by the different stakeholders in sodium reduction
- Engaging with the stakeholders on sodium reduction

Canada is also working with food manufacturers to gradually decrease the level of sodium in food as part of its Healthy Eating Strategy. Canada has voluntary sodium targets for processed foods with a 2025 target date (Government of Canada, 2021). Currently, Canada has 117 categories with sodium reduction targets. The country's goal is to decrease the average sodium intake to 2300 mg daily (Government of Canada, 2021).

European Union (EU) members continuously work on a common regional salt reduction framework. The framework aimed to assist its member states in reducing salt intake among their citizens (WHO, 2020). The EU salt reduction framework was approved in 2008. Eighteen countries highlighted the following challenges as a hindrance in implementing their salt reduction strategies for 2008-2012. These were a lack of industry involvement, public consumer awareness, lack of resources and the legislative process. (EU, 2012). Individual countries have also implemented their sodium reduction strategies as part of broad national or standalone sodium reduction-targeted strategies.

Ireland mainly fights excess sodium through its Healthy Ireland strategy for 2021-2025. The strategy's phase 2 has six themes as part of its sodium reduction framework (Health Ireland-Strategic Action Plan, 2021-2025). These are:

- Theme 1-Government and policy
- Theme 2 -Partnership and cross-sectoral work
- Theme 3- Empowering people and communities
- Theme 4- Slaintecare Healthcare reform
- Theme 5- Research evidence, monitoring, reporting and evaluation
- Theme 6- Reducing health inequalities

From the researcher's perspective, the strategy has cross-cutting regulatory, social and economic concerns, among them the effects of health inequalities on sodium consumption.

In Portugal, sodium reduction policies are part of the country's National Health Plan, which also aims to reduce salt intake in the diet by 10% (Goncalves, 2020). For instance, the country's laws state that the amount of salt in 100 g of bread was not to contain more than 1,3mg by January 2019 (Goncalves, 2020). This was set to gradually reduce to 1,3mg by January 2020 and 1.1g by January 2021, finally reaching the target of 1mg of salt per 100g by January 2022 (Goncalves, 2020). In Greece, the country's salt reduction strategy has guidelines for reformulating the amount of salt in bread (Greek Ministry of Health 2017). The four main components of the strategy are data collection, consumer awareness of salt, reducing the amount of sodium in food and monitoring and evaluation of bread.

Similarly, Belgium, Hungary, and the Netherlands have mandatory limits on bread (Greek Ministry of Health, 2017). In Finland, a wide range of strategies has been implemented since 1970 to decrease sodium intake by their population. Food products with a high salt content are mandated to have a high salt content warning label. Products with a low salt content can also have a pan salt logo, and in 2000 the Finnish Heart Association launched the 'Better Choice Label' to guide consumer product choices on low sodium foodstuffs (World Action on Salt, Sugar and Health, 2021). Hungary implemented a public health sodium tax in 2011. The tax was implemented as part of its strategy on food products with high levels of salt, sugar and other significant ingredients. The goal was to reduce sodium intake, promote healthy eating for the broader population and fund health services (World Health Organization, 2021). In England, the public health department released voluntary targets for the manufacturing industry, which must be met by 2024. The guidance documents outline 84 food groups contributing more to the population's sodium intake (Public Health England, 2020).

Beyond Europe, Israel launched a national program to reduce salt intake by 3g per day. The national program includes raising public awareness of salt intake and practical steps on how consumers can make better food choices (Ministry of Health - Israel, 2021). The Education and Culture Ministries launched a project called

'Efsharibari' (Health is Possible). The programme aims to reduce salt intake to 6g per day (Ministry of Health - Israel, 2021)

In 2012, South Korea established a goal to decrease the amount of sodium consumed by its citizens by 20% by 2020. South Korea's National Plan to decrease sodium consumption included five key strategies (Park et al., 2020). These were:

- Consumer awareness to advocating for change.
- Increasing consumer accessibility to foods which have a low sodium content.
- Increasing the availability of recipes with low sodium content in restaurants
- Implementing voluntary reformulation strategies with manufacturers who make processed foods
- Encouraging the use of low-sodium recipes for food prepared at home.

According to the Global Institute, Australia started its sodium intake reduction programmes in 2009 when it created the Food and Health Dialogue (FHD). The FHD outlined food categories which had to be reformulated with set voluntary targets to reduce the level of sodium in those food categories. The partnership reformulation programme is voluntary and stipulates sodium targets that food manufacturers need to meet within four years. It started with 27 categories, and a further 14 categories were added (Healthy Food Partnership, 2020).

The above preview shows how countries worldwide are concerned with high sodium diets and the adverse consequences to public health. The review shows countries implementing and encouraging voluntary and involuntary sodium reduction mechanisms to varying extents. Among common approaches to reducing sodium content is legislation, specifically setting legal and illegal sodium content limits in foodstuffs. Voluntary stakeholder engagement with consumers and manufacturers and the raising of consumer awareness on the risk of high sodium intake is also a common global strategy, based on the findings from the briefly reviewed countries.

2.5 African sodium reduction efforts

In Africa, high sodium intake is considered a major health problem (Sookram et al.,2015). The continent's cardiovascular disease burden among persons aged 25 and above was 46% as of 2015 (Sookram et al., 2015). Over the years, there has not been much evidence of its decline. While in European countries, high salt intake is attributed to processed foodstuffs, in Africa, Sookram et al. (2016) link it to discretionarily added salt in home-prepared meals. The 2021 Global Nutrition Report states that southern Africa can be considered a high-salt intake zone. The report further highlights that southern Africa was not on course towards meeting WHO's 2025 salt reduction target by 30% as a region. Many countries in the region, including Botswana, had not implemented any meaningful sodium reduction strategies as expected under the WHO targets (Global Nutrition Report, 2021). Zimbabwe, Malawi, Zambia and Namibia were also discussed as not being on the trajectory to meeting 2025 WHO salt reduction goals to national strategic and policy deficiencies (Global Nutrition Report, 2021).

While national-level strategies for sodium reduction lagged in Southern Africa (Global Nutrition Report, 2021), community-level responses to salt reduction supported by non-governmental organisations seem to be on course (Muthari et al., 2015). Muthari et al. (2015) report tests to assess the effectiveness of various salt reduction strategies in community diets in South Africa, Ghana, Nigeria and Tanzania.

The interventions applied in this test were counselling and educating those with high mean BP, raising awareness of the dangers of salt and offering discounts for healthy, low-sodium foodstuffs. The results indicated positive responses as recorded in reduced systolic BP, mean BP and sodium excretion in urine (Muthati. et al.,2015). The results led to the conclusion that community-based interventions, including ones that consider residents' food environment, can be highly effective in reducing salt intake and consequentially in reducing cardiovascular disease risks (Muthari et al.,2015).

A Morrocan-focused study by Noubiap (2020) concluded that bread was a major contributor to sodium, given that it was regularly consumed. The study also found bread to be a significant sodium contributor in Mozambican and South African diets. This led to the conclusion that strategies targeting bakeries to reduce sodium intake were a dire necessity. Such strategies were implanted in Morroco (Noubiap, 2020).

2.6 South African sodium reduction efforts

Like several other countries, South Africa has invested in strategic efforts to curb high sodium intake in foodstuffs. The country's efforts are reflected in Acts of Parliament and their respective regulations and strategic and policy documents. The *Foodstuffs, Cosmetics and Disinfectants Act 54 of 2008* is the primary legislation affecting foodstuff composition and labelling in South Africa, including sodium content-related matters.

2.6.1 National strategic plans and sodium content

The DoH is the custodian of national health strategies (DoH, 2013). The DoH has implemented five-year strategies, including the following:

- National Strategic Plan for the Prevention and Control of Non-Communicable Diseases 2013-17
- National Strategic Plan for the Prevention and Control of Non-Communicable Diseases 2020-2025.
- National Strategic Plan for the Prevention and Control of Non-Communicable Diseases 2022 – 2027

The 2013-17 strategy highlighted salt intake reduction as a low-cost but highly effective method of reducing the country's disease burden (DoH, 2013). The Draft 2020-2025 identifies excessive salt consumption as a major risk. High salt intake is associated with heart disease and gastric cancer problems. In addition, *"high salt intake promotes gastric cancer, is associated with osteoporosis, increased asthma severity, renal stones, progression of renal disease and obesity."* (DoH, 2019:5). In 2017, the DoH implemented the "*National Adolescent & Youth Health Policy 2017".* This policy, however, did not directly address any sodium intake issues among the youth (DoH, 2017).

The 2022-2027 strategy targets the WHO with a 30*% "relative reduction in mean population intake of salt/sodium"* (DoH, 2021: 45). The *National Health Promotion Policy and Strategy 2015-2019* also mentions salt reduction targeting in the SA population but does not give detailed figures (DoH, 2015). All NCD strategic plans point to salt as a significant risk. The 2022-2027 strategy specifically points to savoury snacks as a major contributor to high dietary salt among the SA population (DoH, 2021).

2.6.2 Regulation 146 of 2010 on labelling and advertising

Regulations Relating to the Labelling and Advertising of Foods (Regulation 146) implemented in 2010 and amended in 2014 put much focus on salt-sodium labelling matters (Republic of South Africa, 2014). Regulation 146 of labelling legislation governs how prepackaged products should be labelled in South Africa (Department of Health, 2013). The legislation demands that only the wording presented in the table below may be used to make a nutrient content claim. Other words not stipulated in the nutrient content claim table are prohibited (Department of Health, 2013). In South Africa, claims can include nutrient content, comparative, and adverse claims (Department of Health, 2010). Its critical aspects of salt and sodium include:

- Total sodium in all foodstuffs except those exempted under the regulations must be indicated on product nutritional labels
- Total sodium in milligrams (mg) could be converted and reported as "salt" content in grammes.
- Guideline 9 of the regulations demand accuracy and precision in sodium and general nutrient measurement. Measures are to be done using large enough samples and methods and specified methodologies of Codex if there are no specifically-mandated tests.

The above is therefore crucial for labelling and packaging, which are essential components in this study.

Table 2.2: Conditions for nutrient content claims (Department of Health 2013)

COMPONENT A	CLAIM	CONDITIONS NOT MORE THAN
Energy	Low Virtually free or free from	170kJ per 100g (solids*) 80 kJ per 100ml (liquids*) 17 kJ per 100ml (liquids*)
Total Fat	Low Virtually free or free from	3 g per 100g (solids*) 1.5 g per 100ml (liquids*) 0.5g per 100g/ml
Saturated Fat	Low Virtually free or free from	1.5 g per 100g (solids*) 0.75 g per 100ml (liquids*) and not more than 10% energy 0.1 g per 100g (solids*) 0.1 g per 100ml (liquids*)
Cholesterol	Low Virtually free or free from	20 mg per 100g (solids*) 10 mg per 100ml (liquids*) 5 mg per 100g (solids*) 5 mg per 100ml (liquids*)
Mono and disaccharides	Virtually free or free from	0.5 per 100g/ml
Sodium	Low Very Low	120mg Na per 100g (equals 305 mg NaCl) 40mg Na per 100g

	Virtually free or free	(equals 102 mg NaCl) 5mg Na per 100g (equals 13 mg NaCl)
Alcohol	Non-alcoholic Virtually free or free	0.5% by volume 0.05% by volume
*refers to the end product **percentage expressed per total energy of end product		

As shown above, manufacturers can make three types of sodium content claims. These are "low" for products containing 120mg Na per 100g, "very low" for products with 40mg Na/100g and "Virtually free or free" for products containing 5mg Na/100g or less (Department of Health, 2013).

Manufacturers use nutrient content claims to describe the level of a particular nutrient in a food product as either low, high or free or compare the nutrient level with another food product with terms such as light, reduced and more (FDA, 2018). Franco-Arellano, Bernstein and Norsen (2017) state that future research should focus on observing trends in the use of claims on food products as part of regulatory compliance and public health research. Oostenbach et al. (2019) articulate that policymakers should consider a wide variety of strategies to decrease the number of negative influences when manufacturers use nutrition claims.

2.6.3 Regulation 429 of 2010 on labelling and advertising

Regulation 429, an amended version of Regulation 146, also classified low sodium content as anything below 120mg per 100 grammes and very low sodium content below 40mg Na/100g (Republic of South Africa, 2014). Anything with 40mg Na/100g and below could be considered sodium-free (Republic of South Africa, 2014).

2.6.4 Regulation 214 of 2013 on sodium content reduction in foods

Sodium-specific regulations under *the Foodstuffs, Cosmetics and Disinfectants Act 54 of 2008* are buttressed by the *"Regulations Relating to the Reduction of Sodium in Certain Foodstuffs and Related Matter"* (Regulation 214) implemented in 2013 (Kaldor et al., 2018). In South Africa, much focus has been on the 2016 and 2019 sodium reduction regulations as a cornerstone of the country's salt intake reduction strategy (Peters et al., 2017).

These regulations were amended twice in 2017 and 2019 (University of Pretoria, 2019). The regulation has 13 food categories with two target dates for 2016 and 2019. The two target dates were dates that manufacturers needed to comply with to ensure a gradual decrease are 30 June 2016 and 30 June 2019 (Kaldor et al., 2018).

Table 2.3: South Africa's sodium reduction targets (Department of Health (2013)

Food category	2016 target (Na/100mg)	2019 target (Na/100mg)
Bread	400	380
All breakfast cereals	500	400
All fat and butter spreads	550	450
Savoury snack, excluding salt-and-vinegar flavoured	800	700
Flavoured potato crisps excluding sal and vinegar	650	550
Flavoured RTE savoury snacks and potato crisp, salt-and - vinegar only	1000	850
Processed meat - uncured	1300	1150
Processed meat - cured	850	650
Raw processed meat sausages	800	600
Dry soup powder (not instant type)	5500	3500
Dry gravy powder and dry instant savoury sauces	3500	1500
Dry savoury powders with dry instant noodles to be mixed with liquid	1500	800
Stock cubes, powder, granules, emulsions, paste or jellies	18000	13000

The above targets include reducing sodium content in "Flavoured ready-to-eat savoury snack and potato crisp, salt and vinegar only" to 1000mg Na/100g by 2016 and to 850mg Na/100g by 2019. Stock cubes and powders used in soups with extremely high sodium content were to reduce sodium from 18000mg Na/100g and 13000mg Na/100g by 2016 and 2019, respectively. Like with EU countries, the above list shows concern for bread as a product consumed daily and in high quantities. Compared to Argentina, which also passed regulatory targets (Argentina.gob.ar,2013), South Africa has more product categories under its sodium reduction law.

2.7 Scholarly perception of SA's salt reduction strategy

Much has been said about the above strategies and policies on sodium content reduction in food. Noubiap (2020) and Koen et al. (2021) are among the authors who applaud South Africa as one of the first African countries and one of the few countries in the world to enforce sodium reduction regulations. South Africa and Morocco are also applauded for being the first to develop sodium reduction strategies (Noubiap, 2020). In Noubiap et al.'s observations, salt reduction strategies in both countries were hinged on five elements – legislation, consumer education, public institution interventions and product reformulation, and FoP systems.

South Africa needed an integrated sodium reduction model (Koen et al.,2021). The critical intervention mechanisms of such a model must be consumer education, legislation and product labelling processes (Koen et al., 2021). Koen et al. (2021) stress the importance of understandable, informative labelling, arguing that there is evidence that informative labelling was associated with a reduction in low-sodium foodstuffs. The country needed to address low education on the sources, effects and risks of the excessive sodium consumption (Koen et al., 2021).

Also, their study showed a 16.5% sodium legislation awareness among South African consumers. They recommend consumer education drives that empower consumers to understand product labelling and sodium targets for various products. Webster et al. (2017) also look at SA's sodium reduction strategies that are part of the National Communicable Diseases Strategic Plan. In this plan, the country shares the WHO's goal of reducing sodium intake per adult to 2 to 5g per day (Webster et al., 2017).

Webster et al. (2017) comment that South Africa's strategic efforts stressed legislation as the primary driver of sodium reduction. This neglected the view that individual efforts were more potent in reducing sodium content than externally enforced regulations. Self-regulation resulted from behavioural change associated with increased consumer education and awareness of the risks of excessive sodium intake (Webster et al.,2017). Like Koen et al. (2021), Webster et al. (2017) also assert that sodium content monitoring and evaluation and collaborative approaches that included consultations with manufacturers were critical to the strategies' success.

However, they recommend increased monitoring and surveillance of products on the market for compliance with sodium reduction targets and labelling regulations (Webster et al.,2017). Also, they discuss the importance of sodium measurement consistency systems, arguing that these could result in incorrect nutrient claims and market misinformation (Webster et al.,2017).

According to Loggerenberg et al. (2022), South Africa's sodium reduction strategies are comparatively well-advanced compared to many countries. The strategy, however, needed to consider the effects of FoP on sodium consumption. In addition, the strategy should target the youth, who account for a significant portion of high-sodium consumers and for this to happen, the strategy needs to be well-funded to support consumer awareness programmes (Loggerenberg et al., 2022).

The strategy encompassing the legislative sodium target for selected foodstuffs was also considered collaborative enough to succeed (Loggerenberg et al., 2022). However, according to Kaldor et al. (2017), there were views that while there was an element of consultation and collaboration in the formative stages, the consultative processes were ineffective enough to ensure manufacturers' optimum participation. This was in particular reference to Regulation 214 gazetted into law in 2013 (Kaldor et al., 2018).

2.8 New Zealand and Australia case study on sodium targets compliance

In Australia, some studies have been conducted to investigate the links and associations between sodium regulation laws and policies regarding sodium intake. A modelling study conducted in that country to estimate the impact of sodium reduction if food manufacturers fully complied with the sodium reduction regulation reported that 514 deaths could be prevented and 1,921 new cases of cardiovascular disease, stomach cancer and chronic kidney disease could be prevented yearly (Trieu et al., 2021).

Specifically focusing on savoury snacks, a few other countries also developed sodium content reduction strategies to move towards WHO's 2-5g daily sodium consumption per adult. Farrand (2020) highlights New Zealand's and Australia's sodium reduction targets that, like the South African system, had two deadlines, although these were in 2013 and 2019 compared to South Africa's 2016 and 2019. These are tabled below:

Table 2.4: Findings from Australia and New Zealand survey of sodium targets (Source: NIHI, 2021)

New Zealand	Target	2013		2019	
		n	% Meeting target	n	% Meeting target
Extruded snacks	770	48	54,2%	32	40,6%
Potato crisps	520	133	45,1%	118	51,7%
Salt and vinegar snacks	740	25	20%	21	52,4%

Australia	Target	2013		2019	
		n	% Meeting target	n	% Meeting target
Extruded snacks	720	48	36,9%	13	40,6%
Potato crisps	500	123	33,3%	46	43,0%
Salt and vinegar snacks	810	25	20%	12	57,1%

	2013			2019		
	N	Mean sodium (range) (mg/100g)	Mean sodium/ serving (mg)	N	Mean sodium (range) (mg/100g)	Mean sodium/ serving (mg)
Extruded snacks	48	864 (300-1535)	276	32	965 (180-1910)	288
Potato crisps	122	552 (110-1260)	183	107	549 (120-836)	174
Salt and vinegar snacks	25	895 (390-1210)	306	21	748 (300-1168)	241

In a New Zealand study, the NIHI (2021) shows that 54.2% of RTE snacks (extruded snacks) complied with that country's 2013 sodium content target of 770 mg Na/100g. For the same period, this was, however, lower for Australia, even though the latter had a comparatively lower target of 770 mg Na/100g. The NZ study found a 45.1% compliance rate concerning potato crisps with a target of 520 mg Na/100g. For 2019, the NZ study found the following compliance rates: extruded snacks (40.6%), potato chips/crisps (51.7%) and salt and vinegar chips (52.4%).

The Australian study showed a 40.6% compliance rate on extruded chips, 43% on potato chips and 57.1% on salt and vinegar chips (NIHI, 2021). The studies show that less than a majority (>66.7%) of the sample products complied with set standards for 2013 and 2019. In NZ, the survey showed an increase in mean sodium per 100g from 864 in 2013 to 965 in 2019 on extruded snacks, a decrease from 552 to 549 and 895 to 748 on potato chips and salt and vinegar chips, respectively. Also, for NZ, despite being lower than 2013 levels, 2019 mean sodium levels in the sample were above the targeted limits

The findings highlight that manufacturers in NZ and Australia have been slow in responding to sodium reduction targets (NIHI, 2021). Farrand (2020) comments that the savoury snack with the highest sodium concentration in Australia had 1062 mg Na/100g, over 50% of the recommended 3g per day for a grown-up. Also, the Australian average sodium content for savoury snacks was 601mg above the safe content zone below 600mg Na/100g (Farrand, 2020).

An Australian study to verify industry compliance on health and nutrition claims in the yoghurt sector found that not all claims were valid (Wadhwa et al., 2017). The study included 340 yoghurt products and found that 97.8% made honest claims; the rest had ambiguous claims that did not reflect the actual constituents of elements in yoghurt (Wadhwa et al., 2017).

Breen et al. (2020) emphasise that consumer education strategies should be implemented to ensure that consumers can read and comprehend the information on food labels to assist consumers in making better and healthy choices. Worse results were recorded in a Spanish study which sampled 3197 food products. Of these, only 49.2% of the products complied with Spain's nutrient content claim regulation (Ropero et al., 2020). The researchers further articulated that manufacturers were using nutrition claims to increase sales volumes and that authorities need to implement sufficient plans to encourage healthy eating and better food labelling strategies (Ropero et al., 2020).

Nutrition claims can influence the type of products that consumers buy and the consumption of certain foods with high levels of energy (Oostenbach et al., 2019). The decision on which nutrients should be highlighted in front of a pack of food labels is very complex, and incorrect labelling can be deceitful to consumers and hinder public health work (Hawley et al., 2013).

A study conducted in South Africa to assess the compliance of snack food products with nutrition and health claims using 93 food labels found that 25.3 % of nutrient content claims displayed on the pack were non-complying with the SA labelling regulation. Out of the 14 sodium-related claims, one product was non-compliant as it had 83 mg Na/100g. The labelling regulation states that the sodium content for such claims must be 40mg or less per Na/100g (Bursey, Wiles and Biggs, 2021).

Some studies also focused on the types of claims that food producers were likely to make. A New Zealand cross-sectional study reported that nutrient content claims were the most prevalent claim made based on an analysis of a sample of 7526 products. In the snack food products category, 38% of the food labels carried a comparative nutrient claim, albeit with varying levels of accuracy (Al-An et al., 2016).

Gamboa-Gamboa et al. (2019) collected data from 2042 ultra-processed food products consumed as snacks in Costa Rica. The commonest claim used in front-of-pack was the nutrient content claim. In a cross-sectional study conducted in Serbia on prepackaged foods using a sample of 3141 items, 21.2% of the samples contained claims with a distribution of 19.4% and 8.2% for nutrition and health claims, respectively (Davidović et al., 2021).

South Africa, New Zealand, Australia, and Argentina currently have mandatory sodium reduction targets. The 2013 law outlines limits for 18 food categories. The government initiative is called 'Less salt, More life". Argentina passed Act 26, 905 in 2013 to reduce the amount of sodium consumed by its population. Food manufacturers who do not comply with the mandatory legislation may be issued a fine and strict penalty (Argentina.gob.ar 2013).

Table 2.5: Argentina sodium reduction targets (Source: Law 2019)

Food group	Products	Maximum allowed sodium values of 100 grams of the product
Meat products and their derivatives	Group of cooked sausages, sausages and non-sausages. Cooked salted fish: includes sausages, sausage, mortadella, cooked ham, cooked cold cuts and blood sausage.	1196 mg.
	Group dried sausages: salami, salamin, longaniza and sopresata.	1900 mg.
	Fresh sausages group: chorizos.	950 mg.
	Fresh sausage group: hamburgers.	850 mg.
	Group breaded chicken: nuggets, bocaditos, patynitos,	736 mg.

	supremas, patitas, medallon, chickenitos and formitas.	
Farinaceos	Crackers with bran	941 mg.
	Crackers without bran	941 mg.
	Snacks cookies	1460 mg.
	Snacks	950 mg.
	Dried sweet cookies	512 mg.
	Sweet cookies stuffed	429 mg.
	Baked with bran	530 mg.
	Breads without bran	501 mg.
	Frozen breads	527 mg.
Soups, dressings and preserves	Pasture broths (cubes/tablets) and granules	430 mg.
	Clear soups	346 mg.
	Soups creams	306 mg.
	Instant soups	352 mg.

As tabulated above, the targets include sodium limits on salty snacks set at 950mg per 100g. Also, as noted above, Argentina did not classify salty snacks into subgroups, simply categorising them as snacks.

2.9 The impact of front-of-pack labelling

Some studies focus on the impact of different types and forms of packaging on consumer choices. Kanter et al. (2018) noted that FOP labelling systems had been developed to communicate high-level nutritional information to consumers and to promote food industry reformulation. In New Zealand, for instance, it was noted that the traffic light labelling system was more effective in conveying high-sodium products to consumers when a claim was not made on the food label (McLean & Hoek, 2013). This highlights the possible strength of common colour symbols in helping consumers make informed choices, including sodium content in foodstuffs.

To determine the proper use of FOP nutritional labelling, Ikonem et al. (2019) state that more research should be conducted to better understand consumer perceptions about buying less healthy food products and find better initiatives to make consumers make better food choices. Among other propositions, Kupirovic et al. (2019) proposed that the nutrient profiling database should be expanded to food products with health claims so consumers to make better choices when purchasing food.

Table 2.7 below shows a summary of standard FoP labelling systems used to inform consumer choices globally:

Table 2.6: Different types of front-of-pack labelling and criteria (Source: Pan American Health Organisation 2020)

Front of Pack labelling system	Criteria
Nutritional Warnings	These are used to identify products with high sodium, sugar, fat and calorie levels. The front of the pack system uses seals with information to inform consumers if a particular product has high amounts of sugar, salt, fat and kilojoules.
	These assist the consumers in the identification of unhealthy products.
Traffic Light System	Traffic light labels use 3 colours, namely red, amber and green. The system uses different textual information and bars with colours to indicate the nutrient level of core nutrients.
	The colours indicate whether a food product's particular nutrients are low, moderate or high.
Endorsement Systems	This system uses logos and seals and is applied to the front of the pack to increase the purchase of endorsed food products.
Summary Systems	The system rates the overall nutritional profile of food.
	Includes the nutri- score and health star rating and works on a score basis. This system uses a nutrient profiling model with a score. The labelling system uses red, which is high nutritional quality, and dark green, which indicates low nutritional quality.
Guideline for Daily Amounts systems	This front-of-pack system represents the number of kilojoules and percentage of certain nutrients per serving against the daily intake.
Colour Coded GDA or Reference Intake	This labelling system uses three colours. The GDA cells use the traffic light system and represent the level of nutrients within a particular product. Green is low, amber is medium and red is high.

A study in New Zealand identified that people with hypertension preferred low-salt options, and those individuals read food labels compared to people who do not suffer from hypertension (Mclean et al., 2012). Therefore, proper labelling of foodstuffs is not a vain effort as some people rely on it as part of their health-seeking behaviour. Thus WHO included nutrition labelling as one of the core interventions to ensure that consumers make healthier food choices when purchasing food items (WHO, 2016).

Correct food labelling can ensure that consumers make informed choices, as healthy and unhealthy food products are available at supermarkets (Mclean and Hoek, 2012). A review by Prinsloo et al. (2012) further indicates that the information displayed on food labels directly impacts consumers when making a purchase in-store. The researcher opines that these views and findings motivate and justify the monitoring and evaluation of labelling regimes on all foodstuffs as part of intervention strategies to reduce sodium intake.

Many global efforts to reduce sodium in foodstuffs take cognisance of WHO's colour-coded classification of sodium hazards in foodstuffs. The WHO devised a three-colour scheme to inform and warn consumers of sodium risks in various foodstuffs. The Heart Foundation of South Africa acknowledged this classification, albeit not mandatory in South Africa (Heartfoundation SA, 2020). Figure 2.4 depicts this classification:

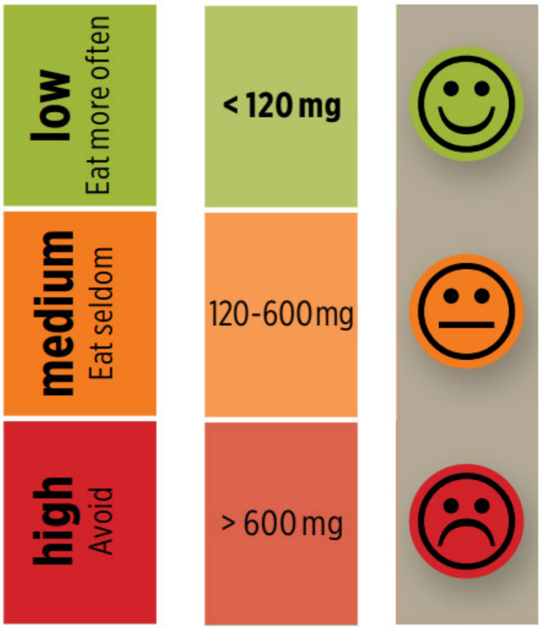


Figure 2.5: WHO's traffic lights signal

Source: Heart Foundation SA (2020)

Any food with less than 120mg Na/100g is considered low in sodium content, and these foods are encouraged. Foods with 600mg Na/100g are considered high in sodium and should, where possible, be avoided. In the centre are medium-content foods with between 212 to 600 mg Na/100g. A cautionary statement is also that such foods should be rarely eaten (Heart Foundation SA, 2020). Some countries, including Sri Lanka, have adopted colour-coded classifications to create a better-informed consumer population (Gunarathne et al., 2021).

As noted, the above colour-coded classifications are generally far below South Africa's 2019 sodium contents for savoury snacks (Department of Health, 2013; Gunarathne et al., 2021).

2.10 Opportunities and challenges in product sodium reformulation

One of the common remedies for complying with low sodium target requirements is the reformulation of food production formulas and recipes (Taylor, Doyle and Webb, 2018).

2.10.1 Opportunities and possibilities for replacing salt

Some studies focus on how sodium can be reduced from foods through substitution in the manufacturing process (Kloss et al., 2015; Clave-Coibre et al., 2021). Kloss et al. (2015) suggest that the recomposition of flavourants through increasing snack prices can enhance the saltiness in snacks, thereby reducing the need for high amounts of salt to maintain savouriness. Such substitution was effective in starchy and cereal-based snacks (Kloss et al., 2015). Clave-Coibre et al. (2021) found that sarcopenia perennis, a green plant, can be processed into a green salt that tastes ordinary but has a very low sodium content. This green salt also facilitates longer shelf preservation of roughly three months for snacks (Clave-Coibre et al.,2021). Additionally, they argue that green salt can be manipulated to produce an appealing look on snacks and reduce salt intake by as much as 70%.

Maluly et al. (2017) state that enough literature supports monosodium glutamate (MSG) as a food additive. Nucleotides and natural flavour enhancers can also be raw materials in products with high salt content (Maluly et al. 2017). When sodium is added to a food processor, it impacts the recipe and final product quality (Beck et al., 2012). Greer et al. (2022) state that potassium chloride is the most widely used ingredient in reformulations as a partial replacer for salt. They also report that this replacement works well in several foodstuffs. The Heart Foundation SA (2020) recommends using lemons as a flavourant enhancer asserting that lemons play this role as well as salt.

The substitution of salt with potassium chloride depends on various factors such as taste, cost, and preservation of the food products (Greer et al., 2022). Different replacement flavour enhancers would need to be diversified using an investigated process to ensure that taste and quality are of a high standard (Beck et al., 2012).

Durack et al. (2008) assert that product developers can use two alternatives as salt replacers. The alternatives are salt replacers and salt enhancers. Salt replacers include ingredients such as calcium, lithium and potassium chloride. Salt enhancers include ingredients such as monosodium glutamate and trehalose and glycine.

Besides substituting salt for other components, Allison and Fouladhkhah (2018) confirm that using technology such as high-pressure processing has been investigated to be an effective tool in producing products with a salt profile but with lower sodium levels in the recipe. Rodrigues et al. (2016) emphasise that high-pressure processing is a preservation method that can decrease the number of pathogens that cause food spoilage through pressure. This process can produce food with low sodium levels and limit micro-organisms' growth (Rodrigues et al.,2016).

2.10.2 Challenges associated with a salt reduction in manufacturing

Food formulation plays a huge role in promoting health and inhibiting diseases, as it can limit specific nutrient intake in the diet (Kloss et al., 2015). However, several cost and technical challenges can be faced in the process. Taylor et al. (2018) report that challenges faced by manufacturers in reducing sodium included producing products with low microbial growth, maintaining consistent shelf life, difficulty in finding replacement ingredients with the same functionality as salt, and creating products which will have 'clean labels'.

Buttriss (2013) describe salt as an ingredient used as a preservative in food formulations as it controls the water activity level and inhibits the growth of microorganisms. This preservative role of salt also comes at a low cost to manufacturers and changing it might demand increasing the prices of affected foodstuffs. With savoury, salty snacks being consumed, among other things, for their affordability (Bastami et al. 2019), this might not be a favourable option for both manufacturers and consumers.

Producing low-sodium products is a very vast process with safety hurdles. Sodium chloride is an inexpensive ingredient, and many alternate raw materials can make the existing recipes expensive (Beck et al., 2012). Developing a product low in salt involves various resources such as consumer sensory sessions, pilot plant tests, and reformulation (Doyle & Glass, 2010).

Regardless of the emphasis on product reformulation, reformulation alone will not be enough to decrease salt intake. Food manufacturers need to produce products that are low in salt and provide transparent labelling for consumers (Reagan et al., 2017). Overall, the above literature suggests several common food reformulation approaches, such as replacing salt with substitute elements, reducing salt in current formulations, enhancing salt and applying preservation processes that can replace the need for salt used as a preservative.

2.11 Conclusion

This chapter reviewed the literature on salty, savoury snacks concerning sodium content. It also looked at the literature on global, African and local strategies to combat excess sodium consumption and the opportunities and challenges for salt reduction through the manufacturing processes. A significant section was South Africa's sodium regulations, policies and strategies. As highlighted, Regulation 214 was important considering that it contained the 2016 and 2019 sodium reduction strategies of concern to this study. In the literature, there was a general view that sodium intake remains a problem, globally and locally, despite the existence of policies, regulations and strategies attempting to reduce this. Several scholars discussed the importance of ensuring adherence to set salt regulations, among other things, through surveillance, monitoring and evaluation of products on the market. The next chapter discusses the methodology applied in this study as part of the recommended product surveillance strategies.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the research methodology and procedures used to sample salty snacks studied in this report. It highlights the research design, methods, statistical techniques used to analyse the data, and the research ethics that guided the study. The methods and processes applied below were guided by the need to meet the following research objectives within reliability and validity parameters acceptable for this type of study and these were to: obtain the sodium content and compare the level of compliance per food category with R.214; identify the type of sodium claim made on each product and determine if the sodium claim is compliant with the labelling legislation; determine the average sodium nutrient per snack category and determine the level of sodium in savoury snacks and potato crisps by chemical analysis for products with a sodium nutrient claim. The chapter starts with a review of research philosophies that grounded the quantitative research approaches that were applied in the study.

3.2 Research paradigms or philosophy

For ages, research processes have been guided by varying, often competing and contrasting sets of philosophies. Research paradigms refer to a philosophical view that guides research within a given discipline - also seen as a “worldview” of such a discipline (Saunders et al., 2018). While many research paradigms are acknowledged among researchers, positivism, interpretivism and pragmatism generally provide a backbone upon which several philosophies are based (Kumar, 2018).

According to Rehman and Alharthi (2016), a paradigm consists of core beliefs and elements that guide a collective group of researchers. This section discusses these paradigms with the primary goal of eventually highlighting how they affected the methodological choices made in this study.

A paradigm consists of various elements in research: ontology, epistemology, axiology and methodology (Rehman & Alharthi, 2016). As far as researchers agree, a paradigm general consists of the above, albeit some researchers may still debate these. Kumar (2018) concludes that whose concept of a paradigm is marred with much disagreement.

3.3 Positivism

Positivism is argued to be the main research paradigm that guides scientific investigations in the natural science disciplines. By origin, positivism is attributed to natural scientists interested in studying the world as an external phenomenon with hidden truths waiting to be discovered via systematic, objective processes. Positivists hold the following core beliefs:

1. Knowledge already exists and is waiting to be discovered
2. Knowledge is meaningful if its objective is a result of systematic discovery
3. Knowledge is definite and therefore, there is a single truth relating to the phenomenon

In studying paradigms, epistemology relates to how acceptable knowledge is generated and in the views of positivists, this is through scientific and objective means. Thus Saunders et al.(2018) assert that positivists accept knowledge when it is systematically generated and recorded. Another element highlighted above is ontology. Ontology relates to how one views reality (Saunders, Thornhill and Lewis, 2018). The ontology of positivism is that reality is independent of its observer and is therefore external. This external nature of reality means that a single reality exists and any researcher or researchers applying themselves systematically will come to a similar understanding of it (Kivunja & Kuyini, 2017). Regarding methodology, positivists believe that quantitative research, because of its objectivity-focus, separation of the researcher from the reality under investigation and quest for rigorous, objective means in search of answers, is the accepted methodology for the natural sciences (Kumar, 2018).

3.4 Research design and method used in this study

3.4.1 Research methods

The study applied a quantitative research method in investigating the phenomenon of interest, specifically the levels of compliance with 2016 and 2019 sodium reduction targets in snacks and crisps. Quantitative research uses numerical data to make an important conclusion about a phenomenon (Kumar, 2018). This study was used out of the need for objective, measurable results that can be used to effectively inform of the current state of sodium compliance in the foodstuffs of interest.

3.4.2 Research design

The study applied an observational descriptive research design. This design focuses on observing a phenomenon for descriptive purposes (Creswell & Creswell, 2018). Generally, the study was guided by González-Duarte et al.'s (2021) approach to observational research, as depicted in the below flow chart (Figure 3.1).

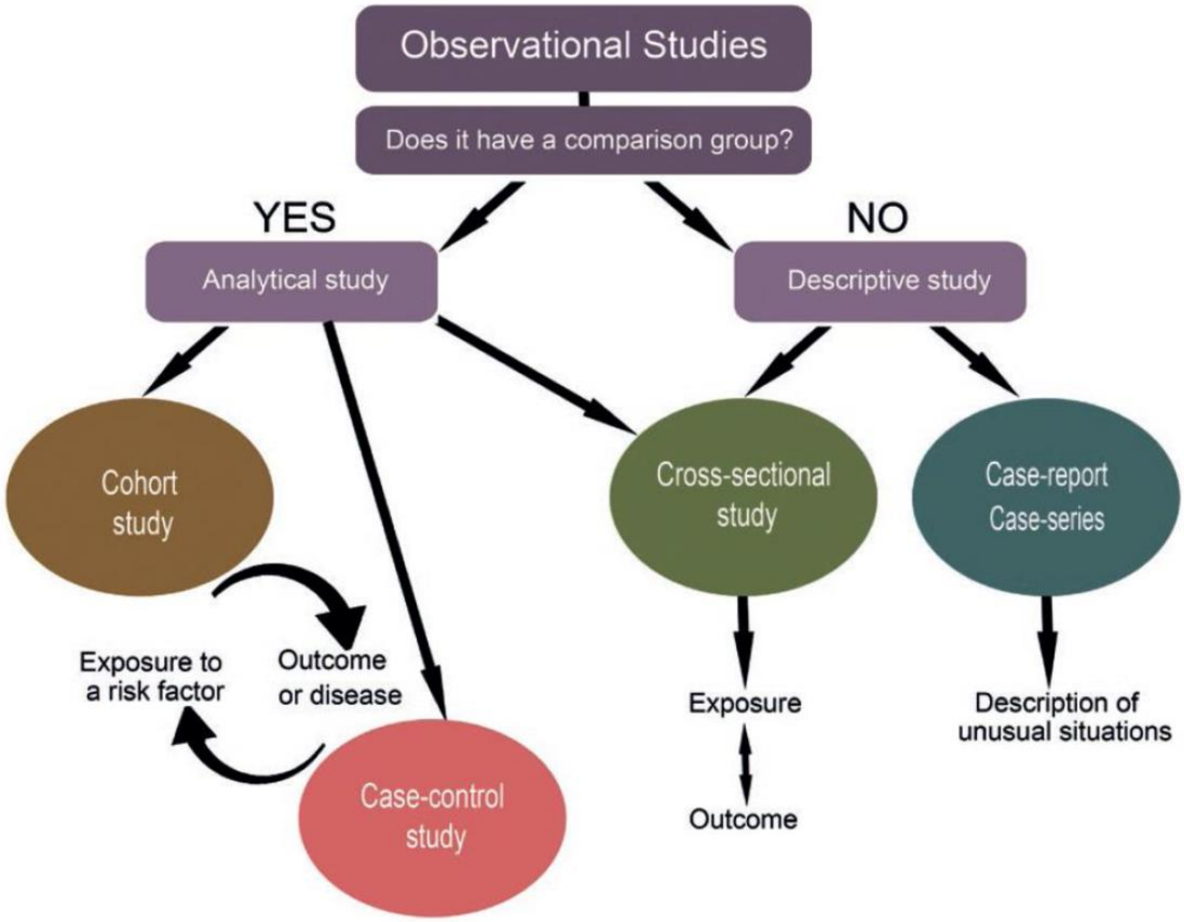


Figure 3.1: Observational descriptive studies typologies

Source: González-Duarte et al. (2021)

The study was descriptive rather than analytical. While results were compared to other studies, as is the custom in research results discussions, the overall aim of the study was not to attain such a comparative analysis. Based on González-Duarte et al.'s (2021) classifications, the study was cross-sectional as it recorded observations at a single point in time, despite these recordings being for two different periods of interest -2016 and 2019 sodium targets. A cross-sectional approach was considered rational as the researcher did not have adequate time and resources to record the same products at distant intervals, like over two years. González-Duarte et al.'s (2021) approach also includes a case report, another type of descriptive observational study. This was applied to this study on observations of products with low sodium content claims. A brief case report for each product highlighted the similarities and differences between claimed or reported sodium content on the packaging versus laboratory-observed sodium content. In this study, a sodium content claim was generally considered an "unusual situation" (González-Duarte et al., 2021).

In this study, the observed phenomenon was compliance with 2016 and 2019 sodium content in three snack categories. These were:

- Ready-to-eat savoury snacks
- Flavoured potato crisps
- Flavoured ready-to-eat, savoury snacks and potato crisps -salt and vinegar only

The observation method involved looking at and recording selected snacks' sodium content as reported on nutritional guide labels on their packaging. The descriptive aspect of the study is that most of the analysis did not manipulate any variables to see how they affect others (Creswell & Creswell, 2018). The study adopted a descriptive analysis method using the information on front-of-pack labels. A descriptive research design was deemed appropriate for this study as it intends to verify the sodium levels displayed on a pack with the legislative sodium targets set out by the Department of Health. Powell (1999) describes descriptive studies as a study which is designed to assess data with set conditions and experimental studies as studies which are conducted in a lab.

3.5 Population and sampling

The study's population was all snacks and crisps that belonged in the three listed categories available for sale in Durban. To reiterate, these were: ready-to-eat savoury snacks, flavoured potato crisps and salt and vinegar only flavoured ready-to-eat, savoury snacks and potato crisps. This population could be described as finite but challenging to reach and estimate in terms of size. This was because of the general vastness of the size of Durban and the existence of many retailers and brands. The Euromonitor (2021:1) classifies salty snacks into several categories, specifically "potato chips, tortilla chips, puffed snacks, rice snacks and vegetable, pulse and bread chips.” Other salty snacks include “savoury biscuits, popcorn, pretzels and other savoury snacks.”

3.5.1 Sample selection method

The study used convenience sampling methods. Convenience sampling is a non-random sample selection method in which the researcher relies on a given convenience factor or set of factors to recruit research candidates (Kumar, 2018). This involved collecting data from readily available products. Additionally, this convenience was applied in selecting retailers from which the products or samples were collected.

The products for observation were purchased from five South African retail shops in Durban: Pick n Pay, Woolworths, Spar, Checkers and Shoprite stores. The *Global Powers of Retail Report for 2020,* which Deloitte publishes, ranks 250 of the world's most prominent retail groups; four were Shoprite, Spar group, Pick n’ Pay and Woolworths from South Africa (Businesstech, 2020). This highlights that the entities from which the selected products were acquired have a broad outreach to South African and Durban societies. Using them as a data source was envisaged to afford the research an equally wide outreach that would capture more products that reach the Durban consumer markets. Spar has more than 100 stores and made a group turnover of R127.9 billion in the 2021 financial year (The Spar Group, 2021).

The Shoprite group reported an increase of 8.1% in sales of merchandise to R168 billion. The trading profit increased by 24.9% to R10.3 billion (Shoprite holdings 2021). Pick n Pay reported a group turnover of R46 billion and a gross profit margin of 18.2% for the financial year 22 (Pick n Pay Investor, 2021). These financial indicators further corroborate the extent to which the selected retailers greatly impacted the Durban consumer markets.

An IPSOS (2021) study also highlighted that over 755 of all snacks were distributed via the five shops, with Shoprite having the widest market outreach (Figure 3.2).

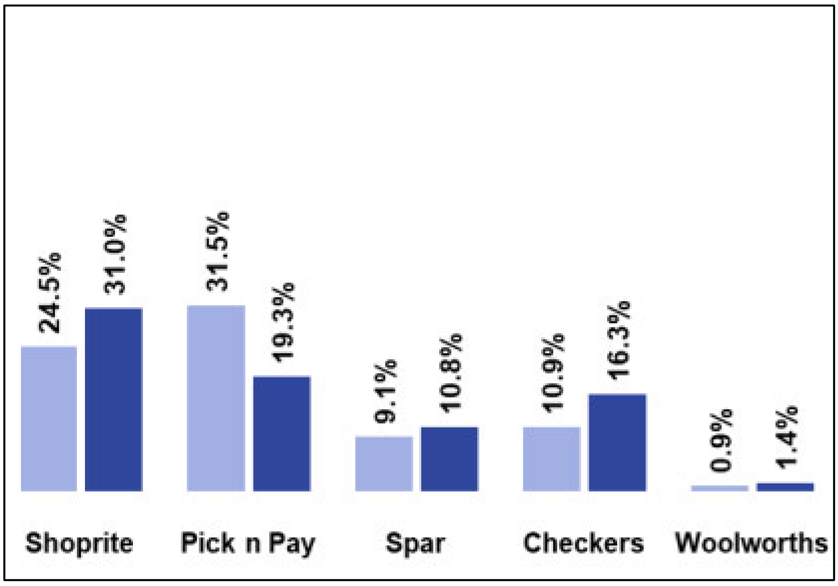


Figure 3.2: Market share for snacks - South Africa

Source: IPOS (2021)

Only snacks from the three categories with a nutritional information panel were included. In total, 90 products were bought and divided into three subgroups as per the sodium regulation. The population and sample size statistics are highlighted below:

Table 3.1: Study sample

Product	**Population size**	**Sample size**
C1: Ready-to-Eat Savoury Snacks	Not known with certainty	40
C2: Flavoured Potato Crisps	Not known with certainty	40
C3: Flavoured Ready-to-Eat, Savoury Snacks and Potato Crisps -Salt and Vinegar Only	Not known with certainty	10
Total		**90**

As highlighted above, the final sample was 40 for C1, another 40 for C2 and 10 for C3. The above sample was

3.6 Data collection

The data collection process involved three steps. The first was the identification and collection of the actual products from the five retailers. A data collection checklist was used to ensure that products meeting the sample selection criteria were purchased and that there was no exclusion and duplication of eligible products and the inclusion of non-qualifying products. Once the samples were collected, sodium composition data recorded in mg Na/100g was collected and recorded on a Microsoft Excel sheet.

Sodium values were collected using the nutritional information panel (Table 3.2), usually displayed on the food products' side or back panel.

Table 3.2: Typical nutritional tables (Source: Department of Health 2013: 46)

	Per 100g/ml	Per single serving
Energy (kJ)		
Protein (g)		
Glycaemic Carbohyrate (g) Of which total sugar (g)		
Total fat (g)		
Of which saturated fat (g)		
*		
**		
**		
***		
Dietary fibre# (g)		
Total Sodium (mg)		
• Any other nutrient or food component to be declared in accordance with these regulations • In alphabetical order, in the order: vitamins, minerals, others.	• Indicated in grams (g), milligrams (mg), micrograms (mcg), or appropriate unit of measurement	• Indicated in gram(g), milligrams (mg), micrograms (mcg) or appropriate unit of measurement
Nutrient reference values (NRVs) for individuals 4 years and older.		
*Place to insert transfat **place to insert subgroup nutrient ***place to insert cholesterol when cholesterol information is given #Indicate method of analysis used to determine dietary fiber		

According to R1055 of the Foodstuffs, Cosmetics and Disinfectants Act 54 of 1972, a nutrient content claim is defined as “a claim that describes the level of nutrient contained in a foodstuff”. The samples’ nutrition content claims, specifically low sodium claims, were recorded alongside the measured sodium content per 100g.

3.6.1 Sodium analysis in the laboratory

The samples were analysed using the Association of Official Analytical Chemists (AOAC) official method 984.27 in an accredited lab. This test was used because of its availability to the researcher and its common use and acceptability as a reliable scientific testing method for elements in foodstuffs and beverages. The test uses the inductively coupled plasma-atomic emission spectroscopy (ICP-AES) principle (Poitevin et al., 2009).

Four significant steps were followed in the testing and measurement processes: digestion, atomization, excitation and relaxation. Each sample for measurement was independently digested in nitric acid (HN03). This reduced the samples to a liquid solution analysable through ICP-AES (Lee et al.,2022). The digested solutions were transferred into test tubes for further analysis.

This process was conducted to convert the digested solutions for each test into atomic and ionic states. This is done through the introduction of excess heat energy to the solution. The excess heat led the ionized and itomised solutions into an excited state for a few seconds. The withdrawal of heat energy led them back to a ground state again. The differences in the emitted wavelength between the grounded and excited states were important. This was measured and sodium existence and quantity were determined through inductively coupled plasma emission spectroscopic. The reagents used were water, perchloric acid and 2.5421 g NaCl dissolved in water and diluted to 1 litre with water (Horwitz, 2000). Every periodic table element has different electromagnetic radiation wavelengths between their excited and grounded states. These differences were used to identify sodium and its quantity separating it from the other nine elements measurable through the same processes.

3.7 Data analysis

The information collected from the nutritional table and artwork panel was captured on a spreadsheet by the researcher and the information was separated into three specific categories. The data was entered two times to minimize errors. The researcher coded the results to ensure that no brand names were mentioned.

Data were analysed using Microsoft Excel and SPSS version 23. Three ready-to-eat snacks and potato crisps categories were individually and comparatively analysed for (1) their current sodium content per 100g versus the set 2016 and 2019 sodium content per 100mg, and (2) the degree to which they failed to meet any of the two targets.

3.7.1 Descriptive statistics

Descriptive statistics, mainly the mean or average scores and their accompanying standard deviations were used for the tests. Kurtosis and skewness tests were included in determining whether the data were normally distributed or close enough to a normal distribution to be interpreted using average or mean scores.

Kurtosis assesses the closeness of a data distribution tail to the tails of normally distributed data (Wagner & Gillespie, 2018). Skewness assesses whether the same data's symmetry resembles that expected in a normal distribution (Wagner & Gillespie, 2018). Kurtosis and skewness between -2.5 and 2.5 (Warner, 2013) were used as benchmarks to indicate that data was distributed in a manner that enabled it to be reliably analysed using mean scores.

Also included in the analysis was the range for the lowest and highest observation per category. These descriptive statistical analyses were considered adequate for this study because they facilitated several types of comparative analyses. These were:

- Analysis and comparison at the product level – for instance, one product over another
- Comparative analysis across product categories
- Comparative analysis across the target period, specifically 2016 and 2019
- Analysis of claimed nutrient content versus actual nutrient content

Additionally, a descriptive analysis made it possible to compare these studies' general findings to other South African and international studies that dwelt on similar or relatable research questions. These included studies by Hattingh (2015), Peters et al. (2017) and Korff (2019), among others.

The heavy reliance on descriptive statistics was also strengthened by the need for greater reliability in findings. Given the small sample size, statistical measures involving significance-level tests were considered a potential risk to research outcomes (Shreffler & Huecker, 2022). The possibility of both error I - rejecting a true null hypothesis and error II- involves the failure to reject a false null hypothesis (Shreffler & Huecker, 2022). This study's risk was compounded by the view that the salty snacks population size was unknown. Fisher’s exact test was therefore used for further data analysis because of its suitability for small sample tests of associations (Wagner & Gillespie, 2018).

3.7.2 Fisher’s exact tests

Fisher’s exact tests compare variables that can be cross-tabulated for associations. This test is considered more reliable and less prone to type I and type II errors when small samples are involved (Wagner & Gillespie, 2018). Fisher’s exact test is considered a parametric test used in cases where data is not normally distributed (Nelson, 2020). However, the test has also found relevance in parametric data sets because of the said ability to produce reliable results when dealing with small samples. One of the three sample groups (C3) had a comparatively tiny sample of 10. This added another dimension where the overall sample of 90 was small and had uneven or unequal subsample groups that needed comparison. Fisher’s exact test ability to handle uneven sample groups appealed to the study (Nelson, 2020).

Cramer’s V test was used as a post hoc test to Fisher’s exact tests. Fisher’s exact tests show the presence or absence of an association between two variables but do not indicate the strength of such an association (Wagner & Gillespie, 2018). Cramer's V tests were used to assess the strength of Fisher’s exact test statistics. Cramer’s V tests were interpreted using Lee’s (2016) in Table 3.3 below:

Table 3.3: Cramer's V test Interpretation (Lee, 2016)

Estimated values	Interpretation
0 to 0.1	Negligible
0.1 to 0.2	Weak
0.2 to 0.4	Moderate
0.4 to 0.6	Relatively strong
0.6 to 0.8	Strong
0.8 to 1	Very strong

Cramer’s V statistics above 0.8 indicate a robust association between variables, while a statistic below 0.1 indicates a negligible association between variables (Lee, 2016). In both Fisher's exact tests and Cramer’s V, a probability value of 0.05 was used to indicate statistically significant relationships that warranted further discussion.

3.8 Reliability and validity

The research process noted the importance of reliability and validity. In this study, validity is related to the extent to which the study measured what it intended to measure. To reiterate, this was the levels of sodium per 100g in three types of salty snacks and to measure the actual sodium content in salty snacks with low sodium claims. To ensure the reliability of measurements, the research relied on the following:

- Cross-checking to ensure that the measured product belongs to the class they were assigned using a checklist
- Measuring and recording each sample twice as a way of controlling data inputting errors
- Only sampling salty snacks with explicit sodium content presented in milligrams per 100g

For the second observation, which involved laboratory measurement of nutrition content claim, the following measures were taken to enhance the study’s ability to measure what it intended to measure:

- The use of proper (ICP-AES) procedure as per the Association of Official Analytical Chemists (AOAC) official method 984.27 procedure
- The repetition of tests to recheck outputs and investigate differences

The study also reviewed the measurement methods that were applied in previous studies, including Hattingh (2015), Peters et al. (2017) and Korff (2019), among others. This review identified strengths and weaknesses, which were applied to better the study’s methods. The above measures, as expected, improved the study’s validity.

While validity assessed whether the results from the study were for what the researcher wanted to measure, reliability focused on whether the same output could be replicated if the study is redone (Creswell & Creswell, 2018). To ensure the reliability of the researcher, the researcher documented the processes applied, the product categories used, and the settings from which they were extracted (Creswell & Creswell, 2018). The study also relied on research methods generally considered appropriate for an observational study, specifically the careful observation, recording and cross-checking of procedurally sampled and categorised data.

The researcher worked towards reducing the effects of the instrumental errors by using an approved laboratory which used the approved ICP-AES procedure as per the (AOAC) official method 984.27 procedure in a replicable manner. Observational errors of data captured on labels were controlled by capturing each score per sample twice and finally cross-checking this with the labelling (Haradhan, 2017).

3.9 Research ethics

Like most empirical research, descriptive observational studies must comply with acceptable ethical considerations (Shuresh, 2018). Four fundamental ethics that guide academic research are informed consent, voluntary participation, confidentiality and protection from harm (Saunders et al., 2018). These fundamental ethics were fully considered in this research. Another perspective of research ethics is to consider the benevolence or public benefit from a study versus the risks the study took. As further discussed in later paragraphs, this approach was also applied to this study.

The study did not require informed consent or voluntary participation from the producers as it did not involve human beings as respondents (Kumar, 2018). It also relied on publicly available information and therefore did not need to seek any formal permissions from the sampled salty snack producers and distributors (Cooper & Coetzee, 2020). At the same time, Cooper and Coetzee (2020) caution that the process of selecting publicly available data for use in research carries bias risks when researchers choose to select data that meet their predetermined objective. Researchers, therefore, had an ethical responsibility to control bias. In this study, the researcher managed biases by selecting the first 90 products that met the sampling eligibility criteria.

Fundamental ethical questions that were asked to justify whether the study had more significant benefits than risks and whether there were potential research designs with fewer risks (González-Duarte et al.'s (2021) were whether: the study would collect sensitive data; would be able to manage data loss risks and if this resulted in improved knowledge for society. The research was considered highly beneficial to society to justify any potential risks, regardless of how small these might be (Shuresh, 2018). The knowledge on sodium compliance in snacks that constitute a commonly consumed foodstuff, including by children, was expected to help society make more conscious of the need to read through and analyse sodium contents on the products. Additionally, this was expected to keep authorities focused on monitoring and evaluating compliance with R214 regulations. Additionally, laboratory tests were expected to confirm claimed versus observed content, which could help society determine the level of trust it should put on such claims. Overall, as per the researcher's expectations, the study's benefits were a more health-informed society, including authorities, surpassing the risks involved.

On the involved ethical risks, loss of data through physical and virtual compromises like physical device losses, and computer hacks, among others, was considered a potential threat. This was minimised by password-protecting the collected data, as González-Duarte et al. (2021) recommended. The researcher also made a quest to destroy the collected data after keeping it for five years as a way of controlling loss. In terms of loss of confidentiality and anonymity, the researcher used pseudonyms to ensure that the actual brand names associated with each product would remain ambiguous.

The file that linked the pseudonyms to the brand name was kept in a separate virtual location to minimize the risk of invaders linking the two files. As discussed, data that has commercial implications, including product data, can be abused in unethical competitive behaviour, including bad publicity for manufacturers. This risk that could harm the manufacturer necessitated the above ethical procedures. A point to note was whether manufacturers with high sodium content products that endangered society and those with unreliable nutrient content claims deserved this protection.

The view that study's ethical concern was on the participating product manufacturers whose "interests and future wellbeing" (Bhattacherjee, 2019:1). The study, therefore, remained focused on presenting results rather than taking any other confrontational stance against negative findings as recommended by Bhattacherjee (2019:1). At the same time, the study did not hide such negative findings nor manipulated findings to enhance positivity as a recommendation from the same author.

To cement its ethical consideration, the study sought and obtained ethical clearance from the DUT Research Ethics Office as required (DUT, 2021). It was also conducted using the approved ethical terms and conditions.

3.10 Conclusion

This chapter discussed the methods applied when pursuing this study's empirical research aspects. This study was based on a positivist philosophy and therefore used quantitative research methods out of the need to extract quantifiable objective results. The study applied a cross-sectional observational descriptive research approach and used convenience sampling methods to extract a sample of 90 salty snack units from five major retailers in Durban. The study was conducted in line with research ethics approved by the DUT Research Ethics Office. The next chapter presents and discusses the findings from the data collected using the above methods and processes.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the data analysis findings for the study and discusses them by comparing and contrasting them with findings in the literature. Data presented in this chapter were analysed using Statistical Package for the Social Sciences (SPSS) version 19 and Microsoft Excel. The analysis starts with a descriptive summary of the collected data on three categories of products, namely: ready-to-eat savoury snacks (C1), flavoured potato crisps (C2) and flavoured ready-to-eat savoury snacks and potato crisps - salt and vinegar only (C3). The analysis mostly takes a comparative analysis approach looking at 2016 and 2019 sodium targets. To reiterate, the analysis was conducted with the need to meet the following research objectives: To assess and describe sodium content in selected savoury snacks; To assess the selected savoury snack's compliance with Regulation 214 (R.214) on 2016 and 2019 sodium content targets and to assess low sodium claim made on selected products and determine if the sodium claim is compliant with the labelling legislation.

4.2 Descriptive analysis summary

Table 4.1 shows the summarised descriptive data of three groups of RTE snacks, specifically RTE savoury snacks (C1), flavoured potato crisps (C2) and 10 varieties of salt and vinegar flavoured RTE savoury snacks and potato crisps (C3). C1 varieties had a target to reduce their sodium content to 800mg Na/100g by 2016 and to further reduce this to 700mg Na/100g by 2019. C2 varieties had a target to reduce their sodium content to a maximum of 650mg Na/100g by 2016 and further down to a maximum of 550mg Na/100g by 2019. C3 varieties, which consisted of "salt and vinegar" flavoured snacks and potato crisps had a target to reduce their sodium content to a maximum of 1000mg Na/100g and 850mg Na/100g for 2016 and 2019, respectively.

Table 4.1: Descriptive summary - all categories

	C1: Ready-to-Eat Savoury Snacks (n=40)	C2: Flavoured Potato Crisps (n=40)	C3: Flavoured Ready-to-Eat, Savoury Snacks and Potato Crisps -Salt and Vinegar Only (n=10)

N	40	40	10
2016 Target (Na/100g)	800	650	1000
2019 Target (Na/100g)	700	550	850
Mean	532,33	506,68	798,6
Median	595	519	848
Std. Deviation	278,79	68,69	188,54
Skewness	-0,40	-0,53	-0,39
Kurtosis	-0,03	0,25	-1,30
Range	1108	305	524
Minimum	5	325	512
Maximum	1113	630	1036

Ready-to-Eat Savoury Snacks (C1) had a mean of 532 (sd=+/-279, a minimum sodium content of 5mg Na/100g and a maximum of 1113mg Na/100g. Flavoured Potato Crisps (C2) had a mean of 507 (sd=+/-69), a minimum sodium content of 325mg Na/100g and a maximum of 630mg Na/100g. Finally, the C3 category (Flavoured Ready-to-Eat, Savoury Snacks and Potato Crisps -Salt and Vinegar Only) had a mean of 799 (sd=+/-189), a minimum sodium content of 512mg Na/100g and a maximum was 1036mg Na/100g. The kurtosis and skewness alphas for all three ranged from 1.0 to -1.0 indicating closeness to normal distribution in the data and therefore high reliability of using mean scores to describe the data (Lawson, Faul, & Verbist, 2019).

In terms of mean sodium content, this study's 2019 sodium content mean of 798.6 differs from Korff's (2019) mean of 884.33. This indicates a comparatively lower albeit still concerning level.

4.2.1 Summarised performance against 2016 and 2019 benchmarks

Figure 4.1 summarises all categories' performance against benchmarks or targets for 2016 and 2019.

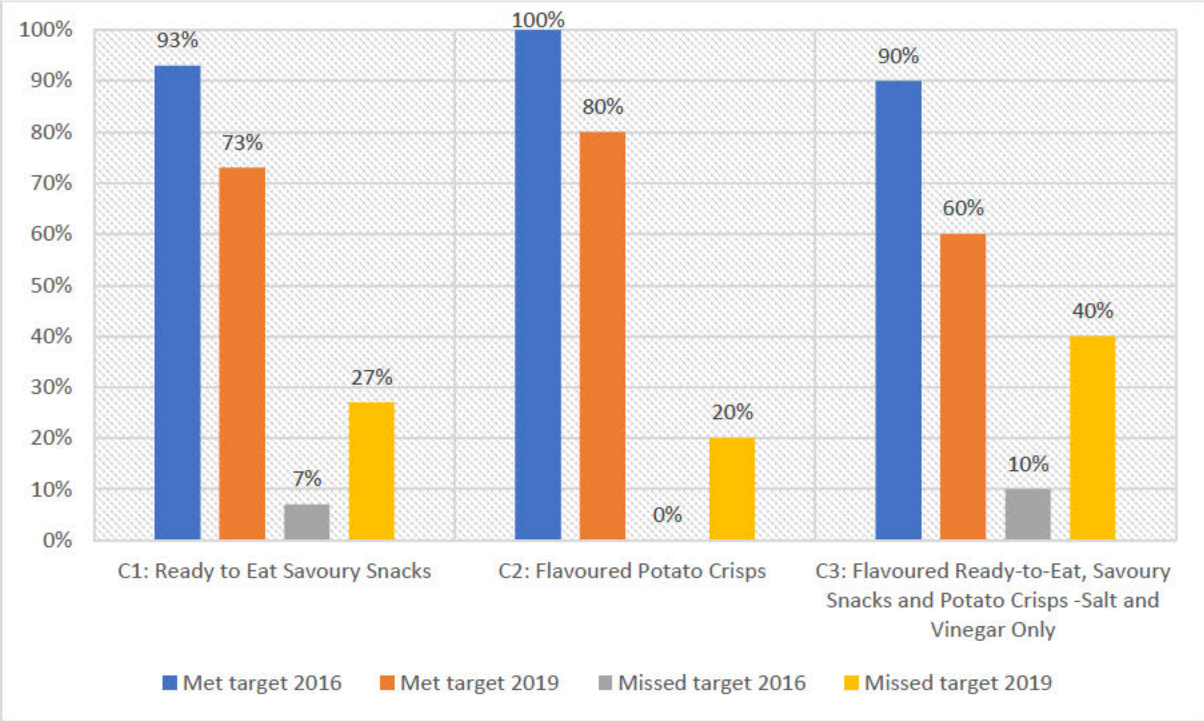


Figure 4.1: Performance against targets - all categories

In the C1 category, 7% of the 40 varieties sampled did not meet their 2016 target of 800mg/100g while 27% did not meet their 700mg/100g target for 2019. In the C2 category, all 40 varieties met their 2016 target of 650mg/100 while 20% did not meet their 2019 target of Na 550mg/100g. In the C3 category, 9 varieties or 90% met their 2016 target of Na1000mg/100g while 40% of the 10 varieties did not meet their 2019 target of Na 850mg/100g. C2 had the highest proportion (80%) of varieties meeting their 2019 targets, followed by C1 (73%) and C3 (60%). Comparatively, C2 had the highest proportion of varieties that met their 2016 target. This was followed by C1 (93%) and C3 (90%). C3 varieties lagged behind the other classes in terms of meeting the set sodium content targets.

The chart below (Figure 4.2) summarises the whole sample's performance against the 2016 and 2019 Na mg/100g targets.

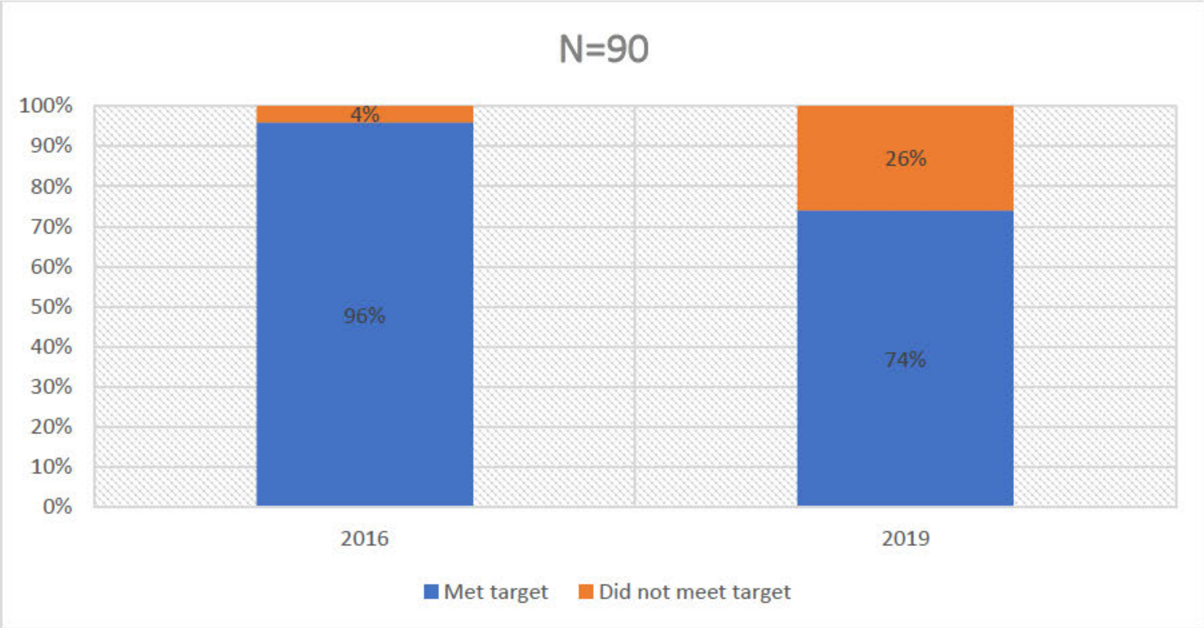


Figure 4.2: Overall sample performance - 2016 and 2019

In a total sample, 96% of the varieties met their 2016 Na/100mg targets while only 4% did not meet their targets. In the same sample, 74% met their 2016 target while 26% did not the 2019 target. The next section presents the individual results of the three categories starting with C1.

4.3 Ready-to-eat savoury snacks (C1)

Figure 4.3 shows the sodium content per 100 grams of C1 category snacks in a sample of 40 products.

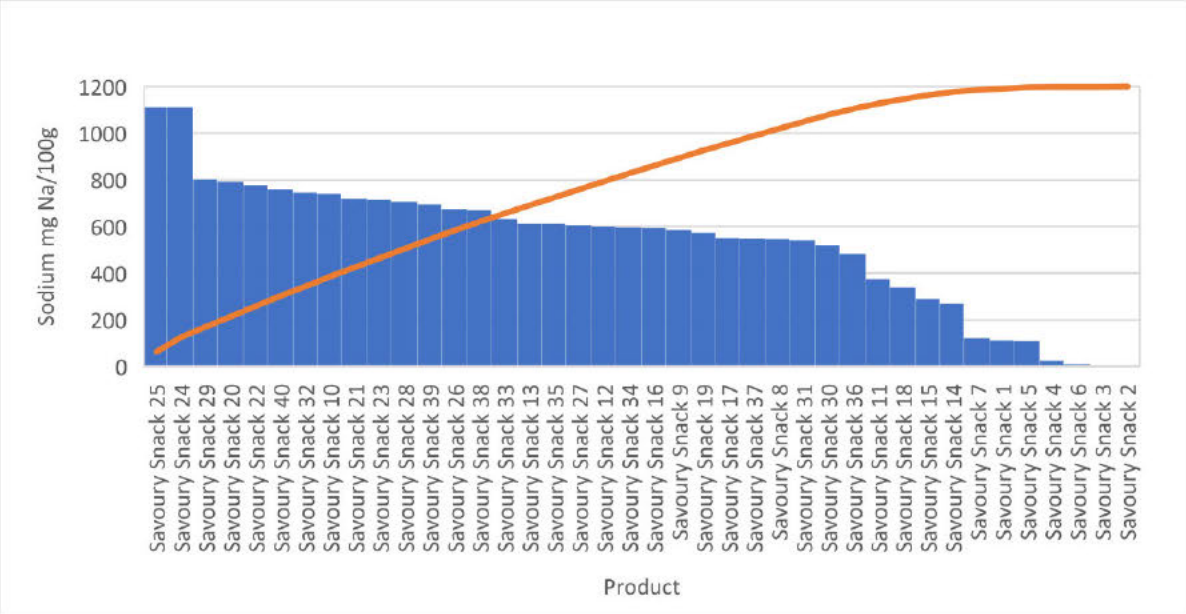


Figure 4.3: Sodium content per 100 grams of C1 snacks

The data shows that the sodium content per 100 grams of C1 snacks ranged from 5 to 1113 mg Na/100g. Table 4.2 summarises the observed descriptive statistical values for Ready-to-Eat snacks also presented as the C1 category.

Table 4.2: Descriptive Summary - RTE Snacks (C1)

C1: Sodium level per 100g on pack	Met 2016 target	Did not meet 2016 target	Met 2019 target	Did not meet 2019 target
Valid	37	3	29	11
Target (Na/100g)	800	800	700	700
Mean	493,62	1009,67	424,38	816,91
Median	585	1113	547	758
Std. Deviation	248,8	179,0	237,4	149,7
Skewness	-0,9	-1,7	-0,8	1,7
Kurtosis	-0,49	0	-0,99	1,60
Range	788	310	690	406
Minimum	5	803	5	707
Maximum	793	1113	695	1113

For the C1 category, the mean Na mg/100g for 2016 was 494 (sd+/-249). The minimum sodium content was 5mg/100g recorded on Savoury Snack 2 and Savoury Snack 3 and the maximum was 793mg/100g recorded for Savoury Snack 20. Three (3) of the 40 varieties failed to meet their 2016 target and their mean was 1010 (sd=+/-179). These were Savoury Snack 24, Savoury Snack 25, and Savoury Snack 29.

The mean Na mg/100g for 2019 was 424 (sd+/-237). The minimum sodium content was 5mg/100g recorded on Savoury Snack 2 and Savoury Snack 3 and the maximum was 595mg/100g recorded for Savoury Snack 39. Eleven (11) of the 40 varieties failed to meet their 2019 target. Their mean was 817 (sd=+/-150). Their highest sodium content per 100g was 1113mg/100g and was for Savoury Snack 24 and Savoury Snack 25.

The kurtosis and the skewness for mg Na/100g for 2016 and 2019 were below 2.5. For 2016 the kurtosis was 0.49 and the skewness was -0.9, while for 2019, the kurtosis was -0,8 and the skewness at -0,99. This shows nearness to a normal distribution (Lawson et al., 2019).

Amongst C1 snack varieties, five reported a nutrient content claim for sodium which was “low in sodium”. These are shown in Table 4.3 below.

Table 4.3: RTE Snacks with a low in sodium claim Mg Na/100g

C1: Savoury Snacks	(mg Na)	2016-SODIUM LIMIT per 100g (mg Na)	2019-SODIUM LIMIT per 100g (mg Na)
Savoury Snack 1	112	800	700
Savoury Snack 2	5	800	700
Savoury Snack 3	<5	800	700
Savoury Snack 4	24	800	700
Savoury Snack 14	270	800	700
Mean	103		
Standard deviation	105		
Minimum	5		
Maximum	270		

Their mean score was 103 (sd=+/-105 and their minimum and maximum sodium content was 5mg Na/100g and 270mg Na/100g, respectively.

4.4 Flavoured potato crisps (C2)

Figure 4.4 shows the sodium content per 100 grams of flavoured potato crisps, excluding salt and vinegar crisps.

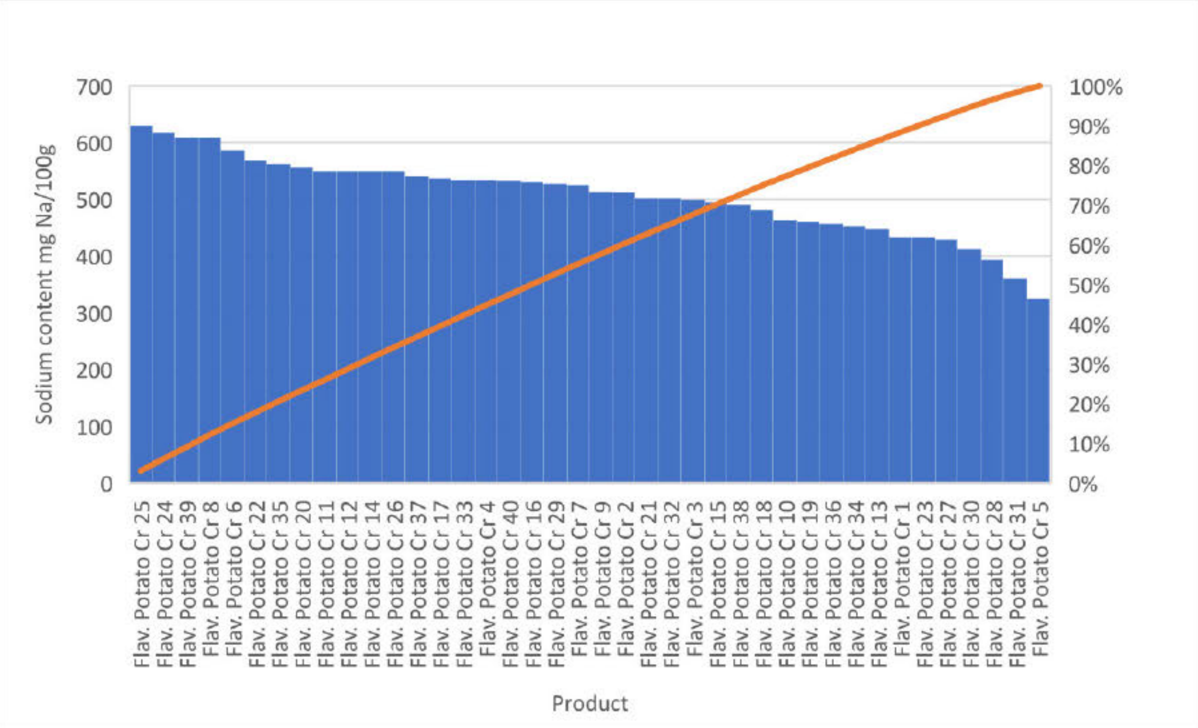


Figure 4.4: Sodium content per 100 grams of flavoured potato crisps

The data shows that the sodium content per 100 grams of flavoured potato crisps ranged from 325 to 630 mm Na/100g. Table 4.4 summarises the observed descriptive statistical values for Flavoured Potato Crisps also presented as the C2 category.

Table 4.4: Descriptive Summary - Flavoured Potato Crisps (C2)

C2: Sodium level per 100g on pack	Met 2016 target	Did not meet 2016 target	Met 2019 target	Did not meet 2019 target
N	40	0	32	8
Target (Na/100g)	650	650	550	550
Mean	506,68	0	485,22	592,50
Median	519	0	500,5	597,5
Std. Deviation	68,7	0	58,2	28
Skewness	-0,5	0	-1,0	-.072

Kurtosis	0,2	0	0,6	-1,8
Range	305	0	225	73
Minimum	325	0	325	557
Maximum	630	0	550	630

For varieties that met the 2016 target, the mean Na mg/100g was 507 (sd+/-69). They had a minimum sodium content of 325mg/100g recorded for Flavoured Potato Crisp 5 and a maximum of 630mg/100g recorded for Flavoured Potato Crisp 25. None of the C2 varieties failed to meet their 2016 target of Na 650mg/100g.

For Flavoured Potato Crisp varieties that met the 2019 target of 550mg/100g the mean Na (mg),/100g was 485 (sd+/-58). The minimum sodium content was 325mg/100g recorded on Flavoured Potato Crisp 5 and the maximum was 550mg/100g recorded for Flavoured Potato Crisp 11, Flavoured Potato Crisp 12, Flavoured Potato Crisp 14, and Flavoured Potato Crisp 26. Thus, 12.5% of 4 out of 32 varieties were positioned at the 550mg/100g benchmark.

The 8 C2 varieties that failed to meet the 2019 target of Na 550mg/100g had a mean of 593 (sd=+/-28). This translates to 8% above the 550mg/100g target for 2019. The variety with the lowest above-benchmark Na content was Flavoured Potato Crisp 20 with 557mg/100g. In the C2 group that failed to meet the 2019 target, The highest sodium content was 630mg/100g recorded for Flavoured Potato Crisp 25.

The kurtosis and the skewness for mg Na/100g for 2016 and 2019 were below 2.5. For 2016 the kurtosis was 0.2 and the skewness was -0.5; for 2019, the kurtosis was 0,8 and the skewness at -1. This shows nearness to a normal distribution (Lawson et al., 2019).

4.5 Flavoured ready-to-eat, savoury snacks and potato crisps -salt and vinegar only

Table 4.5 summarises the observed descriptive statistical values for flavoured ready-to-eat, savoury snacks and potato crisps with salt and vinegar also presented as the C3 category.

Table 4.5: Descriptive Summary - Salt and Vinegar Snacks (C3)

C3: Sodium level per 100g on pack	Met 2016 target	Did not meet 2016 target	Met 2019 target	Did not meet 2019 target
N	9	1	6	4
Target (Na/100g)	1000	1000	850	850
Mean	772,22	1036	685,83	967,75
Median	846	1036	674,5	987
Std. Deviation	179,34	0	149,92	74,82
Skewness	-0,33	0	0,07	-1,41
Kurtosis	-1,44	0	-2,47	2,65
Range	475	0	338	175
Minimum	512	1036	512	861
Maximum	987	1036	850	1036

In the C3 category, varieties that met the 2016 target had a mean of Na mg/100g of 722 (sd+/-179). Their minimum sodium content was 512mg/100g recorded on Salt and Vinegar Snack 3 and the maximum was 987mg/100g recorded for Salt and Vinegar Snack 6 and Salt and Vinegar Snack 7.

Only one C3 variety failed to meet the 2016 target, and this was Salt and Vinegar Snack 1 with a sodium content of 1036mg/100g. In the same category, varieties that met the 2019 target of 850mg/100g had a mean Na (mg)/100g of 686 (sd+/-58). Their minimum sodium content was 512mg/100g recorded for Salt and Vinegar Snack 3 and the maximum was 850mg/100g recorded for Salt and Vinegar Snack 5.

The mean for the 4 C3 varieties that failed to meet the 2019 target of 850mg/100g was 968 (sd=+/-75). This translates to 14% above the 850mg/100g target for 2019. The variety with the lowest above-target content was Salt and Vinegar Snack 4 with 861mg/100g. The highest sodium content was 1036mg/100g recorded for Salt and Vinegar Snack 1 and this translates to 22% sodium content above target.

The kurtosis and the skewness for mg Na/100g for 2019 and 2016 were below 2.5. For 2016 the kurtosis was -1.44 and the skewness was -0.33; for 2019, the kurtosis was -2.47 and the skewness at 0.07. This shows nearness to a normal distribution, suggesting the mean score's reliability (Lawson et al., 2019).

4.6 Varieties failing to meet both 2016 and 2019 targets

Table 4.6 summarises varieties that failed to meet both 2016 and 2019 targets. Out of the 90 varieties studied, 4 (4.4%) failed to meet their 2016 and 2019 targets.

Table 4.6: Varieties failing to meet both 2016 and 2019 targets

	Sodium level per 100g on pack	2016- Sodium Limit per 100g (mg Na)	2019- Sodium Limit per 100g (mg Na)	2016 target vs current	2019 target vs current
Savoury Snack 24	1113	800	700	-313	-413
Savoury Snack 25	1113	800	700	-313	-413
Savoury Snack 29	803	800	700	-3	-103
Salt and Vinegar Snack 1	1036	1000	850	-36	-186

Of the four, three were from the C1 category (Savoury Snack 24, Savoury Snack 25 and Savoury Snack 29) and one was from the C3 category (Salt and Vinegar Snack 1). A study conducted in South Africa which collected sodium content using nutritional labels identified that categories which did not meet the legislation sodium levels as per R214 were potato crisps (41%) and salt and vinegar-flavoured snacks (42%) (Peters et al., 2017). The study by Peters et al. (2017) therefore highlighted that meeting the regulated sodium content target was, to an extent, a challenge to some manufacturers in the snacks and crisps business – findings that closely resonated with this study.

4.7 Average category performance below 2016 and 2019 Mg Na/100g benchmarks

This section compares the difference between each of the three category's average performance in terms of how far it was above or below the set benchmarks for 2016 and 2019. Figure 4.5 shows group averages above the 2016 and 2019 benchmarks in percentage terms. It was calculated as the average of items that performed below the benchmarks for each group as a percentage of the benchmark.

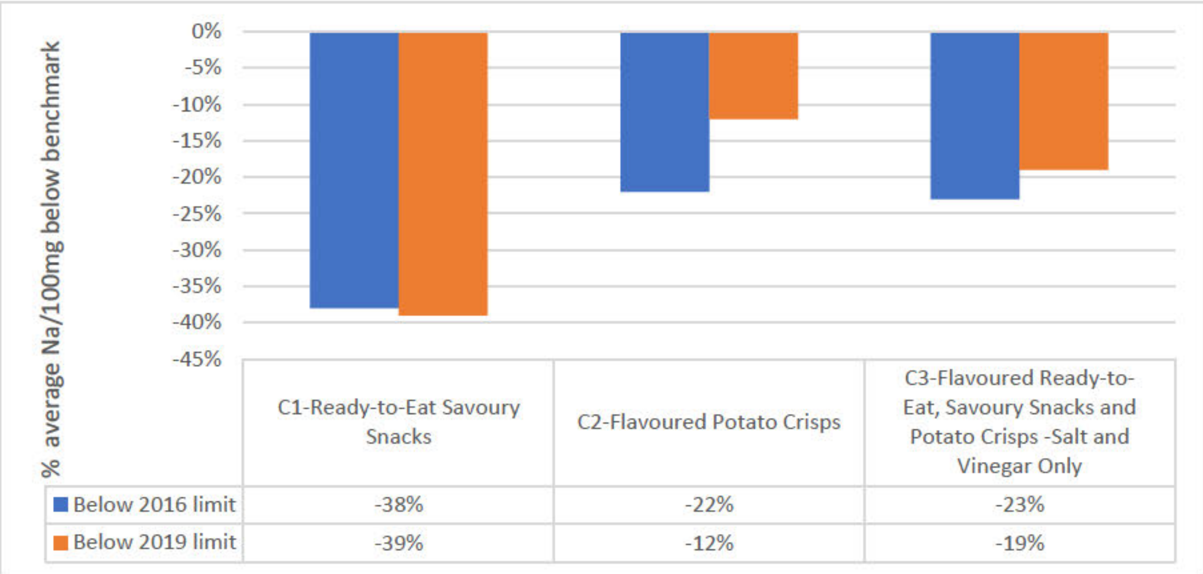


Figure 4.5: Average category performance below benchmarks

The chart shows that the average for the C1 variety's Na mg/100g was 38% below the 2016 limit, followed by C3 (23%) and C2 (22%). On the 2019 targets, C1 varieties were on average 39% below the benchmarked limits followed by C3 (19%) and C2 (12%). This shows that the three product categories surpassed the 2016 and 2019 targets by considerably wide margins. The data highlights that the snack producers that met the 2019 and 2016 targets reduced sodium content by wider margins than desired. Sodium reduction was therefore not marginal and in the researcher's view, this could suggest a greater commitment to reducing sodium beyond simply meeting regulatory needs.

4.8 Average category performance above 2016 and 2019 Mg Na/100g benchmarks

Figure 4.6 highlights the degree to which categories that failed to meet their 2016 and 2019 Mg Na/100g targets missed these targets in percentage terms. It was calculated as the averages of only those that performed above the benchmarks for each group expressed as a percentage for the benchmark.

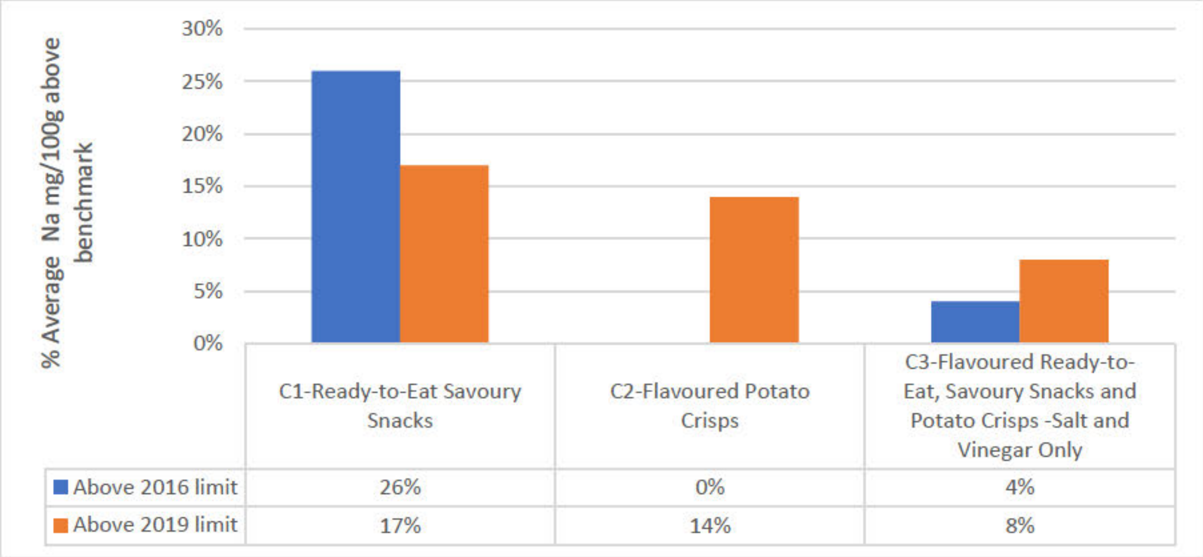


Figure 4.6: Average category performance above benchmarks

C1 varieties had the highest difference between the group's average Na mg/100g and the set limit or benchmark for 2016. C1 varieties were on average 26% above the set sodium content limit followed by C3 varieties that were on average 4% above the 2016 targeted limit. Thus for 2016, C1 had the highest variance or was furthest above the targeted limit compared to other categories. For 2019, C1 varieties were on average 17% above their targeted Na mg/100g limit followed by C2 (14%) and C3 (8%). C1 varieties had the largest differences above their set 2019 targets.

C1 was the only category with products which had a "low in sodium" claim. Savoury snack 4 had the highest variance in terms of the reported sodium content on the nutritional panel and the analysed results from the lab.

4.9 Low sodium claims versus laboratory analysis results

C1 was the only category with products with a "low in sodium" claim. Products with such a claim were further studied in the laboratory to compare the sodium content labelled on the packaging versus the tested or scientifically detected levels. Savoury Snack 1, Savoury Snack 2, Savoury Snack 3, Savoury Snack 4 and Savoury Snack 14 were subjected to these tests and the results are shown in Table 4.7 below.

Table 4.7: Reported low sodium content on label vs laboratory results sodium content

C1: Savoury Snacks	Sodium content on the package (mg Na)	2016-SODIUM LIMIT per 100g (mg Na)	2019-SODIUM LIMIT per 100g (mg Na)	Laboratory sodium content results(mg/Na)
Savoury Snack 1	112	800	700	118
Savoury Snack 2	5	800	700	8.81
Savoury Snack 3	<5	800	700	8.92
Savoury Snack 4	24	800	700	9.47
Savoury Snack 14	270	800	700	380

Of the five, only Savoury Snack 4 had a lower than labelled sodium content of 9.47 mg Na/100g versus the labelled 24mg Na/100g. Other C1 snacks had lower sodium content on their labels than those detected in the laboratory. For instance, Savoury Snack 14 had a low sodium claim of 270mg Na/100g versus a detected content of 380mg Na/100g. Savoury Snack 1 had a claim of 112mg Na/100g and a detected content of 118mg Na/100g, while Savoury Snack 2 had a claim of 112mg Na/100g and a detected 118mg Na/100g sodium content.

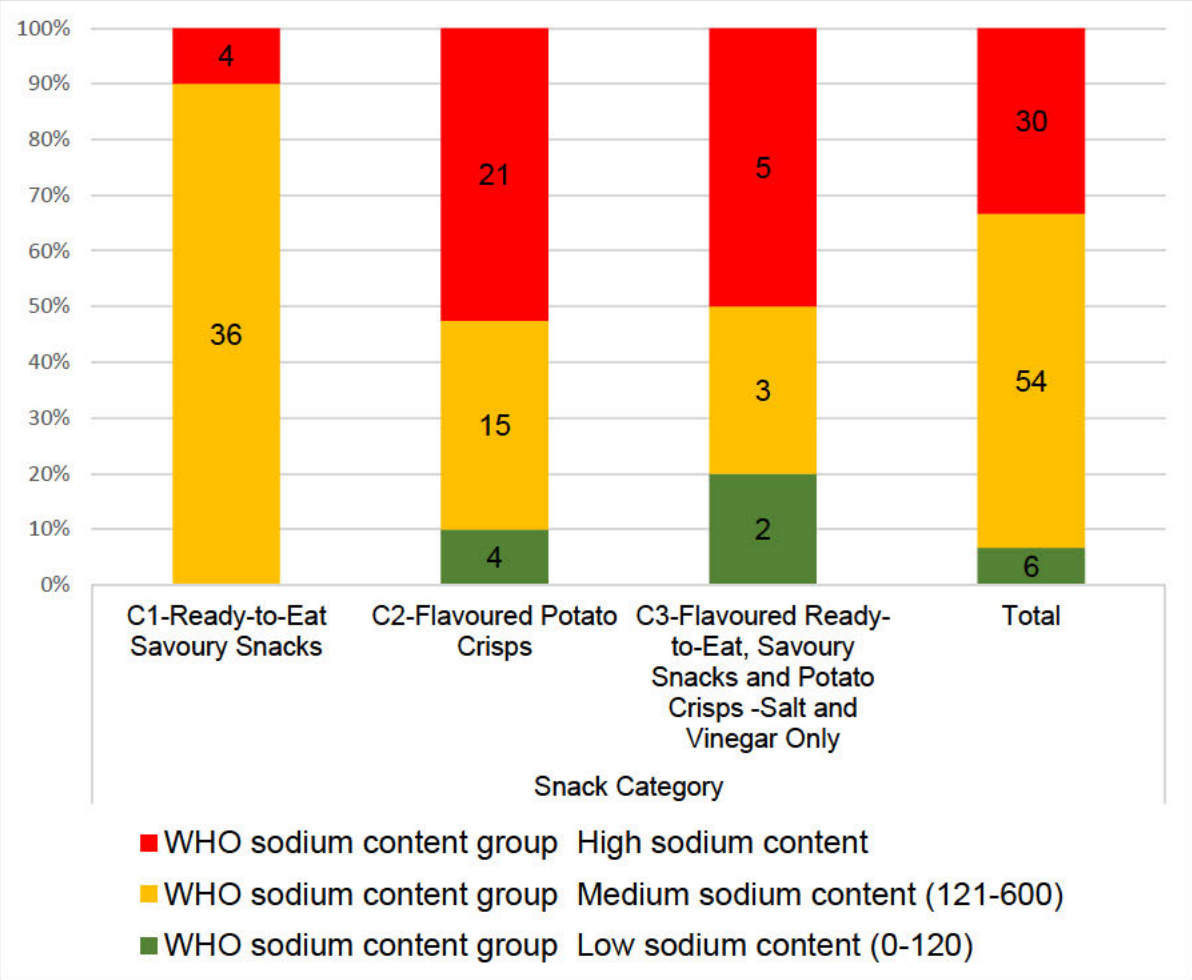
4.10 Comparing data against WHO sodium classification guidelines

The 2019 sodium content was compared to the WHO sodium classifications guidelines that classified sodium content by colour (colour coding) and mg (Na). To reiterate, the following classifications were made:

- Low sodium content per 100 g (0 -120) – green colour code
- Medium sodium content per 100 g (121-600)- amber colour code
- High sodium content per 100g (Over 600)-red colour code

Figure 4.7 below classified 90 snacks into the above classes and also uses WHO colour codes for this purpose.

Figure 4.7: Comparing data against WHO sodium classification guidelines



Out of the 40 C1 snacks, 36 were in the amber category and 4 in the red category. Also, out of 40 C2 snacks, 4 were in the green category, 15 in the orange and 21 in the red category. Within the 10 c3 snack groups, 2 were in the green category, 3 in the orange and 5 in the red category. In total, most of the snacks (54 out of 90) were in the amber category, followed by 30 out of 90 that were in the red category.

4.11 Tests of association

Fisher's exact tests were used to test for the associations between selected variables. These were between snack category and compliance with 2016 and 2019 targets (i.e. to assess if some snack groups were more compliant than others in a statistically significant way); WHO sodium content group versus snack category and WHO sodium content group versus compliance with 2016 and 2019 targets. Cramer's V tests were further conducted to test the strength of such associations.

4.11.1 Fisher's exact tests – snack category and compliance with 2016 and 2019 targets

Fisher's exacts tests were done to test if the ability to comply with both 2019 and 2019 targets was associated with product category – In other words, did some product categories show a lower or higher inclination to meet the targets than others. Table 4.8 below shows the results.

Table 4.8: Compliance with 2016 and 2019 targets versus target versus snack category - Fisher's exact tests

Target	Description	Statistic	Exact Sig. (2-sided)
2016	Fisher's Exact Test	3,97	0,208
	N of Valid Cases	90	
2019	Fisher's Exact Test	1,95	0,376
	N of Valid Cases	90	

At a 0.05 p-value ($p<0.05$), the above data shows no statistically significant relationship between the target year and product category. It was concluded that no product category was more inclined to meet the two targets than the other. As Fisher's exact tests were not statistically significant, no further tests were carried out on this relationship.

4.11.2 Fisher's exact tests – WHO sodium content group versus snack category

A cross-comparison between WHO sodium content group that the snack belongs to and the snack category was also done using Fisher's exact test. Table 4.9 below shows the descriptive outcome of this test.

Table 4.9: WHO sodium content group versus Snack Category Crosstabulation – Descriptive tests

Snack Category			
C1-Ready-to-Eat	C2-Flavoured Potato Crisps	C3-Flavoured Ready-to-Eat,	Total

		Savoury Snacks		Savoury Snacks and Potato Crisps - Salt and Vinegar Only	
WHO sodium content group	Low sodium content (0-120)	0	4	2	6
	Medium sodium content (121-600)	36	15	3	54
	High sodium content	4	21	5	30
	Total	40	40	10	90

Out of the 40 C1 snacks, the majority (36 or 90%) fell in the high sodium content category. In the C2, 21 out of 40 (53%) also fell in the high sodium content group while 15 out of 40 (38%) fell in the medium content group. Finally, 5 out of 10 (50%) of C3 snacks also fell into this group. Fisher's exact tests on the above cross-comparisons are shown in Table 4.10.

Table 4.10: WHO sodium content group versus Snack Category Crosstabulation – Fisher's Exact and Cramer's V

	Value	Exact Sig. (2-sided)
Fisher's Exact Test	29.876	.000
N of Valid Cases	90	
Cramer's V	.399	.000
N of Valid Cases	90	

There was, therefore, an association between snack category and WHO sodium content classifications with C1 snacks being highly associated with medium sodium content, most C2 and C3 snacks with high sodium content, albeit these had considerable snacks in the medium content range as well.

4.11.3 Fisher's exact tests – WHO sodium content group versus compliance with 2016 and 2019 targets

Having determined which snacks were associated with what WHO sodium content classification guidelines, the next set of tests was to determine the association between WHO sodium content classification (low, high and medium sodium content classifications) and the three snack categories (C1, C2 and C3) compliance with 2016 and 2019.

Table 4.11: – WHO sodium content group versus compliance with 2016 and 2019 targets - Fisher's Exact and Cramer's V

	Value	Exact Sig. (2-sided)
Fisher's Exact Test	.784	.709
N of Valid Cases	90	
Cramer's V		.116
N of Valid Cases	90	

The above table (Table 4.11) shows no statistically significant relationship between being in a low, medium or high sodium content group and the ability or failure to meet 2019 sodium reduction targets. Because of the insignificance of this relationship, no further tests were carried out on this relationship. However, it highlights an important aspect: even low-sodium snacks were likely to fail to meet the deadlines, just like high-sodium snacks. The findings reveal that sodium content levels were therefore not a significant determinant for sodium compliance indicating the existence of other non-content-related factors that were outside this study's scope.

CHAPTER 5: DISCUSSION OF RESULTS

5.1 Introduction

In this chapter, the findings made in Chapter 4 are further discussed. This discussion involves comparing the findings with similar or relatable studies and adding the researcher's perspectives on the results. Like the data analysis processes, the discussion was guided by the study's three research objectives and their respective research questions. These research objectives were: To assess and describe sodium content in selected savoury snacks; To assess the selected savoury snack’s compliance with Regulation 214 (R.214) on 2016 and 2019 sodium content targets and to assess low sodium claims made on selected products and determine if the sodium claim is compliant with the labelling legislation.

5.2 To assess and describe sodium content in selected savoury snacks

The study’s first objective was to assess and describe sodium content in selected savoury snacks.

5.2.1 Ready-to-eat savoury snacks (C1)

For the C1 category, the following key findings were made and these are also discussed in the section:

- The mean Mg Na/100g for 2016 was 494 (sd+/-249).
- The minimum sodium content was 5mg Na/100g in 2016.
- The maximum was 793mg Na/100g for 2016.
- The mean Mg Na/100g for 2019 was 424 (sd+/-237).
- The minimum sodium content was 5mg Na/100g the maximum was 595mg Na/100g for 2019.

Peter et al. (2017) found a minimum sodium content of 510mg/100, a maximum of 2851mg Na/100g and a mean of 1173mg Na/100g on savoury snacks. Theirs was a sample of 19. Generally, this study found comparatively lower minimum, maximum and mean sodium contents than that of Peters et al. (2017). Hattingh (2015) found a mean sodium content of 764 mg Na/100g and 720 mg Na/100g for March 2014 and March 2015 in RTE snacks, excluding salt and vinegar. These were relatively low compared to the mean sodium content of only RTE snacks that did not meet the 2016 sodium content target. This study found a mean of 1009.67mg Na/100g among snacks that did not meet the 2016 target and 816.91mg Na/100g among those that did not meet the 2019 targets. In terms of the mean for all RTE snacks, regardless of whether they met the set targets or not, Hattingh's (2015) study found higher mean scores (764 and 720) compared to this study's 532,33 (+/-278,79). Therefore, the Durban findings represent an improvement from Hattingh's findings, although it must be noted that the two studies were conducted in different contexts.

The data shows that most snacks, based on WHO classifications, were considered medium sodium content, albeit with a considerable percentage containing dangerous sodium content levels as per WHO guidelines (WHO, 2013). Other studies also show similar trends where the average sodium content per snack category was higher than WHO guidelines. The NIHI (2021) study for Australia and New Zealand showed that only potato crisps had sodium content below the 600 Na mg/100g considered safe by WHHO (2013).

This was attributable to the fact that in New Zealand and Australia, the 2019 sodium reduction targets for extruded snacks and salt and vinegar chips were set above the WHO-recommended levels (NIHI, 2021). Thus in Australia, salt and vinegar chips had a target of 810 Na mg/100g, which was 740 Na mg/100g for New Zealand (NIHI, 2021). In NZ, similar findings were made with extruded snacks and slat and vinegar targets of 770 and 740mg Na/100g (NIHI, 2020).

5.2.2 Flavoured potato crisps (C2)

- The mean Mg Na/100g for 2016 was 507 (sd+/-69).
- The minimum sodium content was 325mg Na/100g for 2016.
- The maximum was 630mg Na/100g for 2016.
- All varieties met the 2016 target.

In another study, Peters et al. (2017) found a minimum sodium content of 175mg Na/100g and a maximum of 1670mg Na/100g on potato crisps. They also found a mean of 721 on the same product out of a sample of 96. As highlighted earlier, C2 had the highest proportion (80%) of varieties meeting their 2016 targets.

Kongstad and Giacalone (2020) identified that it was possible to replace salt with 30% potassium chloride and monosodium glutamate in a potato chip recipe without affecting the taste profile of the potato chips. While it was beyond this study's scope to investigate how manufacturers reformulated their products to reduce sodium content, Kongstad and Giacalone's (2020) study suggests the availability of affordable substitute constituents could also be related to sodium content compliance in some foodstuffs.

Another study in South Africa analysed food products included in the sodium regulation and reported that 70% of the flavoured potato crisp, excluding the salt-and-vinegar group, did not comply with the targets set out in 2016 and 2019, respectively (Swanepoel et al.,2017). This study, however, shows significantly lower non-compliance levels, which the researcher attributes to the data being collected closer to the deadlines when manufacturers had had enough time to reformulate their products. Also, in Swanepoel et al.'s (2017) research, the 2019 target was considered a futuristic target, and manufacturers were not compelled to meet it then. There was, therefore no pressure to rework product constituents to meet this future deadline.

Hattingh's (2015) study also showed significantly high mean sodium content for flavoured potato crisps as of March 2015 compared to the results obtained in this study. The mean mg Na/100g for potato crisps was 819 mg Na/100g in 2015 compared to 506.68 for this study. While the comparison is complicated by timing and sampling differences, the baseline is that the current results indicate a generally lower level of sodium in potato crisps.

5.2.3 Flavoured Ready-to-Eat, savoury snacks and potato crisps -salt and vinegar only

In the C3 category:

- varieties that met the 2016 target had a mean of mg Na/100g of 722 (sd+/-179).
- minimum sodium content was 512mg Na/100g for 2016 and 2019
- the maximum was 987mg Na/100g for 2016 and 1036 mg Na/100g for 2019

Hattingh's (2015) study found a considerably higher mean sodium content in salt and vinegar ready-to-eat, savoury snacks and potato crisps than this particular study. These were 1330 and 1149mg Na/100g for data collected in March 2014 and 2015, respectively. This was much higher than the mean sodium content in this study's products which did not comply with the 2016 and 2019 targets. The comparison suggests higher sodium contents in the past than in the present, although it is vital to comment that Hattingh's study sampled two popular retailers in South Africa while this study sampled stores in Durban.

5.3 To assess the selected savoury snack's compliance with Regulation 214 (R.214) on 2016 and 2019 sodium content targets

The study's second objective was to assess the selected savoury snack's compliance with Regulation 214 (R.214) on 2016 and 2019 sodium content targets. As discussed in Chapters 1 and 2, this was considered South Africa's main piece of legislation directly focusing on sodium content reduction in foods. To an extent, compliance with R.214 would indicate the degree to which South Africa was moving from being a significantly high sodium-consuming country, possibly for the betterment of its people's health (Koen et al.,2021).

5.3.1 Compliance by product category

The data indicate that most snacks had sodium levels below the 2019 target on average when studied as a group. However, when the minimum and maximum Na/100mg were considered, some snacks contained excessive amounts of sodium – far above the 2019 regulated levels. This shows the wide variability in sodium content across brands and manufacturers.

A study by Peters et al. (2017) highlights a similar state of affairs that indicates that the South African consumer market is a wash with both compliant and non-compliant products whereby the sodium content differences across products under the same categories were wide. Thus while some products were highly compliant, for example containing as little as 5mg Na/100g, some were severely overstocked with sodium contents of 113mg Na/100g.

Looking at the different categories, the following findings were made:

- In the C1 category, 7% of the 40 varieties sampled did not meet their 2016 target - 27% did not meet the target for 2019.
- In the C2 category, all 40 varieties met their 2016, and 20% did not meet their 2019 target.

- In the C3 category, 90% met their 2016 target, while 40% did not meet their 2019 target.

In the earlier cited study by Peters et al. (2017), a slightly different picture regarding meeting 2016 targets is highlighted. In that study, as of 2017, 41% of potato crisps had not met their 2016 target, while 42% of salt and vinegar snacks and crisps had also failed to meet their 2016 Na mg/100g compliance levels. This confirms that the meeting of stipulated targets has generally been lagging.

Nonetheless, when comparing these 2016 targets to this study's findings, it is worth noting that in this study, products had at least five years to comply with the 2016 targets giving them more adjustment time. This view can conclude that perhaps more readjustment time could lead to more compliance. All the same, it is worrisome that even after such a long readjustment time, some of the salt and vinegar-flavoured crisps and snacks still failed to comply with the 2016 sodium content regulations. Pravst et al. (2017) suggest that more studies should be conducted to verify the effectiveness of sodium reduction strategies and they should include data on sodium diet intake and changes over time in sodium levels available at retail shops.

C1 was the only category with five sodium-related nutrient content claims. C2 and C3 products did not make any nutrient content claims. One product in the C1 category had a sodium nutrient content claim which was non-compliant. The labelling legislation R.146 clearly states that for a food product to be eligible to make a "low in sodium" claim, the sodium level per 100g needs to be 120 mg or below. The product had 270 mg Na/100g on the nutritional panel and the lab analysed value was 380mg Na/100g.

Norman and Fraser (2014) point out that a designed labelling system should be designed in a way that makes it clear for consumers to understand. The FOP labelling system should present key nutrients such as fat, sugar and sodium with easy-to-understand words reflecting whether the nutrient is low, medium or high.

5.3.2 Overall compliance with 2016 and 2019 targets

As shown in Chapter 4, in the total sample of 90, 96% of the varieties met their 2016 targets while only 4% did not. Also, 74% met their 2019 target, while 26% did not. One of the major debates surrounding mandatory sodium reduction in foodstuffs has been its effectiveness, especially whether producers and distributors of listed foodstuffs would duly comply (Trieu et al., 2015). The above results highlight that even though some of the studied products did not comply with the 2016 and 2019 regulations, government involvement in the process positively affects the extent to which producers and distributors attempt to reduce sodium content in products.

Similarly, a study by Korff et al. (2020), which investigated the compliance of seven foodstuffs with R214's 2016 and 2019 sodium content targets, comments that there is evidence that regulation can result in reduced-sodium composition in foods. The study further comments that small cases of non-compliance with both 2016 and 2019 targets among some products highlight the need for continuous monitoring and evaluation as we follow ups on manufacturers to ensure compliance. Like this study, Korff et al.(2020) noted that compliance with 2016 sodium content targets was generally higher than with 2019 targets. The element of time enabled manufacturers the opportunity to find new formulations as well as to retire some products (Korff et al., 2020).

5.4 Average category performance above 2016 and 2019 Mg Na/100g benchmarks

The average for the C1 variety's Mg Na/100g was 38% below the 2019 limit, followed by C3 (23%) and C2 (22%). The average for C1 varieties was 39% below the 2016 benchmarked limits, followed by C3 (19%) and C2 (12%). A modelling study to evaluate replacing sodium chloride with potassium chloride using 3 different formulations recommended using potassium chloride in food products as a replacement for sodium chloride (Van Buren et al.,2016). This was based on the view that this would ensure that manufactured products could meet industry targets (Van Buren et al., 2016).

C1 varieties were on average 26% above the set sodium content limit, followed by C3 varieties that were on average 4% above the 2016 targeted limit. In Brazil, it was pointed out in a study to assess sodium levels of snacks consumed by children and adolescents out of the 2945 foods analysed. It was reported that 21% of the foods had high levels of sodium (>600mg Na/100g)(Kraemer et al., 2015). In SA, an assessment was conducted to measure the sodium of content foods and snack foods had the highest median level of sodium reported at (746/mg/ 100g) (Peters et al. 2017).

C1 varieties were, on average, 17% above their targeted 2016 Mg Na/100g limit, followed by C2 (14%) and C3 (8%). In Slovenia, the sodium content of foodstuffs was monitored in 2015 and compared to data previously collected in 2019. The authors advised that the National Action Plan to reduce sodium intake had an inadequate impact on the prepackaged food products, which contribute to a high sodium intake in the diets of its population. They also highlighted that effective industry collaboration and consumer education should be strengthened. (Pravst et al.,2017).

5.5 To assess low sodium claims made on selected products and determine if the sodium claim is compliant with the labelling legislation

C1 was the only category with products with a "low in sodium" claim. Only one of these had a lower than labelled sodium content. Others had lower sodium content on their labels than those detected in the laboratory. Under South African law, manufacturers can make three types of sodium content claims.

These are "low" for products containing 120mg Na per 100g, "very low" for products with 40mg Na/100g and "Virtually free or free" for products containing 5mg Na/100g or less (Department of Health 2013). Two of the snacks (Savoury Snacks 2 and 3) made a "virtually free" from sodium claim. They each had 8.81 mg Na/100g and 8.92 mg Na/100mg falling in the very low sodium content range. The other two snacks (Savoury Snack 1 and Savoury Snack 4) remained in the same content claim category even after factoring in the differences between recorded and observed mg Na/100g.

The researcher opines that this could result from measuring method differences rather than misleading labelling considering the small differences. The case of Savoury Snack 14 is worrisome as the product made a low sodium content claim even after reporting a 270mg Na/100g which proved to be 380mg Na/100mg after the ICP-AES test. Bursey, Wiles and Biggs (2021) found a relatable case in a South African study where a product with a high sodium content above 40 mg Na/100g came with a low sodium content claim.

The researchers comment that reporting inaccuracies were common and manufacturers needed to finetune their testing and reporting to comply with labelling regulations on sodium content and other elements (Webster et al., 2017). Webster et al. (2017) recommended using common, standardised sodium content measurement systems.

Thus there were considerable differences between what was reported on the product label and what was detected in laboratory tests. It was outside the scope of this study to determine the reasons or explanations behind these variations but several studies have attempted to explain them.

Kraemer et al. (2016) assert that product labelling is the information link between the ordinary consumer and the producer communicating a product's constituents and their quantifications. Any variances between the labelled information and the actual constituents could expose consumers to the risks and dangers they would otherwise have escaped.

Some scholars like Moreira, Diez, de Almeida and Saraiva (2021) attribute such differences to intentional acts of public misinformation, which might be classified as food fraud. Others, however, see the use of different measuring methods as the cause of such discrepancies. However, regardless of the cause, they risk the erosion of public confidence in labelling (Moreira et al.,2021). Amato (2018) asserts that some health hazards like obesity can be attributed in South Africa to mislabelling which exposes consumers to unpreferable ingredients and quantities in products.

In a Spanish study, Ropero, Blain and Beltrá (2020) articulated that manufacturers can abuse nutrition claims to increase sales volumes and authorities need to implement sufficient plans to encourage healthy eating and better food labelling strategies.

As Oostenbach et al. (2019) discuss, nutrition claims can influence the type of products consumers buy and the consumption of certain foods. Incorrect labelling can be deceitful to consumers and hinder the work of public health and for these reasons, this is a matter that should be urgently dealt with (Hawley, Roberto, Bragg, Liu, Schwartz and Bronwell 2013).

5.6 Conclusion

The discussion above shows that the Durban savoury snacks met sodium content compliance standards. In some instances, they performed better than local and global comparisons, while in some cases, as depicted in some studies, their performance could improve. Some labelling and misinformation risks discussed in the literature also applied well to the Durban findings, as some results showed mismatches between labelled sodium content and laboratory test results. Many relationships were discussed in the study, specifically associations between snack category and compliance with 2016 and 2019 targets; WHO sodium content group versus snack category and WHO sodium content group versus compliance with 2016 and 2019 targets were not well-covered in the literature and they could therefore not be comparatively discussed. The next chapter concludes the study.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter summarises and concludes the study. The purpose of this study was to evaluate industry compliance with the sodium regulation R214. Forty (40) samples were collected from the savoury snack category, 40 samples were collected from the potato crisp category and 10 samples were bought from the Potato crisp, savoury snack salt and vinegar category. Products with a low sodium nutrient claim were further sent to the lab to verify the legitimacy of such claim as per labelling regulation R146. The conclusions, limitations and main findings will be presented in this chapter. The study was carried out to answer the following questions: What is the sodium content in selected savoury snacks? What is the selected savoury snack's level of compliance with Regulation 214 (R.214) on 2016 and 2019 sodium content targets? And Are low sodium claims on selected products compliant with South African labelling legislation?

6.2 Main findings

The study made interesting findings across its three research questions. These are outlined in this section, starting with the findings for the first research question.

6.2.1 What is the sodium content in selected savoury snacks?

The findings show that the Ready-to-Eat Savoury Snacks (C1) had a mean of 532 (sd=+/-279, a minimum sodium content of 5mg Na/100g and a maximum of 1113mg Na/100g. Flavoured Potato Crisps (C2) had a mean of 507mg Na/100g (sd=+/-69), a minimum sodium content of 325mg Na/100g and a maximum of 630mg Na/100g. C3 category (Flavoured Ready-to-Eat, Savoury Snacks and Potato Crisps -Salt and Vinegar Only) had a mean of 799 mg Na/100g (sd=+/-189), a minimum sodium content of 512mg Na/100g and a maximum was 1036mg Na/100g.

The mean scores of 2 of the 3 snack categories were below the 2019 R.214 targets. These also met WHO's (20130 classifications of medium sodium content as they had a sodium content below 600mg Na/100g. However, some individual snacks had significantly high sodium levels, as shown by the maximum content of 1108mg Na/100g.

6.2.2 What is the selected savoury snack's level of compliance with Regulation 214 (R.214) on 2016 and 2019 sodium content targets?

In terms of compliance, the study showed that out of the 90 selected snacks that 26% of the snacks did not meet their 2019 targets, while 4% did not meet their 2016 targets. Fisher's exact tests showed that no snack category had a better inclination towards meeting 2019 tests than others. In the C1 category, 7.5% of the 40 varieties did not meet their 2016 target of 800mg Na/100g while 27.5% did not meet their 700mg Na/100g target for 2019. In the C2 category, all 40 varieties met their 2016 target of 650mg/100 while 20% did not meet their 2019 target. In the C3 category, 9 varieties or 90%, met their 2016 target of 1000mg Na/100g while 40% of the 10 varieties did not meet their 2019 target of 850mg Na/100g. Generally, most snacks met their 2016 and 2019 targets, but a concerning proportion failed to do so.

6.2.3 Are low sodium claims made on selected products compliant with South African labelling legislation?

4 out of 90, 4.4% of the products made a compliant low sodium content claim (sodium levels below 120mg Na/100g). The findings from laboratory tests show that 4 of these were indeed low sodium content products, although their claimed sodium content was slightly higher than reported from independent laboratory tests. The findings also show that 1 product had a label indicating low sodium content, although it had sodium content far above the low sodium limit. The findings show the potential errors and misrepresentations in sodium content labelling in savoury snacks.

6.3 Conclusion

Data from this study shows that products from retail shops still do not comply with the sodium reduction legislation. There are impressive attempts by manufacturers to comply with R.214 although the risk of non-compliance remains. This risk exposes the consumer to high-sodium content snacks that have been extensively discussed as a major risk factor among South African consumers.

Another risk comes from poorly labelled products that claim to contain low sodium levels, while others claim to contain no sodium at all. This exposes consumers to misinformed decision-making that also adds to the risk that low-sodium-seeking consumers could face when buying savoury snacks. While there is general compliance with R.214, there is also evidence that this regulation's set targets fall far above WHO

(2013) guidelines that take anything above 600mg Na/100g as too high for a healthy lifestyle. The study, therefore, concludes that despite a generally higher compliance rate.

6.4 Recommendations

Various recommendations were made for food manufacturers, the government and consumers and these stem from the empirical research and the literature consulted. These are outlined in this section.

6.4.1 Recommendations for food manufacturers

The following recommendations apply to food manufacturers:

- Manufacturers needed to look at possible replacements for salt in savoury snacks. In the literature, it was suggested that green salt, lemon and vinegar were among the effective flavour enhancers that could be used in manufacturing.
- Food manufacturers should ensure a sodium testing programme to identify discrepancies in sodium content reporting on food labels.
- Manufacturers are encouraged to enhance their sodium content reporting and labelling systems to comply with government needs. This is critical as some products in the study had incorrect sodium content information.

6.4.2 Recommendations for Government

The following recommendations apply to the government:

- The government should develop a sodium reduction monitoring plan that the public can access to enforce regulation and ensure industry compliance.
- There is a gap in what DoH is doing regarding food manufacturers not complying with the regulation. More visibility is needed regarding what the department does to ensure manufacturers comply with the regulation.
- The DoH should consider implementing mandatory FOP labelling systems, which will be easy for consumers to understand as South Africa is diverse. This could include the easy-to-read traffic light system used by WHO.
- The DoH should have consumer awareness campaigns on radio, tv, and social media apps to raise awareness of the effects of a diet high in salt intake and

highlight the benefits of using alternative ingredients when consumers are preparing meals at home.

- The government needs to consider further cutting the sodium targets in salty savoury snacks to below WHO recommended standards that put any Na content above 600mg Na/100g.

6.4.3 Recommendations for consumers and consumer groups

The following recommendations apply to consumers and consumer groups.

- Consumers and consumer groups need to keep abreast with salt and sodium content developments to stay informed on the risks and dangers associated with sodium as a food substance.
- Consumers needed to work towards protecting the child consumer reported in the literature as a major at-risk group due to their high consumption of salty, savoury snacks.
- Consumer groups needed to lobby the government and manufacturers to reveal non-compliance among products and publicly report the risks associated with non-compliant snack products.

6.5 Limitations

The study reports a few limitations and these are:

- Only products which were available during data collection were bought from Durban.
- The products were bought from the four major food retailers: Spar, Shoprite, Checkers and Woolworths. Products from other outlets, including those made in the informal sector, were excluded, and the study's results do not apply to these categories.
- Only three snack categories from the sodium regulation list were analysed as part of this study. It, therefore, excludes several categories and its results may not apply to these excluded groups.
- Only the products with a sodium nutrient content claim were verified through lab analysis.

6.5.1 Future research

The following studies could help South Africa better understand and manage the high slaty savoury snack sodium content environment:

- Studies investigating savoury salt manufacturers' challenges in complying with sodium reduction regulations and product labelling systems in Durban and South Africa.
- Tests and experiments that assess the effects of salt substitution in savoury snacks. Such effects could include technical aspects like product quality, longevity, taste and texture, and socio-economic effects like product affordability and accessibility.
- Studies investigate the feasibility of further reducing the current sodium content levels in savoury snacks to meet WHO’s (2013) benchmark that puts anything above 600mg Na/100g as a severe health risk to the consumer.
- Studies investigate the effectiveness of sodium testing and measuring systems and processes that South African salty savoury snack manufacturers apply.

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APPENDIX A

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Salty and Savoury Snacks Compliance with 2016 and 2019 Sodium Content Targets—Durban Market, South Africa

Nomcebo Zama [1,*], Kemlall Ramdass [2] and Kgabo Mokgohloa [2]

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Abstract: South Africans consume a significantly high amount of sodium from salty snacks. The study aimed to evaluate savoury snacks (ready-to-eat savoury snacks, flavoured potato crisps and flavoured ready-to-eat, savoury snacks and potato crisps—salt and vinegar only) for compliance with the June 2016 and 2019 target date for sodium reduction as set out by the Department of Health in Regulation 214. It also looked at low-sodium claims made by the evaluated products. The study's research problem is located at the confluence of three critical trends: increasing consumption of sodium-containing salty snacks, increasing sodium-related disease burden and deaths and attempts to regulate sodium intake through regulation as a response. A total sample of 90 products belonging to the above categories was considered. Sodium content information was collected from the selected product packages. The study also applied the Association of Official Analytical Chemists' (AOAC) official method 984.27 in laboratory tests to verify low-sodium claims on the sampled products. The study showed that out of the 90 selected snacks, 26% of the snacks did not meet their 2019 targets, while 4% did not meet their 2016 targets. Fisher's exact tests showed that no snack category had a better inclination toward meeting 2019 tests than others. The laboratory tests showed that 4.4% of the products made a compliant low-sodium content claim (sodium levels below 120 mg Na/100 g), while one made a non-compliant sodium content claim. Among other things, the study recommended increased product compliance monitoring and evaluation, using standardised, rigorous sodium testing and measuring systems, using more consumer-friendly labels and consumer education on sodium labelling.

Keywords: sodium content; salty; savoury snacks; South Africa

Citation: Zama, N.; Ramdass, K.; Mokgohloa, K. Salty and Savoury Snacks Compliance with 2016 and 2019 Sodium Content Targets—Durban Market, South Africa. *Int. J. Environ. Res. Public Health* **2022**, *19*, 14118. https://doi.org/10.3390/ijerph192114118

Academic Editor: Paul B. Tchounwou

Received: 5 September 2022
Accepted: 24 October 2022
Published: 29 October 2022

1. Introduction

Salt is a common everyday ingredient used to flavour and preserve food in households and commercial entities. Over the years, there has been increasing concern about the quantity of salt consumed by societies, including processed salty snacks [1]. Excessive amounts of salt in both its discretionary and non-discretionary forms are linked to many health problems, especially cardiovascular problems [2]. Hypertension is a global problem that increases the risk of heart attack, stroke, kidney failure, and blindness. It has been reported that 1.13 billion people have been diagnosed with hypertension [3]. High salt intake was identified as one of the contributing factors to hypertension.

Non-discretionary salt comes in processed foods, and consumers do not have immediate control over it except to reduce taking such foodstuffs [1]. Such processed foods constitute a significant element of modern diets and lifestyles, and replacing them is not always a preferable choice for consumers. Supranational, international, and local entities continuously endeavour to reduce foods' salt or sodium content. In this vein, South Africa implemented the Regulations Relating to the Reduction of Sodium in Certain Foodstuffs and Related Matters (Regulation 214) of the Foodstuffs, Cosmetics and Disinfectant Act, 1972, published in the Government Gazette by the Department of Health [4]. These regulations targeted the reduction in non-discretionary salt in 13 food categories. This study looks at three product classes that fall into three categories regulated for sodium reduction by 2016 and 2019 to ascertain the degree of success in meeting these two targets as illustrated in Table 1. The study looks at "Savoury snacks, excluding salt-and-vinegar", "Flavoured Potato Crisps, excluding salt-and-vinegar" and "Flavoured ready-to-eat savoury snack and potato crisps—salt and vinegar only". Collectively, in this study, these are referred to as salty snacks or salty, savoury snacks.

Table 1. Reduction in total sodium content (Na) of certain foodstuffs (Source: Department of Health, 2013).

Product	2016 Target (Na/100 mg)	2019 Target (Na/100 mg)
C1: Ready-to-Eat Savoury Snacks	800	700
C2: Flavoured Potato Crisps	650	550
C3: Flavoured Ready-to-Eat, Savoury Snacks and Potato Crisps—Salt and Vinegar Only	1000	850

1.1. Background

Salty snacks are a popular treat among people of all ages. Several global research reports published by independent research agencies highlight continuous growth trends in salty snack volumes and revenues. For instance, Grand View Research, a US research firm, reports that in 2021, the global salty snacks industry realised a total revenue of US$250 billion and on top of that, it is expected to continue on a growth trajectory until 2030. The reports point to this growth rate as "urbanisation and hectic lifestyles" that have seen some individuals and households even substituting traditionally cooked meals for snacks [5]. A different agency also projected significant revenue growth for salty snacks [6]. Another report by Markets and Markets (2022) projected the global salty snacks industry revenue to rise to US $263 billion by 2027, and this report attributes this positive growth to changing lifestyles. The impact of COVID-19, especially the "stay-at-home" options and restrictions significantly increased the volume of snacking in developed countries. At the same time, constrained supply chains forced price increases and constrained demand, yet the industry recorded significant positive performance [7].

The salty snack market is broad and diverse in South Africa. South Africa's salty snack revenue for 2020 amounted to US $1345 billion and was projected to grow by 3.94% between 2021 and 2026. The same report cites another study by Knorr, a well-known vegetable flavour brand, which states that 70% of SA consumers snacked on salty snacks with potato chips being the most popular snacks [7]. The consumption of snacks increased by 43% between 2020 and 2021. As of the second quarter of 2021, salty snacks held a 23% market share of all snacks purchased and consumed in South Africa. This declined to 16.1% in the second quarter of 2021 [8]. In addition to sales volumes, revenue and market share growth related to salty snacks, five major retailers dominate this market: Shoprite, Pick n; Pay, Spar, Checkers and Woolworths. As of the second quarter of 2021, 31% of all salty snacks were distributed via Shoprite, followed by 19% through Pick n' Pay, 16.3% through Checkers, 10.8% via Spar, and 1.4% via Woolworths [8]. Generally, statistics point to an ever-increasing consumption of salty snacks—a trend that is not expected to slow down any time soon.

In this environment characterised by increasing snacking, some studies and reports talk of significant increases in high sodium-related diseases and conditions. Between 2009 and 2019, the death burden and disability risks associated with increased sodium intake increased in both the developed and developing world [9]. The World Health Organization (WHO) reports that globally 4.1 million people die because of sodium-related deaths. The same report castigates poor dietary choices that include snacking on high-sodium foodstuffs as severe sodium-related death risk factors. In South Africa, sodium-connected deaths are rising round about the same time snacking on sodium-rich foodstuffs is increasing. A National Department of Health report puts South African hypertension prevalence at 33% of the adult population [10]. The WHO also reports a considerable prevalence of people worldwide dying from cardiovascular diseases. In 2016, 17.9 million people died from cardiovascular diseases [11].

In response to such problematic situations, the South African government implemented regulatory measures to limit sodium content in selected foodstuffs. The South African Department of Health released the regulation in March 2013 for implementation in June 2016 and June 2019 [4]. The regulations have been amended two times, and government notice 1071/2017 included updates on specific definitions, the method of testing for sodium analysis and updated food categories [12]. The last amendment regulation, Government notice 812/2019, was published in 2019 and included updated food categories for processed and raw meat sausages [13].

The main objective of the regulations was to decrease the salt level in certain foodstuffs. The National Department of Health established this regulation to monitor consumers' use of non-discretionary salt in South Africa [4]. Salt Watch noted that effective coordinated marketing strategies to communicate to South Africans regarding the use of discretionary salt could aid in empowering consumers [14]. Therefore, food manufacturers must comply with the levels set out by the government. Some scholars recommend that consistent monitoring of food products in South Africa is vital to ensure industry compliance and evaluate the impact of reduced sodium in the diet [15]. Before these regulations, South Africa lacked a harmonised policy for regulating sodium. Reducing sodium content in South Africa to the mandated level will contribute to the decrease in hypertension prevalence. However, it will take some time for the full impact of regulatory sodium reduction to be felt [16].

1.2. Salty Savoury Snacks and Sodium Content

In many studies, snack foods are not well-defined, although researchers seem to describe them well [17]. Snacks can be classified either as sweet or savoury, while savoury ones can be further classified into salty snacks and spicy snacks [18]. The common components of savoury snacks were the use of a starchy or vegetable base, fat/oils and salt and spices rather than sugar as main flavourants [17,18]. Salty, savoury snacks use salt as the main flavourant and are classified under different names. Potato crisps are made from potatoes, while ready-to-eat extruded salty snacks are usually made from starches such as flour and corn as the main ingredients. While potato chips can be made through frying and baking, extruded snacks are made through the extrusion process [19]. These snacks can come out with a puffy or crunchy texture depending on the ingredient, temperature, and pressure combination [20].

Salt is made up of sodium and chloride and plays various important roles in the savoury snack manufacturing processes. These are [21,22]:

- Texture enhancement—Salt can be manipulated to give the desired snack texture when combined with water, fats, starches, and other substances. It helps with a firm texture that is required in most savoury snacks.
- Flavourant—Salt enhances the taste of snacks. Many snacks apply it as their primary flavour rather than as an additive (for example, salt and vinegar-flavoured chips).
- Flavourant enhancer—Salts also enhance how other flavours in a savoury snack can come out. They suppress bitterness while reducing sweetness, making flavours such as vinegar more testable.
- Nutrient source—As the body requires sodium as a nutrient, salt in savoury snacks also serves this purpose.
- Emulsifying agent—Salt helps to bind protein with other substances to avoid product crumbling or disintegration.

- Preservative—Salt reduces water content in snacks, limiting microbial activity and making products last longer on shelves.

The reasons for the popularity of salty snacks are their ease of accessibility, affordability, and storability [23]. These appeal to both the manufacturer and the consumer. An adult eats an average of 40 grams of savoury snacks in the United States daily. Some attribute the increasing consumption of savoury snacks to dietary shifts as societies move away from traditional, more stable diets toward highly processed, sugary, and savoury diets [24].

A common aspect of salty, savoury snacks is their affordability to the rich and the poor, making them a socially cross-cutting foodstuff [25]. One of the demographic groups considered major salty snack consumers were school children [24], and potato chips are the commonest of such snacks [26]. The effect of affordability and convenience of snacks for the school environment combined with limited knowledge of health risks, and pressure from colleagues and family experiences make school children highly vulnerable to the adverse effects of high sodium in savoury snacks [27].

2. Materials and Methods

2.1. Research Design

The study applied a quantitative observational descriptive research design in investigating the phenomenon of interest, specifically the levels of compliance with 2016 and 2019 sodium reduction targets in snacks and crisps. The objects of observation were:

- Ready-to-eat savoury snacks;
- Flavoured potato crisps;
- Flavoured ready-to-eat, savoury snacks and potato crisps—salt and vinegar only.

The observation method involved looking at and recording selected snacks' sodium content as reported on nutritional guide labels on their packaging.

2.2. Sampling

The study sampled snacks and crisps that belonged in the three listed categories available for sale in Durban. Convenience sampling was used and involved collecting data from readily available products. Additionally, this convenience was applied in selecting retailers from which the products or samples were collected. The products for observation were purchased from five South African retail shops in Durban: Pick n Pay, Woolworths, Spar, Checkers and Shoprite stores. The *Global Powers of Retailing Report for 2020*, which Deloitte publishes, ranks 250 of the world's most prominent retail groups; four were Shoprite, Spar group, Pick n' Pay and Woolworths from South Africa. This highlights that the entities from which the selected products were acquired have a broad outreach to South African and Durban societies.

Only snacks from the three categories with a nutritional information panel were included. In total, 90 products were bought and divided into three subgroups as per the sodium regulation. The sample was 40 units for C1, another 40 for C2 and 10 for C3.

2.3. Data Collection

The data collection process involved three steps. The first was the identification and collection of the actual products from the five retailers. A data collection checklist was used to ensure that products meeting the sample selection criteria were purchased and that there was no exclusion and duplication of eligible products and the inclusion of non-qualifying products. Once the samples were collected, sodium composition data recorded in mg Na/100 g were collected and recorded on a Microsoft Excel sheet.

2.4. Sodium Analysis in the Laboratory

The samples were analysed using the Association of Official Analytical Chemists (AOAC) official method 984.27. This test was used because of its availability to the researcher and its common use and acceptability as a reliable scientific testing method for elements in foodstuffs and beverages. The test uses the inductively coupled plasma-atomic emission spectroscopy (ICP-AES) principle [28].

The information collected from the nutritional table and artwork panel was captured on a spreadsheet by the researcher, and the information was separated into three specific categories. The data were entered two times to minimize errors. The researcher coded the results to ensure that no brand names were mentioned. Data were analysed using Microsoft Excel and SPSS version 23.

2.5. Quantitative Data Analysis

Descriptive statistics, mainly the mean or average scores and their accompanying standard deviations, were used for the tests. Kurtosis and skewness between −2.5 and 2.5 [29,30] were used as benchmarks to indicate that data were distributed in a manner that enabled it to be reliably analysed using mean scores.

Given the small sample size, statistical measures involving significance-level tests were considered a potential risk to research outcomes [31]. Fisher's exact test was therefore used for further data analysis because of its suitability for small sample tests of associations [29].

2.6. Reliability and Validity

The research process noted the importance of reliability and validity. In this study, validity related to the extent to which the study measured what it intended to measure. To reiterate, this was the levels of sodium per 100 g in three types of salty snacks and to measure the actual sodium content in salty snacks with low sodium claims. To ensure the reliability of measurements, the research relied on the following:

- Cross-checking to ensure that the measured product belongs to the class they were assigned using a checklist;
- Measuring and recording each sample twice as a way of controlling data inputting errors;
- Only sampling salty snacks with explicit sodium content presented in milligrams per 100 g.

For the second observation, which involved laboratory measurement of nutrition content claims, the following measures were taken to enhance the study's ability to measure what it intended to measure:

- The use of proper (ICP-AES) procedure as per the Association of Official Analytical Chemists (AOAC) official method 984.27 procedure;
- The repetition of tests to recheck outputs and investigate differences.

The study also reviewed the measurement methods that were applied in previous studies, including Hattingh [32], Peters et al. [15] and Korff [33], among others. This review identified strengths and weaknesses, which were applied to better the study's methods. The above measures, as expected, improved the study's validity.

3. Results

In a total sample, 96% of the varieties met their 2016 Na/100 mg targets, while only 4% did not meet their targets. In the same sample, 74% met their 2019 target, while 26% did not. Table 2 summarises all categories' performance against benchmarks or targets for 2016 and 2019.

Table 2. Product performance against Na/100 mg benchmarks or targets for 2016 and 2019.

	C1: Ready-to-Eat Savoury Snacks (*n* = 40)	C2: Flavoured Potato Crisps (*n* = 40)	C3: Flavoured Ready-to-Eat, Savoury Snacks and Potato Crisps—Salt and Vinegar Only (*n* = 10)
n	40	40	10
2016 Target (Na/100 g)	800	650	1000
2019 Target (Na/100 g)	700	550	850
Mean	532.33	506.68	798.6
Median	595	519	848
Std. Deviation	278.79	68.69	188.54
Skewness	−0.40	−0.53	−0.39
Kurtosis	−0.03	0.25	−1.30
Range	1108	305	524
Minimum	5	325	512
Maximum	1113	630	1036
Missed 2016 targets	7%	0%	10%
Missed 2019 targets	27%	20%	40%

In the C1 category, 7% of the 40 varieties sampled did not meet their 2016 target of 800 mg/100 g, while 27% did not meet their 700 mg/100 g target for 2019. In the C2 category, all 40 varieties met their 2016 target of 650 mg/100, while 20% did not meet their 2019 target of Na 550 mg/100 g. In the C3 category, nine varieties or 90% met their 2016 target of Na 1000 mg/100 g, while 40% of the 10 varieties did not meet their 2019 target of Na 850 mg/100 g. C2 had the highest proportion (80%) of varieties meeting their 2019 targets, which was followed by C1 (73%) and C3 (60%). Comparatively, C2 had the highest proportion of varieties that met their 2016 target. This was followed by C1 (93%) and C3 (90%). C3 varieties lagged behind the other classes in terms of meeting the set sodium content targets.

Ready-to-eat savoury snacks (C1) had a mean of 532 (sd = +/−279, a minimum sodium content of 5 mg Na/100 g and a maximum of 1113 mg Na/100 g. Flavoured potato crisps (C2) had a mean of 507 (sd = +/−69), a minimum sodium content of 325 mg Na/100 g and a maximum of 630 mg Na/100 g. Finally, the C3 category (flavoured ready-to-eat, savoury snacks and potato crisps—salt and vinegar only) had a mean of 799 (sd = +/−189), a minimum sodium content of 512 mg Na/100 g and a maximum was 1036 mg Na/100 g. The kurtosis and skewness alphas for all three ranged from 1.0 to −1.0, indicating closeness to normal distribution in the data and therefore a high reliability of using mean scores to describe the data [34].

In terms of mean sodium content, this study's 2019 sodium content mean of 798.6 differs from Korff's (2019) mean of 884.33. This indicates a comparatively lower albeit still concerning level. The next section presents the individual results of the three categories starting with C1.

3.1. Ready to Eat Savoury Snacks (C1)

Table 3 summarises the observed descriptive statistical values for all snacks including ready-to-eat snacks presented under the C1, C2 and C3 categories.

Table 3. Descriptive summary—all snacks.

		Valid	Target (Na/100 g)	Mean	Median	SD	Skew.	Kurt.	Range	Min.	Max.
RTE Snacks (C1)	Met 2016 target	37	800	493.62	585	248.8	−0.9	−0.49	788	5	793
	Did not meet 2016 target	3	800	1009.7	1113	179	−1.7	0	310	803	1113
	Met 2019 target	29	700	424.38	547	237.4	−0.8	−0.99	690	5	695
	Did not meet 2019 target	11	700	816.91	758	149.7	1.7	1.6	406	707	1113
Flavoured Potato Crisps (C2)	Met 2016 target	40	650	506.68	519	68.7	−0.5	0.2	305	325	630
	Did not meet 2016 target	0	650	0	0	0	0	0	0	0	0
	Met 2019 target	32	550	485.22	500.5	58.2	−1	0.6	225	325	550
	Did not meet 2019 target	8	550	592.5	597.5	28	−0.072	−1.8	73	557	630
Salt and Vinegar Snacks (C3)	Met 2016 target	9	1000	772.22	846	179.34	−0.33	−1.44	475	512	987
	Did not meet 2016 target	1	1000	1036	1036	0	0	0	0	1036	1036
	Met 2019 target	6	850	685.83	674.5	149.92	0.07	−2.47	338	512	850
	Did not meet 2019 target	4	850	967.75	987	74.82	−1.41	2.65	175	861	1036

For the C1 category, the mean Na mg/100 g for 2016 was 494 (sd = +/−249). The minimum sodium content was 5 mg/100 g recorded on Savoury Snack 2 and Savoury Snack 3, and the maximum was 793 mg/100 g recorded for Savoury Snack 20. Three (3) of the 40 varieties failed to meet their 2016 target, and their mean was 1010 (sd = +/−179). These were Savoury Snack 24, Savoury Snack 25 and Savoury Snack 29.

The mean Na mg/100 g for 2019 was 424 (sd = +/−237). The minimum sodium content was 5 mg/100 g recorded on Savoury Snack 2 and Savoury Snack 3, and the maximum was 595 mg/100 g recorded for Savoury Snack 39. Eleven (11) of the 40 varieties failed to meet their 2019 target. Their mean was 817 (sd = +/−150). Their highest sodium content per 100 g was 1113 mg/100 g and was for Savoury Snack 24 and Savoury Snack 25.

The kurtosis and the skewness for mg Na/100 g for 2016 and 2019 were below 2.5. For 2016, the kurtosis was 0.49 and the skewness was −0.9, while for 2019, the kurtosis was −0.8 and the skewness was at −0.99. This shows nearness to a normal distribution [35].

Amongst C1 snack varieties, five reported a nutrient content claim for sodium which was "low in sodium". Their mean score was 103 (sd = +/−105) and their minimum and maximum sodium content was 5 mg Na/100 g and 270 mg Na/100 g, respectively.

3.2. Flavoured Potato Crisps (C2)

Table 3 above also summarises the observed descriptive statistical values for flavoured potato crisps also presented as the C2 category.

For varieties that met the 2016 target, the mean Na mg/100 g was 507 (sd+/−69). They had a minimum sodium content of 325 mg/100 g recorded for Flavoured Potato Crisp 5 and a maximum of 630 mg/100 g recorded for Flavoured Potato Crisp 25. None of the C2 varieties failed to meet their 2016 target of Na 650 mg/100 g.

For flavoured potato crisp varieties that met the 2019 target of 550 mg/100 g, the mean Na (mg)/100 g was 485 (sd = +/−58). The minimum sodium content was 325 mg/100 g recorded on Flavoured Potato Crisp 5, and the maximum was 550 mg/100 g recorded for Flavoured Potato Crisp 11, Flavoured Potato Crisp 12, Flavoured Potato Crisp 14 and Flavoured Potato Crisp 26. Thus, 12.5% or four out of 32 varieties were positioned at the 550 mg/100 g benchmark.

The eight C2 varieties that failed to meet the 2019 target of Na 550 mg/100 g had a mean of 593 (sd = +/−28). This translates to 8% above the 550 mg/100 g target for 2019. The variety with the lowest above-benchmark Na content was Flavoured Potato Crisp 20 with 557 mg/100 g. In the C2 group that failed to meet the 2019 target, the highest sodium content was 630 mg/100 g recorded for Flavoured Potato Crisp 25.

The kurtosis and the skewness for mg Na/100 g for 2016 and 2019 were below 2.5. For 2016, the kurtosis was 0.2 and the skewness was −0.5; for 2019, the kurtosis was 0.8 and the skewness was at −1. This shows nearness to a normal distribution [34].

3.3. Flavoured Ready-to-Eat, Savoury Snacks and Potato Crisps—Salt and Vinegar Only (C3)

Table 3 shows the observed descriptive statistical values for flavoured ready-to-eat, savoury snacks and potato crisps with salt and vinegar also presented as the C3 category.

In the C3 category, varieties that met the 2016 target had a mean of Na mg/100 g of 722 (sd = +/−179). Their minimum sodium content was 512 mg/100 g recorded on Salt and Vinegar Snack 3, and the maximum was 987 mg/100 g recorded for Salt and Vinegar Snack 6 and Salt and Vinegar Snack 7.

Only one C3 variety failed to meet the 2016 target, and this was Salt and Vinegar Snack 1 with a sodium content of 1036 mg/100 g. In the same category, varieties that met the 2019 target of 850 mg/100 g had a mean Na (mg)/100 g of 686 (sd = +/−58). Their minimum sodium content was 512 mg/100 g recorded for Salt and Vinegar Snack 3, and the maximum was 850 mg/100 g recorded for Salt and Vinegar Snack 5.

The mean for the four C3 varieties that failed to meet the 2019 target of 850 mg/100 g was 968 (sd = +/−75). This translates to 14% above the 850 mg/100 g target for 2019. The variety with the lowest above-target content was Salt and Vinegar Snack 4 with 861 mg/100 g. The highest sodium content was 1036 mg/100 g recorded for Salt and Vinegar Snack 1, and this translates to 22% sodium content above target.

The kurtosis and the skewness for mg Na/100 g for 2019 and 2016 were below 2.5. For 2016, the kurtosis was −1.44 and the skewness was −0.33; for 2019, the kurtosis was −2.47 and the skewness was at 0.07. This shows nearness to a normal distribution, suggesting the mean score's reliability [34].

3.4. Varieties Failing to Meet Both 2016 and 2019 Targets

Table 4 summarises varieties that failed to meet both 2016 and 2019 targets which constituted four out of the 90 varieties studied (4.4%).

Table 4. Varieties failing to meet both 2016 and 2019 targets.

	Sodium Level per 100 g on Pack	2016-Sodium Limit per 100 g (mg Na)	2019-Sodium Limit per 100 g (mg Na)	2016 Target vs. Current	2019 Target vs. Current
Savoury Snack 24	1113	800	700	−313	−413
Savoury Snack 25	1113	800	700	−313	−413
Savoury Snack 29	803	800	700	−3	−103
Salt and Vinegar Snack 1	1036	1000	850	−36	−186

Of the four, three were from the C1 category (Savoury Snack 24, Savoury Snack 25, and Savoury Snack 29) and one was from the C3 category (Salt and Vinegar Snack 1). A study conducted in South Africa which collected sodium content using nutritional labels identified that categories which did not meet the legislation sodium levels as per R214 were potato crisps (41%) and salt and vinegar-flavoured snacks (42%) [15]. The study by Peters et al., therefore, highlighted that meeting the regulated sodium content target was, to an extent, a challenge to some manufacturers in the snacks and crisps business—findings that closely resonated with this study [15].

3.5. Low-Sodium Claims versus Laboratory Analysis Results

C1 was the only category with products with a "low in sodium" claim [36]. Products with such a claim were further studied in the laboratory to compare the sodium content labelled on the packaging versus the tested or scientifically detected levels. Savoury Snack 1, Savoury Snack 2, Savoury Snack 3, Savoury Snack 4 and Savoury Snack 14 were subjected to these tests.

Of the five, only Savoury Snack 4 had a lower than labelled sodium content of 9.47 mg Na/100 g versus the labelled 24 mg Na/100 g. Other snacks had lower sodium content on their labels than those detected in the laboratory. For instance, Savoury Snack 14 had a low sodium claim of 270 mg Na/100 g versus a detected content of 380 mg Na/100 g. Savoury Snack 1 had a claim of 112 mg Na/100 g and a detected content of 118 mg Na/100 g, while Savoury Snack 2 had a claim of 112 mg Na/100 g and a detected 118 mg Na/100 g sodium content.

4. Discussion

4.1. Ready-to-Eat Savoury Snacks (C1)

Generally, this study found comparatively lower minimum, maximum and mean sodium contents than Hattingh, who found a mean sodium content of 764 mg Na/100 g and 720 mg Na/100 g for March 2014 and March 2015 in RTE snacks, excluding salt and vinegar [32]. These were relatively low compared to the mean sodium content of only RTE snacks that did not meet the 2016 sodium content target. This study found a mean of 1009.67 mg Na/100 g among snacks that did not meet the 2016 target and 816.91 mg Na/100 g among those that did not meet the 2019 targets. In terms of the mean for all RTE snacks, regardless of whether they met the set targets or not, Hattingh's [32] study found higher mean scores (764 and 720) compared to this study's 532.33 (+/−278.79). Therefore, the Durban findings represent an improvement from Hattingh's findings, although it must be noted that the two studies were conducted in different contexts.

Other studies also show similar trends where the average sodium content per snack category was higher than WHO guidelines. The NIHI study for Australia and New Zealand showed that only potato crisps had sodium content below 600 Na mg/100 g considered safe by the WHO. This was attributable to the fact that in New Zealand and Australia, the 2019 sodium reduction targets for extruded snacks and salt and vinegar chips were set above the WHO recommended levels. Thus, salt and vinegar chips had a target of 810 Na mg/100 g in Australia and 740 Na mg/100 g for New Zealand [37].

4.2. Flavoured Potato Crisps (C2)

For C2, in another study, a minimum sodium content of 175 mg Na/100 g and a maximum of 1670 mg Na/100 g were found in potato crisps [15]. They also found a mean of 721 on the same product out of a sample of 96. As highlighted earlier, C2 had the highest proportion (80%) of varieties meeting their 2016 targets. It was possible to replace salt with 30% potassium chloride and monosodium glutamate in a potato chips recipe without affecting the taste profile of the potato chips [38]. Another study in South Africa analysed food products included in the sodium regulation and reported that 70% of the flavoured potato crisps, excluding the salt-and-vinegar group, did not comply with the targets set out in 2016 and 2019, respectively [39]. This study, however, shows significantly lower non-compliance levels, which the researcher attributes to the data being collected closer to the deadlines when manufacturers had had enough time to reformulate their products. In addition, in the research of Swanepoel et al., the 2019 target was considered a futuristic target, and manufacturers were not compelled to meet it then [39]. Therefore, there was no pressure to rework product constituents to meet this future deadline.

Hattingh's study also showed a significantly high mean sodium content for flavoured potato crisps as of March 2015 compared to the results obtained in this study [32]. The mean mg Na/100 g for potato crisps was 819 mg Na/100 g in 2015 compared to 506.68 for this study. While the comparison is complicated by timing and sampling differences, the baseline is that the current results indicate a generally lower level of sodium in potato crisps.

4.3. Flavoured Ready-to-Eat, Savoury Snacks and Potato Crisps—Salt and Vinegar Only

In the C3 category, varieties that met the 2016 target had a mean of mg Na/100 g of 722 (sd = +/−179). Hattingh's study found a considerably higher mean sodium content in salt and vinegar ready-to-eat, savoury snacks and potato crisps than in this study [32]. These were 1330 and 1149 mg Na/100 g for data collected in March 2014 and 2015, respectively. This was much higher than the mean sodium content in this study's products, which did not comply with the 2016 and 2019 targets. The comparison suggests higher sodium contents in the past than in the present, although it is vital to comment that Hattingh's study sampled two popular retailers in South Africa, while this study sampled stores in Durban

4.4. Compliance by Product Category

The data indicate that most snacks had sodium levels below the 2019 target on average when studied as a group. However, when the minimum and maximum Na/100 mg were considered, some snacks contained excessive amounts of sodium—far above the 2019 regulated levels. This shows the wide variability in sodium content across brands and manufacturers. One highlights a similar state of affairs that indicates that the South African consumer market is awash with both compliant and non-compliant products whereby the sodium content differences across products under the same categories were wide [16]. Thus, while some products were highly compliant, for example containing as little as 5 mg Na/100 g, some were severely overstocked with sodium contents of 113 mg Na/100 g.

Looking at the different categories, the following findings were made:

- In the C1 category, 7.5% of the 40 varieties sampled did not meet their 2019 target, while 27.5% did not meet the target for 2016.
- In the C2 category, all 40 varieties met their 2019 target, while 20% did not meet their 2016 target.
- In the C3 category, 90% met their 2019 target, while 40% did not meet their 2016 target.

In the earlier cited study [16], a slightly different picture regarding meeting 2016 targets is highlighted. In that study, as of 2017, 41% of potato crisps (C2) had not met their 2016 target, while 42% of salt and vinegar snacks and crisps had also failed to meet their 2016 Na mg/100 g compliance levels. This confirms that the meeting of stipulated targets has generally been lagging. Nonetheless, when comparing these 2016 targets to this study's findings, it is worth noting that in this study, products had at least five years to comply with the 2016 targets, giving them more adjustment time. This view can conclude that perhaps more readjustment time could lead to more compliance. All the same, it is worrisome that even after such a long readjustment time, some of the salt and vinegar-flavoured crisps and snacks still failed to comply with the 2016 sodium content regulations. Some suggest that more studies should be conducted to verify the effectiveness of sodium reduction strategies, and they should include data on sodium diet intake and changes over time in sodium levels available at retail shops [39].

C1 was the only category with five sodium-related nutrient content claims. C2 and C3 products did not make any nutrient content claim. One product in the C1 category had a sodium nutrient content claim which was not non-compliant. The labelling legislation R.146 clearly states that for a food product to be eligible to make a "low in sodium" claim, the sodium level per 100 g needs to be 120 mg or below. The product had 270 mg Na/100 g on the nutritional panel, and the lab analysed value was 380 mg Na/100 g. A designed labelling system should be designed in a way that makes it clear for consumers to understand [35]. The FOP labelling system should present key nutrients such as fat, sugar and sodium with easy-to-understand words reflecting whether the nutrient is low, medium or high.

4.5. Overall Compliance with 2016 and 2019 Targets

In the total sample, 96% of the varieties met their 2016 targets, while only 4% did not. In addition, 74% met their 2019 target, while 26% did not. One of the major debates surrounding mandatory sodium reduction in foodstuffs has been its effectiveness, especially whether producers and distributors of listed foodstuffs would duly comply [40]. The above results highlight that even though some of the studied products did not comply with the 2016 and 2019 regulations, government involvement in the process positively affects the extent to which producers and distributors attempt to reduce sodium content in products.

Similarly, a study which investigated the compliance of seven foodstuffs with R214′s 2016 and 2019 sodium content targets comments that there is evidence that regulation can result in reduced-sodium composition in foods [33]. The study further comments that small cases of non-compliance with both 2016 and 2019 targets among some products highlight the need for continuous monitoring and evaluation and follow-ups on manufacturers to ensure compliance.

4.6. Average Category Performance above 2016 and 2019 Mg Na/100 g Benchmarks

The average for the C1 variety's Mg Na/100 g was 38% below the 2019 limit, which was followed by C3 (23%) and C2 (22%). A modelling study to evaluate replacing sodium chloride with potassium chloride using three different formulations recommended using potassium chloride in food products as a replacement for sodium chloride [41].

C1 varieties were on average 26% above the set sodium content limit, which was followed by C3 varieties that were on average 4% above the 2016 targeted limit. In Brazil, it was pointed out in a study to assess sodium levels of snacks consumed by children and adolescents out of the 2945 foods analysed. It was reported that 21% of the foods had high levels of sodium (>600 mg Na/100 g) [42]. In SA, an assessment was conducted to measure the sodium of content foods, and snack foods had the highest median level of sodium reported at (746/mg/100 g) [16].

In Slovenia, the sodium content of foodstuffs was monitored in 2015 and compared to data previously collected in 2019. The authors advised that the National Action Plan to reduce sodium intake had an inadequate impact on the pre-packaged food products, which contribute to a high sodium intake in the diets of its population. They also highlighted that effective industry collaboration and consumer education should be strengthened [43].

4.7. Low-Sodium Claims by Evaluated Products

C1 was the only category with products with a "low in sodium" claim. Only one of these had a lower than labelled sodium content. Others had lower sodium content on their labels than those detected in the laboratory. Under South African law, manufacturers can make three types of sodium content claims. These are "low" for products containing 120 mg Na per 100 g, "very low" for products with 40 mg Na/100 g and "Virtually free or free" for products containing 5 mg Na/100 g or less [36]. Three of the snacks (Savoury Snack 2, 3 and 4) made a "Low in sodium", albeit, in reality, they each had 8.81 mg Na/100 g, 8.92 mg Na/100 mg and 9.47 Na/100 mg falling in the very low sodium content range. The other two snacks (Savoury Snack 1 and Savoury Snack 14) remained in the same content claim category even after factoring in the differences between recorded and observed mg Na/100 g. The researcher opines that this could result from measuring method differences rather than misleading labelling considering the small differences. The case of Savoury Snack 14 is worrisome, as the product made a low sodium content claim even after reporting a 270 mg Na/100 g, which proved to be 380 mg Na/100 mg after the ICP-AES test.

Bursey, Wiles and Biggs found a relatable case in a South African study where a product with a high sodium content above 40 mg Na/100 g came with a low sodium content claim [44]. The researchers comment that reporting inaccuracies were common and manufacturers needed to fine-tune their testing and reporting to comply with labelling regulations on sodium content and other elements [44].

Thus, there were considerable differences between what was reported on the product label and what was detected in laboratory tests. It was outside the scope of this study to determine the reasons or explanations behind these variations, but several studies have attempted to explain them. Product labelling is the information link between the ordinary consumer and the producer communicating a product's constituents and their quantifications [45]. Any variances between the labelled information and the actual constituents could expose consumers to the risks and dangers they would otherwise have escaped. Some scholars attribute such differences to intentional acts of public misinformation, which might be classified as food fraud [46]. Others, however, see the use of different measuring methods as the cause of such discrepancies.

In a Spanish study, it was articulated that manufacturers can abuse nutrition claims to increase sales volumes, and authorities need to implement sufficient plans to encourage healthy eating and better food labelling strategies [47].

Nutrition claims can influence the type of products consumers buy and the consumption of certain foods [48]. Incorrect labelling can be deceitful to consumers and hinder the work of public health, and for these reasons, this is a matter that should be urgently dealt with [49].

5. Limitations

The study reports a few limitations. Only products which were available during data collection were bought from Durban. These products were bought from the five major food retailers: Spar, Shoprite, Checkers, Woolworths, and Pick n Pay. Products from other outlets, including those made in the informal sector, were excluded, and the study's results do not apply to these categories. In addition, only three snack categories from the sodium regulation list were analysed as part of this study. It, therefore, excludes several categories, and its results may not apply to these excluded groups. Finally, only the products with a sodium nutrient content claim were verified through lab analysis.

6. Conclusions

Data from this study show that products from retail shops still do not comply with the sodium reduction legislation. There are impressive attempts by manufacturers to comply with R.214, although the risk of non-compliance remains. This risk exposes the consumer to high-sodium content snacks that have been extensively discussed as a major risk factor among South African consumers. The Africa-Predict study conducted in South Africa using 24 h urine samples showed that sodium intake by individuals aged 20–30 years decreased by 1.2 g/day after the implementation of the mandatory sodium regulations [50]. This is great progress, as previously reported research using regress equations further highlighted that by decreasing the sodium content of certain foodstuffs in South Africa, the initiative could lead to averting 7400 cardiovascular-related deaths [51].

There are various cardiovascular-related benefits of reduced sodium intake in humans. A diet low in sodium can positively affect the cardiovascular system, assisting in stable blood pressure values in hypertensive patients and can assist in vascular functioning [52]. The dietary strategy which includes low-sodium foods and Dietary Approaches to Stop Hypertension (DASH) showed significant reductions in systolic and diastolic blood pressure, respectively [53].

Another risk comes from poorly labelled products that claim to contain low-sodium levels which are not compliant with the labelling legislation. This exposes consumers to misinformed decision making that also adds to the risk that low-sodium-seeking consumers could face when buying savoury snacks. While there is general compliance with R.214, there is also evidence that this regulation's set targets fall far above WHO (2021) sodium levels for a variety of food categories [54].The study, therefore, concludes that despite a generally higher compliance rate, more action needs to be taken to ensure that the population is consuming acceptable levels of sodium.

7. Recommendations

Various recommendations were made for food manufacturers, the government and consumers, and these stem from the empirical research and the literature consulted. These are outlined in this section.

- Manufacturers needed to look at possible replacements for salt in savoury snacks. In the literature, it was suggested that green salt, lemon and vinegar were among the effective flavour enhancers that could be used in manufacturing.
- Food manufacturers should ensure a sodium testing programme to identify discrepancies in sodium content reporting on food labels.
- Manufacturers are encouraged to enhance their sodium content reporting and labelling systems to comply with government needs. This is critical, as some products in the study had incorrect sodium content information.

The following recommendations apply to the government:

- The government should develop a sodium reduction monitoring plan that the public can access to enforce regulation and ensure industry compliance.
- There is a gap in what the DoH is doing regarding food manufacturers not complying with the regulation. More visibility is needed regarding what the department does to ensure manufacturers comply with the regulation.
- The DoH should consider implementing mandatory FOP labelling systems, which will be easy for consumers to understand, as South Africa is diverse. This could include the easy-to-read traffic light system used by the WHO.
- The DoH should have consumer awareness campaigns on radio, TV, and social media apps to raise awareness of the effects of a diet high in salt intake and highlight the benefits of using alternative ingredients when consumers are preparing meals at home.
- The government needs to consider further cutting the sodium targets in salty savoury snacks to below WHO recommended standards that put any Na content above 600 mg Na/100 g.

Consumers and consumer groups need to keep abreast with salt and sodium content developments to stay informed on the risks and dangers associated with sodium as a food substance. They also need to work toward protecting the child consumer reported in the literature as a major at-risk group due to their high consumption of salty, savoury snacks. Consumer groups need to lobby the government and manufacturers to reveal non-compliance among products and publicly report the risks associated with non-compliant snack products.

Author Contributions: N.Z. designed the study, implemented the research and completed the initial first draft. K.R. supervised and K.M. co-supervised the MPhil qualification, which is now being developed into a research paper. N.Z., K.R. and K.M. reviewed and approved the final submission of the manuscript. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data sets are available upon request.

Conflicts of Interest: The authors declare no conflict of interest.

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21st July 2021

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Dear Ms N Zama

MASTERS OF PHILOSOPHY IN MANAGEMENT SCIENCES: QUALITY

This serves to confirm the approval of your research proposal by the Faculty Research Committee, at its meeting on **21st July 2021**, as follows:

1. Research proposal and provisional dissertation title:
An investigation into the nutrient quality, sodium content and compliance of savoury snacks and potato crisps in KwaZulu-Natal.

Supervisor: **Prof KR Rmdass**

Co-supervisor: **Mr Mokgohloa**

Please note that any proposed changes in the thesis/dissertation title require the approval of your supervisor/s, the Faculty Research Committee, as well as ratification thereof by the Higher Degrees Committee.

2. Research budget to the amount of: **R10 000.00(Masters) / R15 000(DPHIL)**
Please note that this funding is not a scholarship or bursary and is therefore not paid directly to you, but is controlled by the Faculty. Any proposed changes to the use of this funding allocation requires the approval of your supervisor and the Dean. Please note that funding will be reimbursed to you after the provision of receipts.

The Institutional Research Committee has stipulated that:

(a) This University retains the ownership of any Intellectual Property (patent, design, etc.) registered in respect of the results of your Masters/Doctors Degree in Technology studies as a result of the award and the provisions of the above Act;

(b) Should you find any of the terms above not acceptable then you are given the option to decline the Research budget award to your project in writing.

May we remind you that in terms of Rule G25(2)(b), if you fail to obtain the Masters/Doctors degree within the maximum time period allowed after first registering for the qualification, Senate may refuse to renew your registration or may impose any conditions it deems fit. You may apply to the Faculty Research Committee for an extension.
Please note that you are required to convert your registration from the informal to the formal course and re-register each year.

Please note that the following must be adhered to:

Registration:

1. Ensure registration has taken place ***(the onus is on the student and the supervisor to ensure registration takes places at the beginning of each year whilst the student is currently engaged with his/her Masters or PhD qualification)***
2. Ensure that application for Conferment of Status has been made in the event of your undergraduate qualification being different to this application. ***Your attention is drawn to the fact that Conferment of Status is required for registration.***
3. Ensure that your supervisor has submitted your proposal to the Faculty Research Officer (FRO) for IREC clearance (institutional research ethics committee). This is in the case of Ethics level 2 and level 3 IREC (in the case of a study dealing with vulnerable populations). See guideline attached. ***It is the researcher's responsibility to check the Ethics requirements and submit to the relevant bodies irrespective of the reviewer's recommendation.***

Dissertation submission for examination:

1. Ensure that you submit the intention to submit form **(PG 5)**, signed by the HOD and Supervisor
2. Ensure that the signed checklist is submitted with the **PG 5**
3. Once your dissertation is submitted to the supervisor for examination purposes, communication from here on will only be with you supervisor and not with the faculty.
4. Your supervisor MUST nominate the examiners three months prior to submission of the dissertation/thesis for examination.
5. On submission for examination, please note that a PDF signed copy must be submitted to your supervisor along with the completed and signed **PG 7** form, **FMS Checklist** and signed **Turn it in report**.
6. Feedback will be provided to your supervisor regarding the examination result after the result is ratified by the Higher Degrees Committee (HDC).
7. In the event of a resubmission the reports will be submitted to the supervisor who will communicate with you for revision. Once revision has taken place your supervisor will submit to the FRO for resubmission to the examiners.
8. In the case where there is a discrepancy in examiners results, an Arbiter will be nominated via the HOD and supervisor and tabled at FRC and ratified at HDC.

On completion of this process, the Arbiters report will be tabled at FRC and ratified at HDC.

9. Results of the Arbitration process will be communicated to your supervisor

Graduation requirements:

1. Ensure that you submit a completed signed PG10 form
2. one hard bound dissertation/thesis with a pdf version to be sent upon HDC ratification
3. response to post graduate examination form
4. completion of study form (IREC form)

Should you experience any problems relating to your research, your supervisor must be informed of the matter as soon as possible. If the difficulties persist, you should then approach your Head of Department and thereafter the Faculty Research Coordinator.

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Kind regards,

____

Dr Melanie Lourens obo the FRC Chair/Executive Dean: Professor Netswera

Faculty of Management Sciences