INCREASING YOUNG CHILDREN'S VEGETABLE CONSUMPTION: EFFECTIVENESS OF A BEHAVIOURAL INTERVENTION IN AN EARLY CHILDHOOD DEVELOPMENT CENTRE IN BOTSWANA

by

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LIST OF ABBREVIATIONS

ECD	Early Childhood Development
CRAM	Coronavirus Rapid Mobile Survey
FAO	Food and Agricultural Organisation
FBDG	Food-based Dietary Guidelines
IBM	International Business Machines
NCDs	Non-Communicable Diseases
NDoH	National Department of Health
NFCS	South African National Food Consumption Survey
NIDS	National Income Dynamics
SANHANES	The South African National Health and Nutrition Examination Survey
SAMRC	South African Medical Research Council
SCT	Social Cognitive Theory
SPSS	Statistical Package for Social Sciences
STATS SA	Statistics South Africa
UNICEF	United Nations Children's Fund
WHO	World Health Organisation

DEDICATION

I would like to dedicate this dissertation and give special thanks to my precious mother and wonderful husband for their unwavering support and motivation throughout my journey of this dissertation. This work is also dedicated to my two children for their inspiration as well as my siblings whose continual support is appreciated.

DECLARATION

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Exact wording of the title of the dissertation as appearing on the electronic copy submitted for examination:

Increasing young children's vegetable consumption: effectiveness of a behavioural intervention in an early childhood development centre in Botswana

I declare that the above dissertation is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

I further declare that I submitted the dissertation to originality checking software and that it falls within the accepted requirements for originality.

I further declare that I have not previously submitted this work, or part of it, for examination at Unisa for another qualification or at any other higher education institution.

(The dissertation will not be examined unless this statement has been submitted.)

SIGNATURE

30 November 2021

DATE

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ABSTRACT

Background: Although several studies have illustrated that the global population consumes a diet low in vegetables and fruits, there are still limited studies on health promoting strategies or interventions to help increase vegetable consumption in children at early childhood development (ECD) centres, especially in Southern Africa. It is important to address children's eating behaviours early in childhood to increase dietary diversity, which will enable them to meet their nutritional requirements that support adequate growth and development as well as establish healthy eating behaviours into adulthood.

Aim: The aim of this study was to determine the effect of a behavioural intervention on vegetable intake in children, aged 3 to 6 years, in an ECD centre in Gaborone, Botswana.

Methods: A quasi-experimental study was conducted, employing the pre-test-post-test design. Firstly, data on habitual intake at home and at school was collected from parents and teachers respectively, using self-administered questionnaires. Children aged 3 to 6 years, from Dipeo Nursery School in Gaborone were provided with set portions of same-sized carrots and green beans on three respective days. On the second day, the social cognitive theory was applied through an intervention that consisted of posters of animated superhero cartoons promoting vegetable intake. The participants' vegetable intake during the tests was assessed by counting the remaining number of vegetables on the plate and converted to the proportion consumed. Dependent t-tests were conducted to deduce inferences between pre-test, intervention, and post-test.

Results: In total, 31 children were included in the study (17 boys, 14 girls). Parents reported carrots (65%), potatoes (61%) and tomatoes (55%) as the most frequent vegetables consumed in the preceding 24 hours. While the teachers reported cucumbers (91%), carrots (82%), corn (73%) and tomatoes (62%) as the most packed vegetables for school. Considering the intervention, there was no significant difference in the mean vegetable consumption (carrots and green beans) between the age groups on the pretest, intervention, or post-test days. For the total group, there was a

significant increase in carrot consumption of 13.3% (t (30) = -3.99, $p<0.001$) from intervention (69.0, ±32.1%) to post-test (82.2, ±23.9%), as well as an increase of 7.1% from pre-test (75.1, ±28.3%) to post-test (82.2, ±23.9%), (t (30) = -2.09, $p=0.045$). Similarly, there was a 9% increase in green bean consumption (t (30) = -3.04, $p=0.005$) from intervention (53.1, ±36.6%) to post-test (62.1, ±35.0%).

Conclusion: This study demonstrated that a behavioural intervention employing animated superhero cartoons paired with repeated exposure on three time points (pretest, intervention, and post-test) is effective in promoting vegetable intake in children aged 3 to 6 years in an ECD centre. It is recommended that children are encouraged to consume vegetables by means of visual characters and repeated exposure. Additionally, children should consume meals in an environment without distractions. The results of this study positively contribute to foundational data and demonstrate the need for further research on interventions on a larger scale.

KEY TERMS

Behavioural intervention; vegetable intake; animated superhero cartoons; early childhood development (ECD) centre; children; quasi experimental design; pre-test-post-test design; carrots; green beans; Botswana; Southern Africa

TSHOBOKANYO

Lemorago: Le fa dithutopatlisiso di le mmalwa di bontshitse gore batho ba mo lefatsheng ba ja dijo tse di nang le merogo le maungo a a kwa tlase, go sa ntse go na le dithutopatlisiso tse di lekanyeditsweng fela tse di ka ga go tsweletsa ditogamaano le ditsereganyo tsa go thusa go oketsa go ja merogo ga bana kwa ditikwatikweng tsa bana ba bannye ba ba golang (ECD), bogolo segolo mo Borwa jwa Aforika. Go botlhokwa go samagana le mekgwa ya bana ya go ja go sa le gale mo bongwaneng go oketsa go nna teng ga dijo tse di farologaneng, e leng se se tlaa ba kgontshang go fitlhelela ditlhokego tsa bona tsa dikotla tse di tshegetsang kgolo e e lekaneng jaaka fa re tlaa bo re simolola mekgwa e e itekanetseng ya go ja mo bogolong.

Maikaelelo: Maikaelelo a thutopatlisiso eno e ne e le go swetsa ka ditlamorago tsa tsereganyo ya mekgwa malebana le go ja merogo ga bana ba bogolo jwa dingwaga tse 3 go ya go 6, mo tikwatikweng ya ECD kwa Gaborone, Botswana.

Mekgwa Go dirisitswe thutopatlisiso e e batlileng e nna ya tekeletso, go dirisiwa thadiso ya pele-ga teko-morago-ga teko. Bana ba bogolo jwa dingwaga tse 3 go ya go 6, go tswa kwa Sekolong sa Bana Bannye sa Dipeo kwa Gaborone, ba ne ba tlamelwa ka dikarolo tse di rileng tsa digwete le dinawa tse di lekanang mo malatsing a le mararo a a latelanang. Ka letsatsi la bobedi, go dirisitswe tiori ya temogo ya loago ka tsereganyo e e neng e na le diphousetara tsa bagaka ba dipopae ba tsweletsa go ja merogo. *Data* ka ga go ja ga tlwaelo kwa gae le kwa sekolong e kokoantswe go tswa mo batsading le barutabana, go dirisiwa makwalopotsolotso a a ikwalelwang ke motho ka boene. Go ja merogo ga banni-le-seabe ka nako ya diteko go tlhatlhobilwe ka go bala palo ya merogo e e setseng mo sejaneng mme ya fetolelwa mo karolong e e jelweng. Go ne ga diragadiwa diteko tsa *t* tsa go bona boikaego jwa *data* go bona pharologano magareng ga tsereganyo ya pele ga teko le ya morago ga teko.

Dipholo: Gotlhe gotlhe, go ne go akareditswe bana ba le 31 mo thutopatlisisong (basimane ba le 17, basetsana ba le 14). Bagolo ba begile gore digwete (68%), ditapole (61%) le ditamati (55%) ke merogo e e jelweng gantsi mo diureng tse 24 pele ga foo. Fa go lebelelwa tsereganyo, go ne go se na pharologano e e bokao mo go jeweng ga merogo (digwete le dinawa) magareng ga ditlhopha tsa bogolo mo

malatsing a pele ga teko, tsereganyo le morago ga teko. Mo setlhopheng sotlhe, go ne go na le koketsego ya go jewa ga digwete ya 13.3% (t (30) = -3.99, $p<0.001$) go tloga ka tsereganyo (69.0, ±32.1%) go ya go morago ga teko (82.2, ±23.9%), gammogo le koketsego ya 7.1% go tloga go pele ga teko (75.1, ±28.3%) go ya go morago ga teko (82.2, ±23.9%), (t (30) = -2.09, $p=0.045$). Fela jalo, go ne go na le koketsego ya 9% mo go jeweng ga dinawa tse ditala (t (30) = -3.04, $p=0.005$) go tloga ka tsereganyo (53.1, ±36.6%) go ya go morago ga teko (62.1, ±35.0%).

Bokhutlo: Thutopatlisiso eno e bontshitse gore go tsereganya mo mekgweng ka go dirisa bagaka ba dipopae mmogo le go bona gantsi go na le bokgoni jwa go tsweletsa go jewa ga merogo mo baneng ba dingwaga tse 3 go ya go 6 mo tikwatikweng ya ECD. Go atlenegisiwa gore bana ba rotloediwe go ja merogo ka tiriso ya baanelwa ba ba bonwang le go bontshiwa gantsi. Go tlaleletsa foo, bana ba tshwanetse go ja dijo mo tikologong e e se nang dikgoreletso. Dipholo tsa thutopatlisiso eno di tshwaela sentle mo dateng ya motheo mme di bontsha tlhokego ya go batlisisa ditsereganyo go ya pele mo tikologong e kgolwane.

INGQIKITHI YOCWANINGO

Umongo: Nakuba ucwaningo olumbalwa luveze ukuthi emhlabeni jikelele mincane imifino nezithelo ekudleni okudliwa abantu, lusekhona ucwaningo oluncane lwezempilo olukhuthaza izindlela noma ukungenelela ukuze kusizwe izingane ziqinise ekudleni imifino ezikhungweni zokuqeqesha izingane ezincane (ama-ECD), ikakhulukazi eNingizimu ne-Afrika. Kubalulekile ukuthi ilungiswe zisencane izingane indlela ezidla ngayo ukuze zijwayelane nokudla okunhlobonhlobo, okuyozisiza zithole imisoco eziyidingayo ukuze zikhule futhi zithuthuke ngokwanele zize zibe abantu abadala abadla ngendlela enempilo.

Inhloso: Inhloso yalolu cwaningo kwakuwukubona umthelela ongaba khona uma kungenelelwa endabeni yokuthi izingane, ezineminyaka emi-3 kuya kweyi-6, zidle imifino, esikhungweni se-ECD eGaborone, eBotswana.

Izindlela Zokwenza: Kwenziwa ucwaningo olungokoqobo, olusebenzisa indlela yokuhlola ngokwesikhathi sangaphambi kwesivivinyo nesikhathi sangemva kwesivivinyo. Izingane, ezineminyaka emi-3 kuya kweyi-6, zaseNkulisa iDipeo eGaborone zanikwa ukudla okulinganayo kwezaqathe nobhontshisi ngezinsuku ezintathu ezihlukene. Ngosuku lwesibili, kwasetshenziswa indlela yokuthonya ingqondo yomuntu ngokwalokho akubona emphakathini ngoba kwakukhona izingqwembe ezazinopopayi abajabulile abangamaqhawe anamandla ababekhuthaza ukudliwa kwemifino. Kwaqoqwa kubazali nakothisha ngokufanayo imininingo eveza imikhuba yokudla emakhaya nasesikoleni, kusetshenziswa amaphephambuzo umuntu angazigcwalisela wona. Ukuthi umbambiqhaza udle imifino engakanani ngezikhathi zesivivinyo kwakuhlolwa ngokuthi kubalwe imifino esele epuletini bese kubonakala ukuthi udle engakanani. Kwenziwa izivivinyo zokuqhathanisa ukuze kufinyelelwe eziphethweni phakathi kwesikhathi sangaphambi kwesivivinyo, isikhathi sokungenelela kanye nesikhathi sangemva kwesivivinyo.

Imiphumela: Sezizonke, izingane ezazikulolu cwaningo zazingama-31 (abafana abayi-17, amantombazane ayi-14). Abazali babika izaqathe (65%), amazambane (61%) kanye notamatisi (55%) njengemifino eyayivame ukudliwa kakhulu emahoreni

angama-24 adlulile. Ngokwalokhu kungenelela, wawungekho umehluko omkhulu ekudliweni kwemifino (izaqathe nobhontshisi) phakathi kwala maqembu ahlukaniswe ngokweminyaka yobudala ngezinsuku zangaphambi kwesivivinyo, zokungenelela noma zangemva kwesivivinyo. Kulo lonke leli qembu, kwenyuka kakhulu ukudliwa kwezaqathe kwaba ama-13.3% (t (30) = -3.99, $p<0.001$) kusukela ekungeneleleni (69.0, ±32.1%) kuya esikhathini sangemva kwesivivinyo (82.2, ±23.9%), kanye nokwenyuka kwama-7.1% okusuka esikhathini sangaphambi kwesivivinyo (75.1, ±28.3%) kuya esikhathini sangemva kwesivivinyo (82.2, ±23.9%), (t (30) = -2.09, $p=0.045$). Ngendlela efanayo, kwenyuka ngama-9% ukudliwa kukabhontshisi oluhlaza (t (30) = -3.04, $p=0.005$) kusukela esikhathini sokungenelela (53.1, ±36.6%) kuya esikhathini sangemva kwesivivinyo (62.1, ±35.0%).

Isiphetho: Lolu cwaningo luveze ukuthi ukungenelela kusetshenziswa opopayi abajabulile abangamaqhawe anamandla nokuthi balokhu bevezwa ngokuphindelela kuyaphumelela ekukhuthazeni izingane ezineminyaka emi-3 kuya kweyi-6 ukuba zidle imifino esikhungweni se-ECD. Kunconywa ukuba izingane zikhuthazwe ukudla imifino kusetshenziswa izithombe zabalingiswa futhi ziboniswe zona ngokuphindelela. Ngaphezu kwalokho, izingane kufanele zidle ukudla zisendaweni engenaziphazamiso. Imiphumela yalolu cwaningo yenezela kahle emininingweni eyisisekelo futhi iveza ukuthi kunesidingo sokwenziwa kocwaningo olwengeziwe ngezinhlelo ezinkulu kakhulu zokungenelela.

CHAPTER 1: INTRODUCTION

1.1 Background

Diets rich in vegetables and fruits are linked to long-term health benefits and overall longevity (Fabbri *et al*. 2016; Sharps *et al*., 2016). There is increasing research stating that a higher intake of vegetables and fruits is correlated with a lesser risk of all-cause mortality (Wang *et al*., 2014), since the nutrients available in vegetables and fruits can be protective against cardiovascular diseases, some cancers and type 2 diabetes (Leal *et al*., 2015; Yi *et al*., 2018). In addition, high intakes of vegetables and fruits can improve the body's response to infections and reduce the prevalence of cataracts, fractures and age-related macular degeneration (Leal *et al*., 2015).

Vegetables and fruits are good sources of many nutrients such as complex carbohydrates, vitamins, minerals, water, fiber and protein (Wang *et al*., 2014). For example, antioxidants such as alpha carotene, beta carotene (provitamin A), vitamin C and phytochemicals plus minerals such as magnesium and potassium (Kaluza *et al*., 2010). Plasma concentrations of these nutrients increase with the intake of vegetables and fruits (John *et al*., 2002), which affects nutritional status.

The majority of the global population consume less than the minimum recommended quantity of vegetables and fruits (Kalmpourtzidou *et al*. 2020; Padrão *et al*., 2012). The recommended dietary guidelines suggest that children under 5 years should consume 200g of vegetables and fruits per day and older children, 400g per day (Gerritsen *et al*., 2019; Knai *et al*., 2005; Nekitsing *et al*., 2018a; Xashlee *et al*., 2018). However, children generally consume less vegetables and fruits than the recommended daily amount (Sharps *et al*., 2016).

Several studies conducted globally have also illustrated that there is an overall decline in vegetable and fruit consumption among school-aged children, mainly during the school-time period. A study conducted in New Zealand found that 10% of girls and 19% of boys (5-15 years) did not consume any vegetables in the week preceding their survey and that over 50% of each group was not eating a fruit daily (Dresler-Hawke *et al*., 2012).

In the United States, children aged 2-5 years were found to eat vegetables less often and when they did, they would eat mostly potatoes and tomatoes or tomato products (Ramsay *et al*., 2017). Children who were reported to consume white potatoes, including French fried potatoes, were found to consume very little fruit, legumes, seafood, dairy, and whole grains. On the other hand, children who consumed non-starchy vegetables and whole fruit had lower total calorie intakes on the day of recall (Ramsay *et al.*, 2017).

In 1999, the South African National Food Consumption Survey (NFCS) reported that children aged 1-9 years consumed a diet that mainly consisted of refined maize, bread (brown and white), white sugar and margarine (Steyn *et al*, 2006). Vegetable and fruit consumption was reported to be very low. Only 440 children out of 2 800 (16%) nationally were found to have consumed a fruit and vegetable in the preceding 24 hours (Steyn *et al*., 2006). Vegetable and fruit consumption varies with geographical location, gender, age and income level because of economic, cultural and agricultural differences (Padrão *et al*., 2020). The findings in the South African survey are comparable to Botswana as the population in general consumes a diet low in vegetables and fruits. Botswana, a landlocked country in Southern Africa, has a populace of over 2 million with 27 districts (10 rural and 7 urban) (The Republic of Botswana, 2015). Approximately 95% of the population in Botswana does not consume enough servings of vegetables and fruits in a day. In 2014, the average amount consumed per day was 1.1 portions of vegetables and 0.8 portions of fruit (The Republic of Botswana, 2015).

In terms of undernutrition, it has been predicted that globally, almost 178 million children aged 0-5 years are undernourished (Mushaphi *et al*., 2015). Fifty percent of children from early childhood development (ECD) centres in developing countries suffer from iron deficiency (Mushaphi *et al*., 2015). In addition, 36 million children from ECD centres in sub-Saharan Africa are vitamin A deficient (Mushaphi *et al*., 2015). Nutritional deficiencies resulting from low levels of micronutrients, insufficient protein and energy may lead to health complications such as reduced capability to fight off infectious disease, limited mental capabilities, loss of sight and, in some cases, even demise (Mushaphi *et al*., 2015). Low and low-to-middle income countries such as Botswana still face the double burden of malnutrition (co-occurrence of undernutrition

and overnutrition), however, the rate of overweight individuals in the population has exceeded that of underweight (Brown, 2014). The Global Nutrition Report (2021) predicted that 32% of adult women over the age of 18 and 10% of adult men are obese. While in children under the age of 5 years, the prevalence of overweight is 10%.

In 2011, twenty eight percent of all the adults in Botswana were found to be overweight or obese as compared to an estimated fifteen percent of all the adults who were classified as underweight (Brown, 2014). The overall diet quality is linked to obesity (Wolongevicz *et al*., 2020). Unhealthy diets include low consumption of vegetables and fruits and a high consumption of highly processed carbohydrate-rich foods (Nnyepi *et al*., 2015). It is important to address poor quality diets during early childhood to help lower the risk of negative health outcomes (Mushaphi *et al*., 2015; Stevens, 2010).

1.2 Problem statement

Due to the low intake of vegetables and fruits in young children, there is an increasing need for the introduction of health promoting programs in ECD centres, mainly focusing on increasing vegetable consumption, as children are not attaining the recommended number of servings per day (Xashlee *et al*., 2018). While there are studies that have examined strategies to encourage vegetable and fruit consumption, there are limited studies that have focused on children in ECD centres, particularly in Southern Africa.

Adequate nutrition is important in childhood as it influences the child's overall growth and development and eating behaviour (Ramsay *et al*., 2017). Some theorists have also stated that early childhood is a delicate period for the establishment of a food acceptance pattern (Cashdan, 1994; Illingworth & Lister, 1964). Also, obesity that starts in infancy and in young children is likely to lead into adult obesity because eating behaviours that develop during childhood continue into adolescence and adulthood (Steyn *et al*., 2006; Mchiza & Maunder 2016; Ramsay *et al*., 2017). Since children's eating behaviours are developed in early childhood stage and are associated with food preferences and intake in adulthood (Skinner *et al.*, 2002), it is important to discover how children can obtain healthy eating habits from an early age (Ramsay *et al*., 2017).

Applying a variety of health promoting strategies, such as supporting an increased consumption of vegetables and fruits in the early years, could have significant results in improving children's dietary quality as a whole and their state of health later in life (Ramsay *et al*., 2017).

A study conducted in the UK in children (ages 9 and 38 months) using various learning theories found that repeated exposure to three variations of a particular vegetable was sufficient to increase the intake of the vegetable, irrespective of the addition of accustomed taste or energy (Caton *et al*., 2013). A systematic review illustrated that taste exposure interventions produce the best results for increasing vegetable consumption in early childhood. Sensory learning strategies such as visual exposure and experiential learning have also resulted in some success (Nekitsing *et al*., 2018b).

Dresler-Hawke *et al*. (2012) and Ramsay *et al*. (2017) demonstrated that there is an association between the consumption of vegetables and fruits and the overall quality of the diet and that there is a need for raising awareness on the importance of vegetables and fruits in the diets of children (Ramsay *et al*., 2017). Therefore, this study aimed to determine the effect of behavioural interventions on vegetable consumption in children at an ECD centre in Botswana. Increasing exposure to vegetables with the use of experimental approaches in presenting food to children and measuring if the change in exposure can increase the consumption of vegetables is important (Caton *et al*., 2013).

To the best of our knowledge, no experimental studies have been conducted in ECD centres in Southern Africa. There is no data on child nutrition interventions in relation to vegetable consumption in Botswana. This research study intended to determine the effect of a behavioural intervention on vegetable consumption in young children at an ECD center in Botswana. The findings of the study could possibly contribute towards improving nutrition interventions and inform strategies in ECD centres around the consumption of vegetables that will ultimately contribute to children’s increased preference of eating vegetables and possibly other healthy foods.

1.3 Aim of the study

The aim of this study was to determine the effect of a behavioral intervention on vegetable intake in children 3-6 years of age in an ECD center in Gaborone, Botswana.

1.3.1 Objectives

The objectives of the study were:

- To describe current practices of nutrition education and children's lunch box content at Dipeo Nursery School, Gaborone, Botswana.
- To describe the children's habitual vegetable intake.
- To assess the effect of an on-site behavioural intervention, consisting of an animated superhero cartoon character of vegetables in conjunction with accessibility, on children's vegetable consumption using the dependent t-test to assess differences in pre- and post-test.

1.4 Assumptions

Quantitative research aims to understand the facts of a phenomenon. It seeks to preserve positivism and believes in the benefit of results obtained through direct observation of experimentation and through interpretation of evidence that can predict further effects (hypothetical deductive procedures) (Velez, 2008). For this study, it was assumed that introducing a visualisation intervention would positively influence children's behaviour towards consuming vegetables.

Consequently, epistemological assumptions of positivism adopts that what happens in the social environment that is being studied can be widespread to future social situations (Velez, 2008). Since the study used a small sample size, it is unlikely to be generalised for all children at ECD centres in Botswana.

It was assumed that the inclusion criteria for the sample was appropriate and therefore expected that the participants experienced the same exposure during all the phases of the study. Furthermore, it was assumed that the participants' parents as well as the teachers at the school answered the questions truthfully. Furthermore, it was assumed

that intervention samples were cooked to the same degree of texture for the duration of the intervention. Lastly, the researcher aimed to remain objective in observations, data collection, data analysis and reporting.

1.5 Chapter layout

This dissertation consists of six chapters which are briefly outlined below:

Chapter 1: Introduction

This chapter provided an overview and background of the study. Other sections included in this chapter are the problem statement, aim and assumptions of the study.

Chapter 2: Literature review

The literature review provides information on existing literature on topics such as child health and vegetable consumption, the school environment, nutritional programmes in Southern African schools as well as behavioural theories relevant to the study.

Chapter 3: Research methodology

The research methodology chapter explains the study design, study setting, sampling methods, analysis of experimental procedures, quality control and ethical considerations.

Chapter 4: Results

This chapter focuses on the findings of the data collected.

Chapter 5: Discussion

This chapter involves discussing the results in more detail.

Chapter 6: Conclusion

Chapter 6 is the conclusion of the study. It draws from the discussion and reflects on the objectives of the study. Recommendations are also provided.

The references used in all the chapters are provided in a single reference list after Chapter 6.

CHAPTER 2: LITERATURE REVIEW

This literature review provides an overview of the scholarly sources of research on children's vegetable consumption and the effectiveness of behavioural interventions in early childhood development centres.

The sections discussed in this chapter include vegetable consumption and child health, current state of health in Botswana (double burden of disease), dietary guidelines, low vegetable consumption, factors contributing to low vegetable consumption, health benefits of consuming vegetables, food environments (school environment and accessibility), nutrition programmes in schools for early childhood development centres, and the behavioural theory.

2.1 Introduction

Vegetables and fruits are significant sources of an extensive range of vital micronutrients (Knai *et al*., 2005). Children are not reaching the daily recommended consumption of 200g for children under 5 years and 400g per day for older children, despite the fact there is increasing evidence of public health benefits related to consuming more fruit and vegetables (Gerritsen *et al*., 2019; Knai *et al*., 2005; Nekitsing *et al*., 2018; Xashlee *et al*., 2018). The examples of daily recommendations for fruit and vegetable consumption have been included in Table 2.1.

Table 2. 1: Daily recommendation for vegetable and fruit intake for children who engage in moderate physical activity

AGE (Years)	FRUITS	VEGETABLES	TOTAL FRUIT AND VEGETABLES (Grams)
2-3	1 cup	1 cup	200g
4-8	1-1/2 cups	1-1/2 cups	400g

Source: Adapted from USDA (USDA)

Globally, there has been a rise in obesity and chronic diseases, while undernutrition remains a concern in many African countries (Daelmans et al., 2017). Although malnutrition is a complex phenomenon, there are direct and indirect factors that contribute to obesity and undernutrition. Direct factors encompass an unhealthy diet and an inadequate supply of food and/or nutrients, while indirect factors can be considered as food environments (Steyn *et al*., 2009). An inadequate intake of

vegetables and fruits has been found to be one of the main influences that contribute to the impact of disease globally (Valmórbida *et al*., 2014). Typically, vegetable consumption decreases with the increased consumption of highly processed foods as identified with the nutrition transition contributing to the increased prevalence of non-communicable diseases (NCDs) (Xue *et al*., 2019). Hence, nutrition transition arises simultaneously with demographic, epidemiologic shifts, urban growth and industrial development which together contribute to the increased occurrence of NCDs (Nnyepi *et al.*, 2015).

Research indicates that obesity is most likely to begin in the early years of life and is a risk factor for a number of chronic diseases such as cardiovascular disease, type 2 diabetes and some cancers (Ziraba *et al*., 2009). Hence, it is important to establish obesity prevention measures in early childhood (Xue *et al*., 2019). Consuming the recommended amounts of vegetables and fruits may reduce the risks of obesity and chronic diseases (Nekitsing *et al*., 2018).

There are several evidence-based dietary changes that can be related to combating overweight and obesity as well as micronutrient deficiencies. These dietary changes include increased intake of whole grains, fruits and vegetables; decreased intake of sugary drinks; increased exercise, limited screen time, increased meals with family and longer hours of sleep (Xashlee *et al*., 2018). For the purposes of this study, the focus was on interventions to support increased consumption of vegetables as the consumption of vegetables has been found to be lower than fruits (Kim *et al*., 2014).

2.2 Child health and vegetable consumption

2.2.1 Current state of health in Botswana: obesity and undernutrition

There is a co-occurrence of overnutrition (overweight and obesity) and undernutrition (micronutrient deficiency, stunting and underweight) in children and/or their households in many developing countries (Nguyen *et al*., 2013; Gerritsen *et al*., 2019). The co-occurrence of undernutrition, overnutrition and nutrition related NCDs is referred to as the double burden of malnutrition (Modjadji & Madiba, 2019). The double burden of malnutrition can arise at household level, for example, the mother may be obese while the child is underweighted. It can also be present at an individual level,

for example, a child can develop two forms of malnutrition such as micronutrient deficiencies co-occurring with obesity. This can also be seen at a population level where overweight and undernutrition are widespread in the same community (Modjadji & Madiba, 2019).

The South African National Health and Nutrition Examination Survey (SANHANES) (Shisana *et al*., 2014) conducted in 2012, indicated that 16.5% of girls aged 2-14 years were overweight and 7.1% obese. The highest number of overweight and obese children was found to be in the 2-5-year age group; the respective proportions were 18.9% and 4.9% for girls and 17.5% and 4.4% for boys. These findings have been predicted to worsen over time (Shisana *et al*., 2014).

In the past, the main nutritional related problem Botswana faced was undernutrition (Brown, 2014). However, the most recent Global Nutrition Report (2021) indicated that Botswana's obesity prevalence is now greater than the regional average of 20.7% for women and 9.2% for men. Earlier, a study involving 3881 participants in Botswana reported that 14.2% of adults suffered from malnutrition while 18.8% were overweight and 11.8% obese. Botswana has a prevalence of 0.4% to 43% in obesity (The Republic of Botswana, 2015). Madondo *et al*. (2012) further state that one in three children in Botswana suffer from malnutrition. Recent data from the Global Nutrition Report (2021) stated that 28.9% of children under the age of 5 years in Botswana are stunted, while 7.3% are wasted and 10% are overweight. South Africa's statistics are similar as 6% of children younger than 5 years are underweight, 27% are stunted and 13% overweight (NDoH *et al.*, 2019)

Children who consume adequate amounts of vegetables and fruit have a decreased risk of nutritional deficiencies, obesity, and obesity related illness. They are also most likely to develop a healthy dietary pattern throughout their lifetime (Gerritsen *et al*., 2019; Leal *et al*., 2015). Thus, it is important to address dietary habits from an early age.

2.2.2 Dietary guidelines

Dietary quality can be referred to as an adequate diet that meets all the energy requirements (Steyn *et al*., 2013). Dietary quality has also been described as the

degree to which a diet decreases the risk of NCDs (Asghari & Yuzbashian, 2017). The global recommendation for a healthy diet is consuming a variety of foods from different food groups while altering food preparation methods (Steyn *et al*., 2013). The Food and Agricultural Organisation of the United Nations (FAO), jointly with the World Health Organisation (WHO) supports Member Countries to create, modify and execute food-based dietary guidelines (FBDG) and food guides persuant with current scientific evidence. Seven countries in Africa have adopted the FBDG as reported to the FAO. These countries are Benin, Kenya, Namibia, Nigeria, Seychelles, Sierra Leone and South Africa (FAO, 2020).

In South Africa, The FBDG guidelines are relevant to the population and local foods (Schonfeldt & Hall, 2009; Vorster *et al*. 2013). The FBDG were formulated to educate South African consumers to develop healthier eating behaviour and avert the growth of micronutrient deficiencies and NCDs (Steyn *et al*., 2013). The revised general FBDG is included in Table 2.2 below:

Table 2. 2: South Africa's revised general food-based dietary guidelines

- Eat a variety of foods
- Be active
- Make starchy foods part of most meals.
- Eat plenty of vegetables and fruit everyday
- Eat dry beans, split peas, lentils, and soya regularly.
- Have milk, maas or yoghurt everyday
- Fish chicken, lean meat or eggs can be eaten daily
- Drink lots of clean, safe water
- Use fats sparingly. Choose vegetable oils, rather than hard fats.
- Use sugar and foods and drinks high in sugar sparingly.

(Source: Vorster *et al.*, 2013)

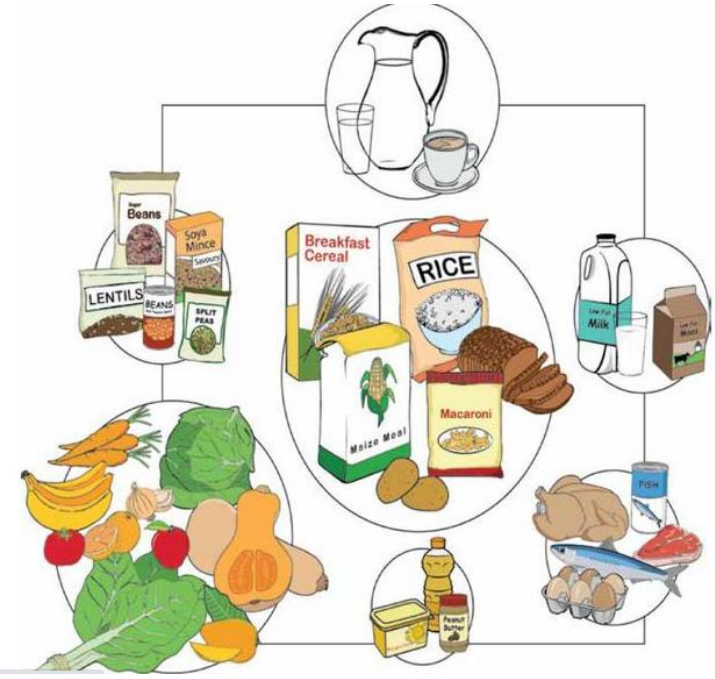


Figure 2. 1: South African Food Guide (Source: Steyn *et al*., 2013)

For the purposes of this study, the focus of the discussions is on vegetable consumption.

2.2.3 Low vegetable consumption

According to Nnyepi *et al*. (2015), seventy-two percent of adults in Southern African countries have fewer vegetable and fruit servings daily than the recommended amounts. In Botswana, the mean number of servings of vegetables and/or fruit consumed is 1.7 per day (The Republic of Botswana, 2015). The low consumption of vegetables and fruits has been estimated to be associated with 31% of ischaemic heart disease, 19% ischaemic stroke, 20% of oesophageal cancer and 19% of gastric cancer worldwide (Schneider *et al*., 2007).

A vital signs report by the Centers of Disease Control and Prevention in the United States (2014) reported that 93% of children aged 1-18 years did not meet the daily recommended number of vegetables. Knai *et al.,* (2005), further states that the estimated number of children between the ages of 1 to 18 years that are not reaching their fruit and vegetable recommendation have a shortfall of 60% for fruit and 93% for vegetables. Fruit intake which was found to have increased from 2003 to 2010 (Kim *et al*., 2014).

A study that was done in six different centrally located European countries involving over 20,000 children, found an association with respiratory symptoms and low vegetable and fruit consumption (Knai *et al*., 2005). Research has also found that 4.4% of the overall problem related to disease in Europe can be related to a low intake of vegetables and fruits (Knai *et al*., 2005). Consuming the daily recommended amount of vegetables can reduce the risk of disease (Nekitsing *et al*., 2018).

In a study that was done in seven African countries, 36% of girls and 33% of boys consumed less than one fruit, while 23% of boys and 22% of girls consumed less than one vegetable (Peltzer & Pengpid, 2010). There is limited data from South Africa and neighbouring countries. Naudé (2007) conducted a secondary data analysis on the National Food Consumption Survey conducted in 1999 to determine the fruit and vegetable intake of children in South Africa. The diet history of children 1-9 years (n=2200) indicated that vegetables were consumed once a day and the mean consumption of fruit and vegetables was 110g per day – much less than the recommended intake. Also in South Africa, a randomised controlled trial in a rural area in the North West Province found no change in iron, zinc and vitamin A status of mildly deficient 6 – 12 year old children after consuming 300g of African leafy vegetables, five times a week (van der Hoeven *et al*., 2015). This may support the recommendation of 400g of vegetables daily. It is important for children to consume a wide variety of vegetables and fruit, dark leafy vegetables as well as orange coloured vegetables and fruit given that these are good sources of vitamin A (Du Plessis *et al.,* 2013).

2.2.4 Factors contributing to low vegetable consumption

There are various factors that contribute to habitual vegetable intake, such as, individual factors, household factors and environmental factors.

Individual factors include demographics, eating habits, health status, lifestyle, and sensory appeal. Household factors are determined by the number of family members and children in the family, marital status, and parenting practices. Environmental factors are food accessibility, food prices and food availability (Qi Zhang & Liuliu Fu, 2011). Environmental factors are discussed in more depth under section 2.3.

Appleton *et al.* (2016) further explain that low vegetable consumption is usually linked with various characteristics in family environments. These characteristics are lower educated parents, low socioeconomic status, low vegetable consumption by parents and caregivers, low accessibility, and negative perceptions of vegetables in the home. Adult vegetable intake is related mostly to childhood experiences as there is a transference of food preferences and eating habits. Unlike vegetables, fruits are generally sweet, mostly soft in texture and consumed raw. Fruits are typically accepted as a raw snack, drink, or dessert. Vegetables on the other hand can taste bitter, have a firmer texture, frequently prepared on cooker and are accepted mostly as part of a cooked meal (Appleton *et al*., 2016).

The bitter and sometimes undesirable taste of vegetables often works as a main barrier in vegetable consumption in young children. Also, the unwillingness to eat or avoidance of fresh or plain foods can hinder with young children's vegetable consumption (Appleton *et al*., 2016). Supporting an increased intake of vegetables and fruits in early childhood could have significant results in the health status later in life (Ramsay *et al.*, 2017). Interventions that address these various factors are required in the early years of life when development takes place to encourage healthy eating habits (Nekitsing *et al*., 2018). The varying consumption patterns of fruit and vegetables may suggest that their consumption can be determined in different ways (Appleton *et al*., 2016).

2.2.5 Health benefits of consuming vegetables

A diet that is high in fruit and vegetable consumption is associated with a decrease in all-cause mortality (Oyebode *et al*., 2014). More specifically, the consumption of ≤7 servings of fruit and vegetable daily has been found to have a higher association with decreased mortality risk than lower consumption (Oyebode *et al.*, 2014).

Fruit and vegetable consumption provide protecting effects that defend against diseases such as cardiovascular disease (Wang *et al*., 2014b), coronary heart disease (Dauchet *et al*., 2005), stroke (Hu *et al*., 2014), hypertension (McCall *et al*., 2009), body weight and adiposity (Ledoux *et al*., 2011), cognitive decline (Loef *et al*., 2012) as well as some cancers (Appleton *et al*., 2016). The antioxidant and phytochemical combination that is found in fruit and vegetables may boost health by fighting free

radicals that are associated with the early development of chronic lifestyle diseases (Carter *et al.*, 2010). Unlike fruit, vegetables are particularly beneficial because they are low in natural occurring sugars thus providing a higher nutrient density. Vegetables have been found to offer a protective benefit of 16% versus 4% from fruit for decreased mortality risk (Nekitsing *et al*., 2018). Thus, it is more important to increase vegetable intake than fruit as vegetables have more of a protective effect than fruit.

Different types of vegetables offer various health benefits. More specifically, high intake of cruciferous vegetables has been linked with reduced risk of several cancers. Cruciferous vegetables, such as broccoli, contain high levels of glucosinolates (sulfur-containing compounds) which contribute to the reduced risk (Zhao *et al*., 2013). The consumption of dark leafy greens has been linked with reduced risk of cancer, depression, and type 2 diabetes. An increase of 1.15 servings of leafy greens a day was linked with a 14% decrease in the risk of type 2 diabetes (Carter *et al*., 2010). The consumption of vegetables rich in Beta Carotene, yellow-pigmented and red-pigmented vegetables has been linked with reduced risk of several cancers (Leong *et al*., 2018). Fruiting vegetables such as peppers have also been linked with reduced risk of several cancers (Appleton *et al*., 2016). Consuming a wide variety of fruits, vegetables, whole grains and other plant foods provides a range of nutrients, bioactive compounds (antioxidant and phytochemicals), vitamins, minerals and fibers that are important for optimal health (Liu, 2013).

2.3 Food environment

The food system influences people's diets and includes individuals, organisations, environments, infrastructures, as well as actions that relate to the manufacturing, processing, supply, marketing, sale, preparation and consumption of food (Raza *et al*., 2020). The Food Systems Framework illustrates the different components, drivers and outcomes of the food system which are all interconnected as demonstrated in Figure 2.2.

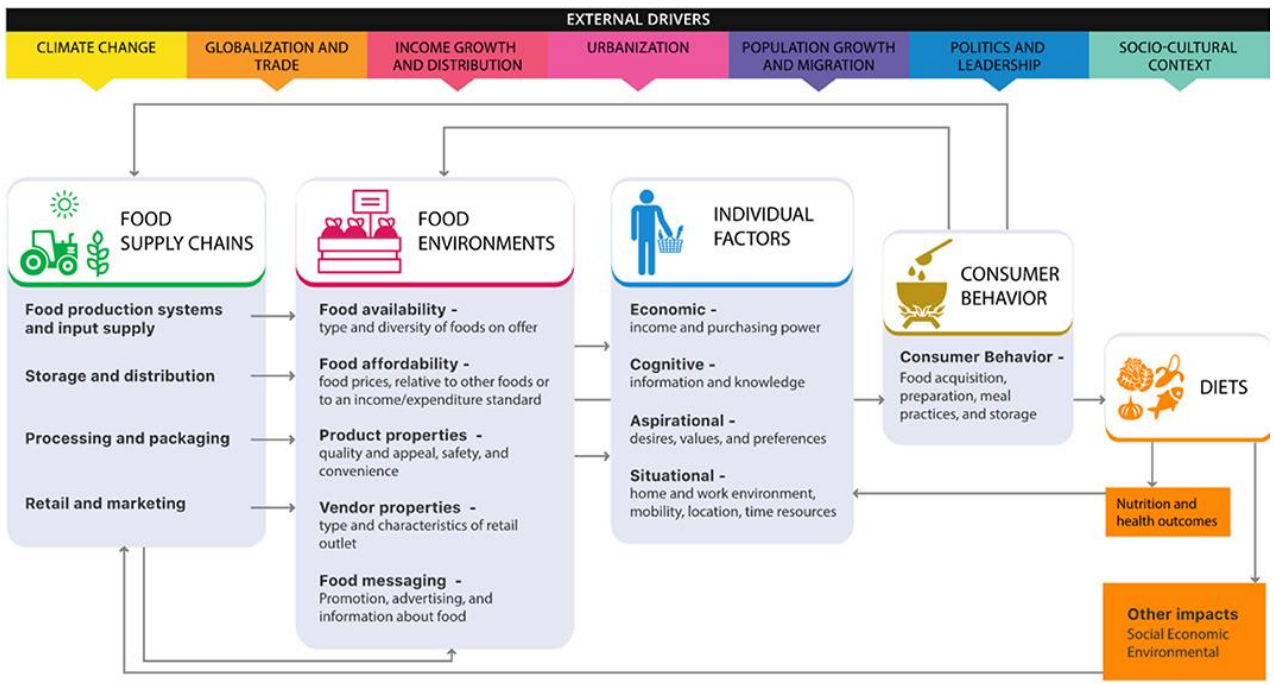


Figure 2. 2: The Food Systems Framework (Source: Raza *et al.* 2020)

Many Southern African countries are experiencing demographic and epidemiological shifts, urbanisation and industrialisation (Nnyepi *et al*., 2015). This involves a nutritional shift from more traditional diets to more westernised diets owing to factors such as changing food environments (Steyn *et al*., 2009). The inundation of fast food outlets, pervasive marketing of the products sold and high cost of fresh produce over fast food act as barriers to children's vegetable intake (Gerritsen *et al*., 2019).

These unhealthy diets, also known as the 'Western diet', include low consumption of vegetables and fruit as well as a high intake of processed carbohydrates. These foods are low in fibre, high in fat, saturated fat, salt and sugar (Nnyepi *et al*., 2015).

Diets of children and teenagers are consistently deficient in foods that form part of a healthy diet such as fruits, vegetables, nuts and seeds (Raza *et al*., 2020). It is important for food environments and systems to transform to supply more nutritious, inexpensive, maintainable and reliable diets for children and teenagers (Raza *et al*., 2020).

Food environments play a key role in addressing the burdens of malnutrition such as undernutrition, micronutrient deficiencies and overweight and obesity. The UNICEF Conceptual Framework (Figure 2.3) of malnutrition highlights the links between parts

of the food systems and the importance of positively influencing food systems continuously (Fanzo *et al*., 2020).

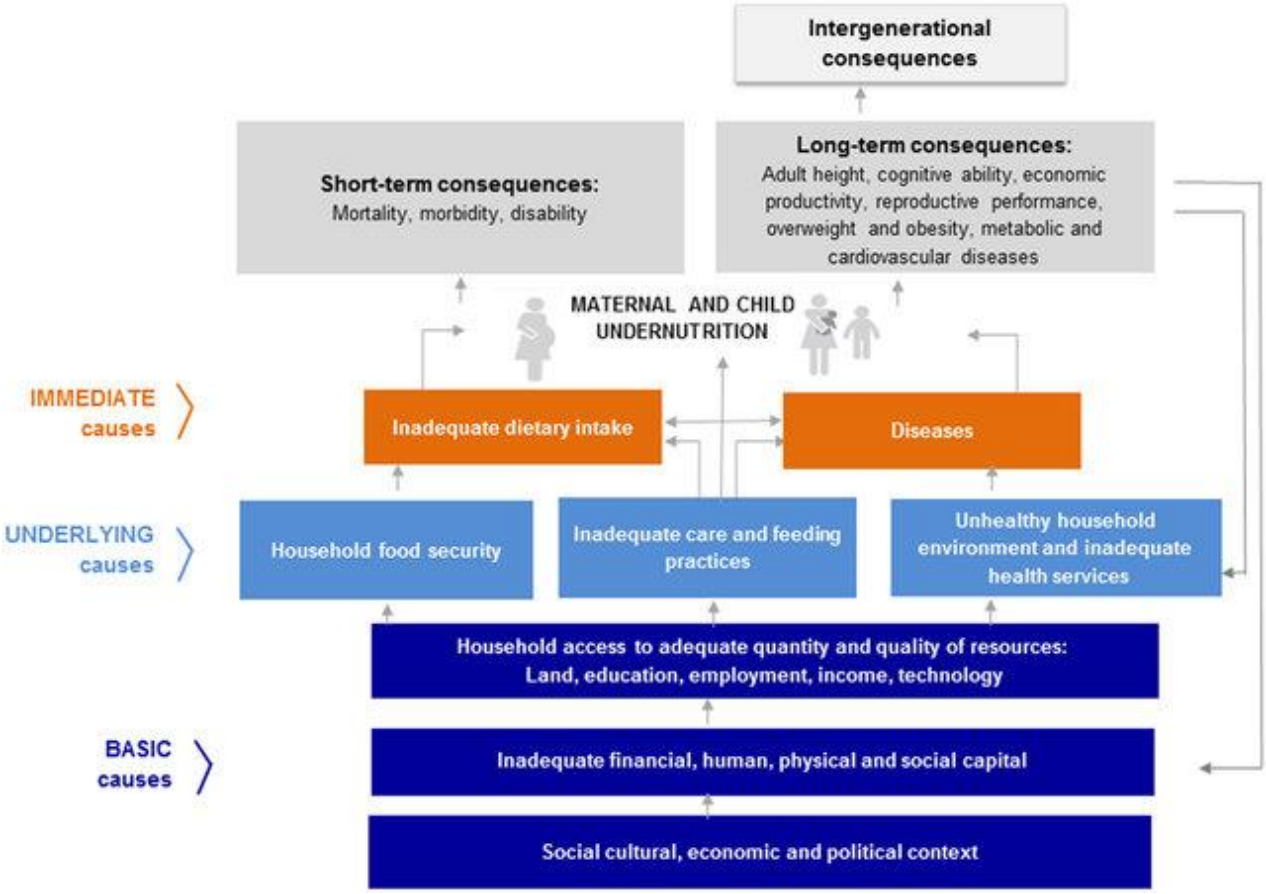


Figure 2. 3: UNICEF Conceptual Framework of malnutrition (Source: UNICEF 2015)

UNICEF's Conceptual Framework has been further adapted to illustrate the linkages between the various elements of food environments with children's and teenagers' diets (Raza *et al*., 2020). This can be seen on the Innocenti Framework in Figure 2.4 below.

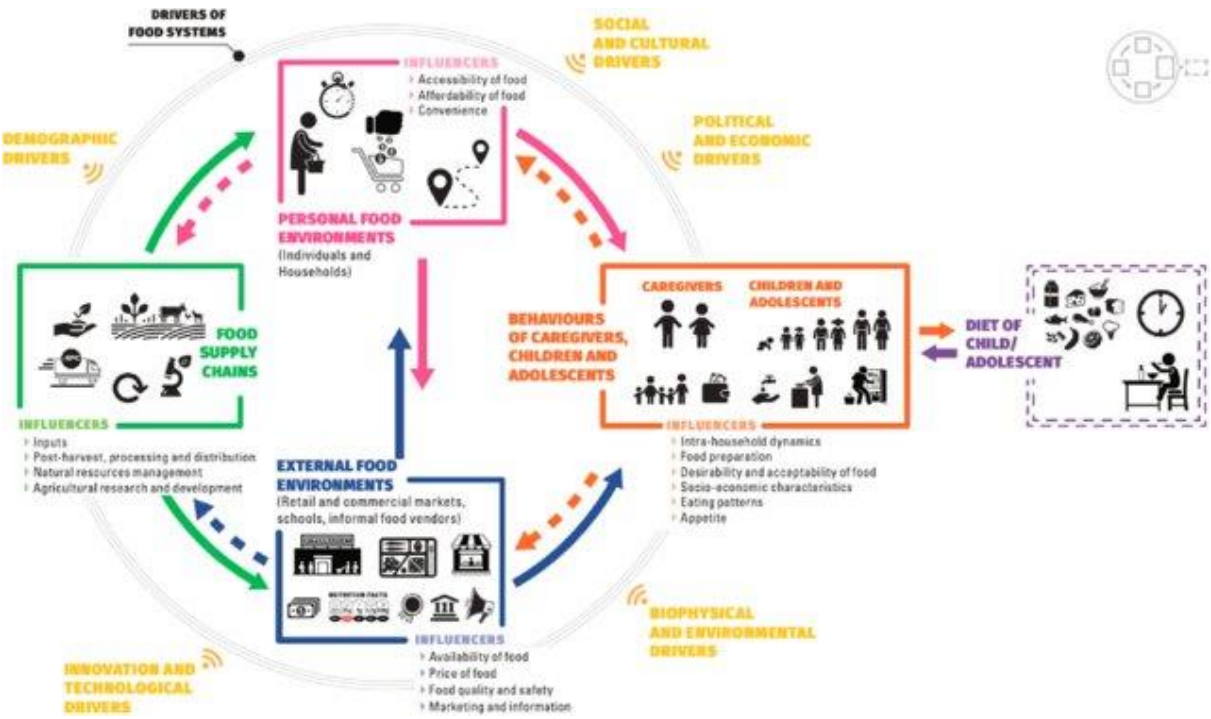


Figure 2. 4: Innocenti Framework for food systems/environments and children's and teenagers' diets (**Source: Raza *et al.*, 2020)**

The food environment framework indicates how children and teenagers react to and connect or participate with activities, inputs and outputs such as food production, processing, marketing, consumption and disposal across the food system (Raza et al., 2020). Children play an important role in influencing the foods that are bought and prepared for them. Even though children rely on caregivers for their food intake, caregivers respond to signals, responses and demands from children (UNICEF *et al.*, 2019).

2.3.1 School environment

Food environments in schools also contributes to children's eating habits. The types of food sold in and around schools are low in nutrients, high in energy, highly processed and prepared in large portions (de Villiers *et al*., 2015). The environment and food related experiences have proven to be essential in the development of a child's eating behaviour (DeCosta *et al*., 2017). In a study that was conducted in South Africa, evaluating the food environment in schools, it was reported that 22% of learners had not eaten breakfast and 24% brought a lunch box that contained mostly bread. Vegetables and fruits were served in 41% of the schools on the survey day, compared

to only 4% serving fruit. Some learners brought money to school (57%), though tuck and vendors served mostly unhealthy foods (Faber *et al.,* 2014). Given that children spend a large amount of their time in school, schools offer an appropriate setting to promote healthy eating behaviours. The advantage of a school-based nutrition program is that all children can get the benefit regardless of their parents' attitudes, skills and food choices (Poelman *et al*., 2019).

Recent research has discovered that there is a need for interventions that are conducted in schools to specifically target increasing the consumption of vegetables (Poelman *et al*., 2019). A meta-analyses investigating the increase of vegetable and fruit consumption after school-based interventions indicated that it is more effective with fruit intake than with vegetable intake (Poelman *et al*., 2019). The studies conducted in schools included an implementation of multi component nutrition intervention programs such as fruit and vegetable distribution, policy education, parent outreach, curriculum alignment, social interaction, marketing and home-based projects (Poelman *et al*., 2019). Reducing barriers to positive behaviour are needed to help increase vegetable consumption among children (Poelman *et al*., 2019).

2.3.2 Accessibility

The first step of increasing vegetable consumption is increasing the accessibility or number of times that children are provided vegetables (Xashlee *et al*., 2018). Increasing the availability of healthy food increases the likelihood of children consuming it (DeCosta et al., 2017; Folkvord & Laguna-Camacho, 2019). Children will most likely eat what they are served most of the time (Caton *et al*., 2013; Nicklas *et al*., 2010). Nekitsing *et al.* (2018) further state that serving the same type of foods repeatedly has been shown to be the most effective way of encouraging the consumption of unfamiliar foods in children, which is especially true for younger children.

In addition, tailored strategies are required to increase children's vegetable consumption. Experiential learning strategies have been found to be most effective in school nutrition education programs (Poelman *et al*., 2019). Experiential learning strategies, such as using the role of senses, positively impacts behavioural factors that are linked with healthy eating. Behavioural factors influencing children's diets include

food neophobia, willingness to taste new foods, capability to describe foods, familiarity or information about foods, intent to eat healthy and perceived subjective standard from the teachers (Poelman *et al*., 2019). Exposure to signals or stimuli of edible food can also lead to their consumption by prompting a reflex eating response. In children, this reactive response to food cues is difficult to constrain. Prompting children with signals can encourage them to select healthier foods (Folkvord & Laguna-Camacho, 2019). The proposed behavioural interventions in this study made use of signals and prompts with the objective of increasing the consumption of vegetables in young children at an ECD centre.

2.4 Nutrition programmes in schools

In the United States, public health strategies have mainly focused on nutrition education, guidelines and legislation concerning food served at schools and ECD centres. The focus has also been on increasing the intake of vegetables and fruit while discouraging the consumption of high calorie foods with increased levels of fat and sugar (DeCosta *et al*., 2017). In South Africa, the National Integrated Childhood Development Policy (2015) was developed to support the food and nutritional needs of children and to ensure that children's right to adequate food and nutrition is protected (Africa, 2015).

Foods offered in ECD centres provide an opportunity to increase vegetable consumption, but this is not always the case. Studies have found that the quality of food in ECD centres in the United States are poor, supplied in small quantities and lacking in variety (Nicklas *et al*., 2010). Some ECD centres have also been found to serve very small portions in spite of the menu-planning guideline and nutrition standards and contributing to children not meeting their recommended daily allowances and nutrient intake (Nicklas *et al*., 2010).

There are compelling reasons to create and implement effective programmes and policies that will contribute to an increase in the consumption of fruit and vegetables amongst children and adolescents (Knai *et al*., 2005). The National Integrated Nutrition Programme was launched in South Africa, focusing on children below the ages of 6 years, at-risk pregnant and breastfeeding women and those affected with communicable and NCDs. Nutrition promotion, education and advocacy are some of

the focus areas that are addressed in the policy (Bourne *et al.*, 2007). The Food Based Dietary Guidelines (FBDG) were also developed as information for nutrition education for school health programmes and Life Skills classes, starting from grade 1. This is complemented with supplementary activities during school times as the scheduling may not be sufficient to completely address issues in the life skills class (Nguyen *et al*., 2013).

A study was done in the Western Cape named the Health Kick study, where a healthy lifestyle promotion intervention was examined amongst primary school pupils and their families as well as teachers with supporting staff. The implementation of the study was not as successful as projected with only 56% of the food and nutrition activities; 54% of the chronic disease activities and 26% of the physical exercise activities being employed by the schools. Better support from the Department of Basic Education, more willingness from the schools and parent involvement are essential for future interventions (Nguyen *et al*., 2013).

ECD centres in Southern Africa that offer nutrition related interventions such as school feeding schemes and the establishment of food gardens are offered mainly by non-profit and/or faith-based organisations. The National School Nutrition Programme includes children from Grade R upwards while almost 50% of preschool children have been found to suffer from iron deficiency and 36 million suffer from vitamin A deficiency (Mushaphi *et al.*, 2015).

2.4.1 Early childhood development centres

The first years of life are a developmental period where dietary preferences and habits are formed thus it is important to provide children with healthy food in diverse settings where they spend most of their time such as at home and ECD centres (Bell & Golley, 2015). Investments in early childhood development will not only result in a long-term benefit for the child but also for the family and the society (The Republic of South Africa, 2015)

Children develop their food preferences by direct contact with food such as tasting, feeling, seeing, smelling as well as by observing the food environment and eating behaviours of others (Nekitsing *et al*., 2018). Interventions conducted in early

childhood will increase the health benefits and eating habits of children which are likely to extend into adulthood (Appleton *et al*., 2016).

In a systematic review, Bell & Golley, 2015 concluded that early childhood setting interventions can bring about changes in children's dietary intake and associated socio environmental determinants. A meta-analysis review study of 30 articles and 44 intervention arms revealed that implementing repeated taste exposure produced better results and that intake was greater when vegetables where offered in their plain form rather than served with dips, flavoured or with added ingredients such as oil (Nekitsing *et al*., 2018). Botswana developed an Early Childhood Care and Education (ECC&E) Policy in 2001 which implemented the revised National Policy of education, focusing on the care and growth of children in addition to adopting the international mediations on the rights of children. The policy requires ECD centres to provide food that meets the nutritional needs of the children. This includes offering a variety of foods in the right quantity and quality (The Republic of Botswana, 2001).

Education and promotion on health is an important part of the public health strategy in Botswana. One of the key areas of focus is reducing malnutrition, more especially stunting in children since 1 in 3 children suffer from chronic malnutrition (Madondo *et al*., 2012). This study investigated the effectiveness of a behavioural intervention aimed at increasing vegetable consumption in an ECD centre in Gaborone, Botswana.

2.5 The Behavioural Theory

There are several common behavioural theories and constructs that can drive change in dietary behaviour. Several theories and constructs have been identified that are relevant to children such as Precede and Proceed Theory, Social Influence Theory, Social Learning Theory and Social Cognitive Theory (Thomson & Ravia, 2011). The Social Cognitive Theory was identified for the purposes of this study and is discussed in more detail below.

The Social Cognitive Theory (SCT) has been found to be the most used theory for fruit and vegetable consumption (Hall *et al*., 2016). The SCT is the interrelation of behaviour, the surroundings and individual factors that foresees behavioural change including practises such as modelling, skills training, self-observation and contracting

(Thomson & Ravia, 2011). The individual is impacted by environmental factors which assists the internal decision-making process that is determined by cognitive and behavioural factors. The Social Cognitive Learning Theory is demonstrated in Figure 2.5 below.

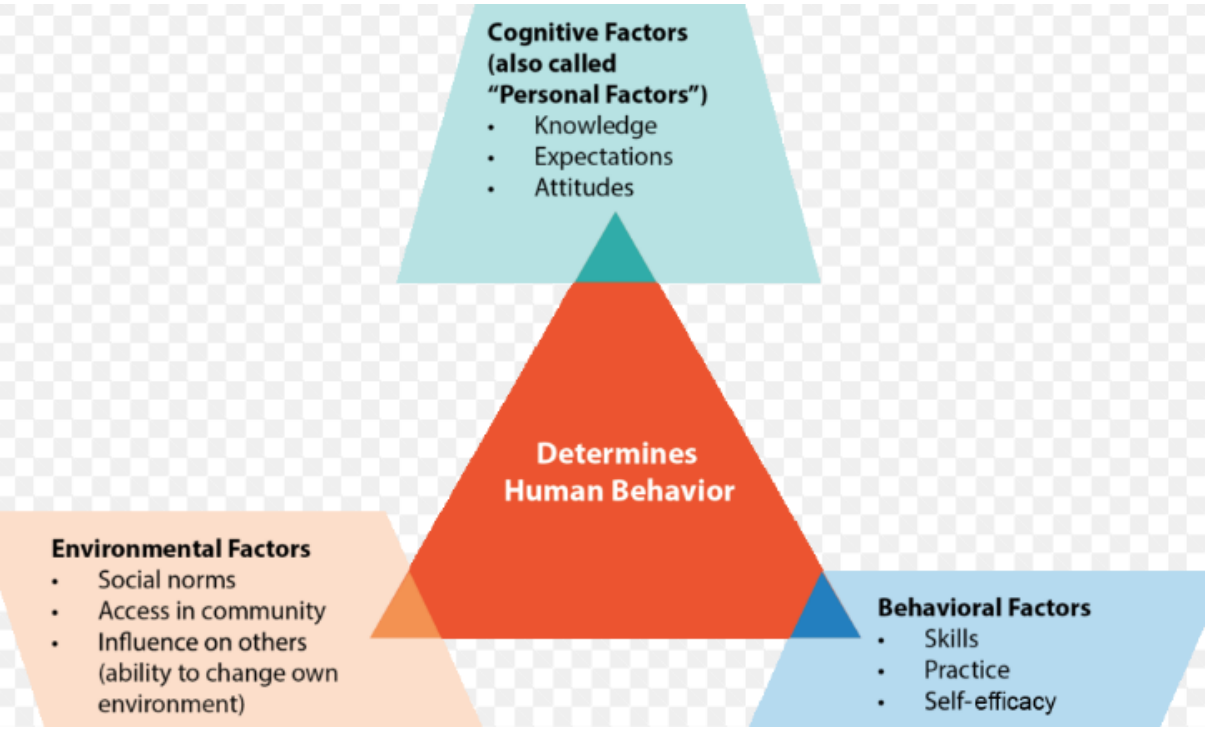


Figure 2. 5: Social Cognitive Learning Theory (Source: John Hopkins University 2020)

Stewart (1994) refers to the individual as an 'information processor'. An example of a study that used the SCT was the mHealth study that focused on increasing fruit and vegetable consumption in children in the United States of America (Xashlee *et al*., 2018). The SCT was used to address the barriers that children had with the intake of vegetables and fruit, for example, food budgeting and meal planning, recipes and cooking videos as well as strategies to address picky eating (Xashlee *et al.*, 2018). These methods were included to address behavioural capability in the constructs of the SCT. The study resulted in the rise of carotenoid levels in children participating in the intervention groups (Xashlee *et al*., 2018).

Several other studies have also applied the SCT successfully such as the Healthy Start, Catch, Pathways, 5-A-Day and Square Quest studies (Steyn *et al*., 2009; WHO, 2013).

2.6 Conclusion

Studies have indicated that there is a growing number of children that are overweight and with micronutrient deficiencies in Southern Africa. Factors contributing to this include, amongst other, demographics, urbanisation, unhealthy eating habits and an inadequate supply of foods (Abrahams, *et al*., 2010; Nnyepi *et al*., 2015). There are several dietary changes that can be explored to combat obesity and improve micronutrient deficiencies.

An increase of vegetable consumption is the dietary intervention that was the focus of this study as vegetables contain a wide range of micronutrients, are nutrient dense, have been shown to provide health benefits and are generally affordable. Even though there is significant evidence that demonstrates the benefits of consuming vegetables, children have not been found to be consuming the recommended amount of fruit and vegetables daily (Knai *et al.*, 2005; Xashlee *et al*., 2018).

There is a need for interventions that are based in schools focusing on the intake of vegetables. Schools offer a good environment to promote healthy eating behaviours as these health initiatives or promotions can reach all the children in the school regardless of their background (Poelman *et al*., 2019). The SCT provides the framework for the investigation of a behavioural intervention in this study.

Limited scientific data is available on child nutrition interventions in relation to vegetable consumption in Botswana and Southern Africa at large. Thus, this study focused on determining the effect of a behavioural intervention on vegetable consumption in young children at an ECD centre in Botswana.

CHAPTER 3: RESEARCH METHODOLOGY

Research methodology includes a description of the various measures that were involved in the experimental study. The sections discussed in this chapter include the aims and objectives of the study, study design, study setting, sampling methods, data collection, experimental procedures, data analysis procedures and ethical considerations. As well as the quality control, reliability, and validity of the study.

3.1 Aim of the study

The aim of this study was to determine the effect of a behavioural intervention on vegetable intake in children 3-6 years of age in an ECD centre in Gaborone, Botswana.

Objectives

- To describe current practices of nutrition education and children's lunch box content at Dipeo Nursery School, Gaborone, Botswana.
- To describe the children's habitual vegetable intake.
- To assess the effect of an on-site behavioural intervention, consisting of an animated superhero cartoon character of vegetables in conjunction with accessibility, on children's vegetable consumption using the dependent t-test to assess differences in pre- and post-test.

3.2 Study design

A quasi-experimental study was conducted, employing the pre-test-post-test design. The study was designed to examine the effect of a behavioural intervention on vegetable consumption in children 3-6 years of age at an ECD centre. The SCT was applied in the intervention. This was packaged in one intervention package. The intervention included an 'extrinsic factor', namely a visual character and engagement to create an interest in children.

Thus, an experimental design was used to observe the effect of the behavioural intervention on vegetable consumption. An experimental design involved influencing or adjusting some variables of the environment and studying the effect compared to pre-intervention. The study included three time-points. This was in the form of a pre-

test on day 1, then intervention on day 3 and thereafter a post-test on day 5. This intervention was conducted among two groups for logistical reasons. Group 1 was tested in the first week and group 2 in the following week.

3.3 Study setting

This study was conducted in Gaborone, Botswana. Botswana is a country that is geographically landlocked (non-coastal) in Southern Africa (Tapera *et al*., 2018). Several ECD centres were considered for the purposes of identifying the ideal setting for conducting the study. The study was conducted at Dipeo Nursery School which offers preschool, day care and afterschool services. The ECD centre was selected based on the number of children in the school (N=150), the willingness of the school to participate in the study and the proximity to the researcher.

The ECD centre is situated in a middle-class suburb called Maruapula in Gaborone. Figure 3.1 is a map of a portion of Gaborone, Botswana. The location of Dipeo Nursery School where data was collected is shown in Figure 3.1.

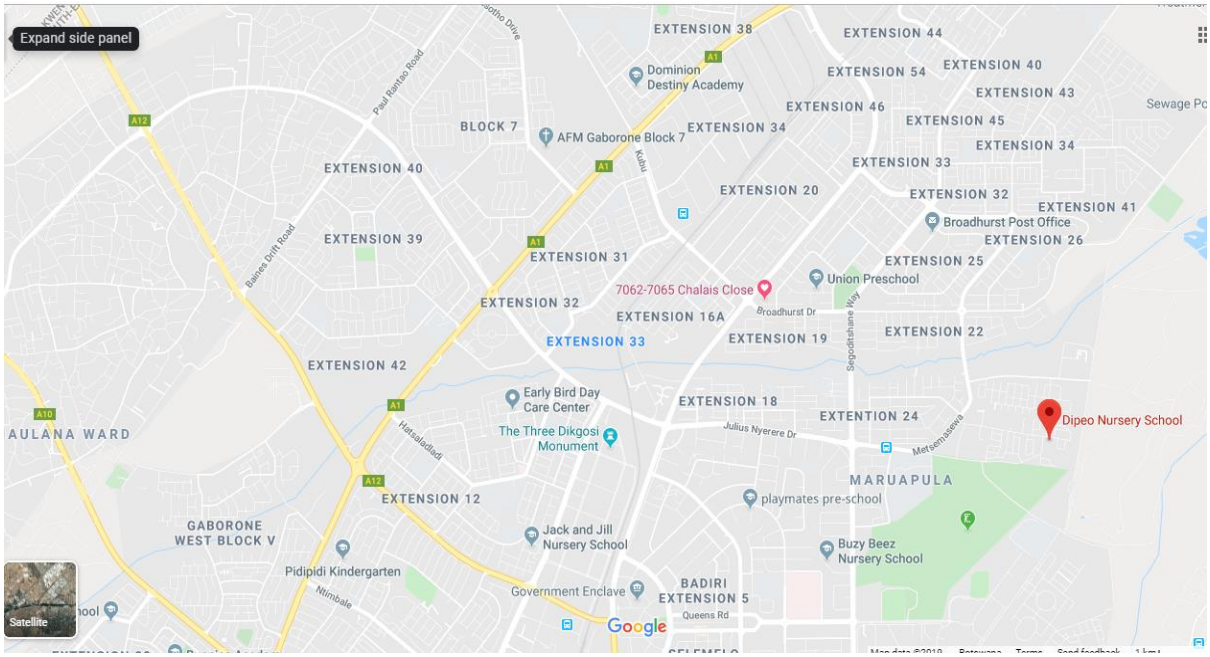


Figure 3. 1: Map of a portion of Gaborone, Botswana (Source: Google Map, 2019)

3.4 Population, sample, and recruitment

The study population was children 3-6 years of age at the Dipeo Nursery School. The school had three classes in each age group from the 3-4 years to 5-6 years age groups. The population was N=150 and the sample size was determined by the population's willingness to participate and providing consent. However, the appropriate sample size was calculated by means of a priori power analysis using the G*Power 3.0.10 (Faul *et al*., 2007) statistical programme. The calculation was based on a t-test to assess the difference of two dependent means: a power (1-β) of 0.8; effect size (d) 0.5 and error probability of 0.05. The result indicated that the total sample size should be 27 children.

Non-probability convenience sampling was implemented, and 150 information sheets were distributed to parents at Dipeo Nursery School on 01 September 2020. Printed copies of consent forms with questionnaires were handed to parents. Electronic forms were sent out on 18 September along with regular reminders to encourage participation. After 4 weeks, a total of 35 parents (23%) provided consent for their children to participate in the study. There were 32 forms that were returned as hard copies and 3 forms were completed online. Finally, 31 children participated in the pre-test, intervention, and post-test. Four children could not participate due to absenteeism.

3.5 Experimental procedure

The experimental research review by DeCosta *et al.* (2017) on changing children's eating behaviour was studied to determine the most appropriate intervention option for this study. The review included the following approaches: parental control; reward/instrumental feeding; social facilitation; cooking programmes; school gardens; sensory education; availability and accessibility; choice architecture and nudging; branding, food packaging and spokes-characters; preparation and serving style; and offering a choice. With reference to the SCT explained earlier, an extrinsic factor, namely an animated superhero character, was chosen as an intervention.

The study was conducted at the school library class and the school's eating area, depending on space availability while observing COVID-19 protocols and without

interfering with non-participants and school activities (See Figures 3.2 and 3.3). The study included a pre-test on day 1 (Monday), then intervention on day 3 (Wednesday) and a post-test on day 5 of a week (Friday). Due to venue space, the procedure was conducted among two groups during the week of 12 October 2020 and 19 October 2020, respectively. At Dipeo Nursery School, parents are required to provide food for their children to consume at school for the mid-morning snack and lunch times. The school caters for the mid-afternoon snack to children attending full day only.

The experiment was conducted just before the mid-morning snack time on each of the days to ensure that the children have the appetite to taste the vegetables. Children were seated on chairs and tables to control the process of social distancing, food exposure and feeding instructions. See Table 3.1 below for an illustration of how the study was applied for group 1 and group 2.

Table 3. 1*: Illustration of the experimental framework for the behavioural intervention study*

n = 31	**PRE-TEST** Day *1*		**INTERVENTION** Day *3*		**POST-TEST** Day *5*
Group 1	Measurement Library	→	Intervention Eating area	→	Measurement Eating area
Group 2	Measurement Eating area	→	Intervention Library	→	Measurement Eating area

Figure 3. 2: Library area where the intervention was conducted

Figure 3. 3: Outside eating area where the intervention was conducted

During each assessment session, each child was presented with a plate consisting of the same size and number of cooked (using stovetop steaming method) vegetables (green beans and coin-cut carrots) and was invited to eat as many as they liked. No other instructions were given during the pre- and post-test sessions, while the

intervention session included additional activities as explained below. Vegetables were cut into the same sizes, with green beans in ±5cm pieces and carrots in ±1cm thick coin cuts (see Figure 3.4). Carrots and green beans were particularly selected as they could be prepared according to a set size to ensure accuracy in assessment of consumption. Children were allocated 15 minutes to eat the vegetables. Each child and plate were labelled with their relevant study number. The number of pieces of vegetables left in the plate were counted and captured on data sheets. Observers were cognisant of food dropped on the floor, thrown out or hidden and did not consider those as 'eaten'.

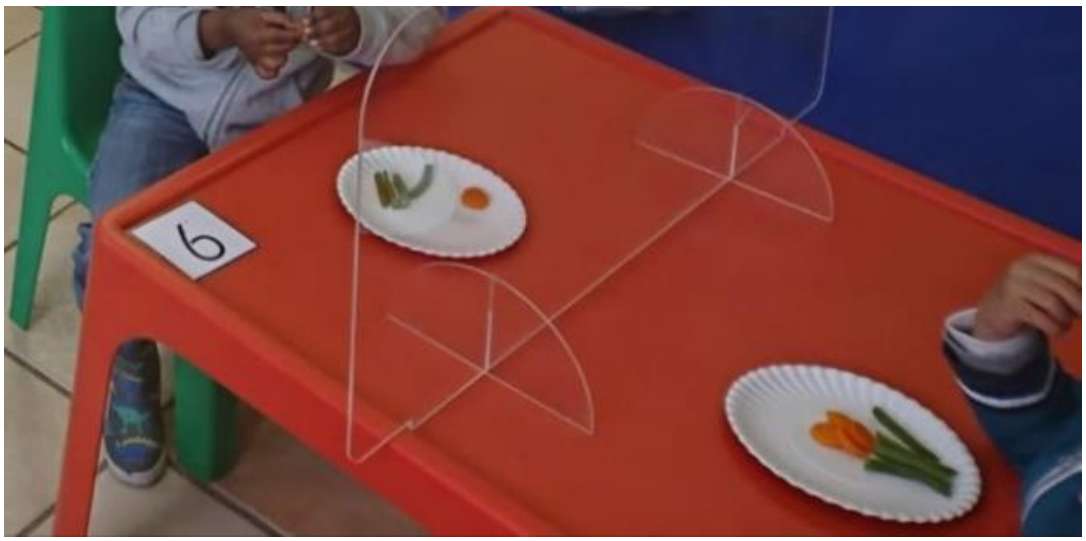


Figure 3. 4: Participants consuming the carrots and green beans

The behavioural intervention, conducted only on day 3, was an application of the SCT including 'extrinsic factors' using an animated superhero character to create an interest in children. The behavioural intervention consisted of a display of the vegetables on a card with a fun nutritional fact presented by an animated superhero character (*PAW Patrol*) and was placed on each table (Figures 3.5 and 3.6). As the cards were placed on each table, the animated superhero cartoon characters' song played in the background to set the scene and create excitement. The fun nutritional fact was an encouragement for children to eat the vegetable. The researcher discussed the posters and content (each nutritional fact) with the children prior to the children being invited to eat the vegetables. Each plate was assessed on all the days of interventions to measure how much food was eaten by each child (explained in section 3.6).

Figure 3. 5: Poster used as intervention to showcase carrots with nutritional facts using the animated superhero cartoon character

Figure 3. 6: Poster used as intervention to showcase green beans with nutritional facts using the animated superhero cartoon character

3.6 Data collection

Data collection included self-administered questionnaires and vegetable intake observations which are explained below.

3.6.1 Questionnaires

The participant consent form (Appendix 2) was presented to the parents along with a parent questionnaire (Questionnaire 1, Appendix 3). Parents had to sign the consent form, before completing the questionnaire. The questionnaire included socio-demographic items plus items to determine children's habitual vegetable consumption behaviour at home. The teachers were requested to complete the teachers' questionnaire (Questionnaire 2, Appendix 4) to obtain information on nutrition education at the school and on their observations of foods that children consumed at school.

3.6.2 Vegetable Intake

The children's vegetable intake was assessed by counting the number of green beans and carrots that remained in the plate for each child during all three sessions (days 1, 3 and 5). This was captured on a datasheet directly after the 15 minutes of allocated time for consumption. Each child and plate were labelled with an allocated participant number.

In cases where children took one bite from the vegetable or not the complete piece of vegetable, it was captured as 0.5 pieces. Children were observed to determine if vegetables were not thrown out, spit out or hidden. The teachers and fieldworker who were involved in the observation and data collection were trained prior to data collection to ensure accuracy of intervention and data collection.

3.7 Data management and analysis

Collected data was captured electronically on Microsoft Excel. Data was cleaned and participants with incomplete data (absenteeism on one or more study days) were removed (n=4). Statistical analysis was conducted using SPSS software (IBM version 27) to provide the results of vegetable consumption of children throughout the study.

Descriptive analysis was conducted to identify the proportion of carrots and green beans consumed at each time point. Vegetable consumption was calculated as follows:

$$Veg_{consumed} = \frac{Veg_{provided} - Veg_{remaining}}{Veg_{provided}} \times 100$$

Inferential statistical analysis (dependent t-test) was used to deduce inferences of the implication of intervention, pre-test, and post-test. The data was distributed non-normally. Thus, the data was transformed in SPSS using the Two-Step Approach (Templeton, 2011).

3.8 Ethical considerations

3.8.1 Ethical clearance

Ethical clearance was obtained from the Health Research Ethics Committee of the College of Agriculture and Environmental Sciences at the University of South Africa (2020/CAES_HREC/031) prior to recruitment.

3.8.2 Permission to conduct study

The Group Operations Director provided permission to conduct the study at Dipeo Nursery School (Appendix 1). This was further supported by an email providing permission to proceed with the study after the COVID-19 lockdowns.

3.8.3 Informed consent

Informed consent letters were handed to all parents prior to the study for permission for their children to participate in the study (Appendix 2). Verbal ascent was obtained from the children prior to vegetable intake observations.

3.9 Quality Control

Quality control in quantitative research refers to the criteria or measures that the investigator or researcher implements for valuation as a way of making sure that the data that will be collected is honest and valuable (Stiles, 1993). One of the measures that was taken was that questionnaire 1 was compared to questionnaire 2.

Questionnaire 2 was answered by the teachers who frequently observe children's lunchboxes and their behaviour at mealtimes, while questionnaire 1 was completed by the parents. Another measure involved was having more than one observer to help capture the data during data collection. The observers were trained on data collection methods and the objectives of study.

3.9.1 Reliability

Reliability is the practical trustworthiness of validations or data. Reliability helps ascertain whether the observations can be repeated after allowing for appropriate differences and whether the investigators report reveals what you would have seen if you were observing (Stiles, 1993). Teachers and the fieldworker received training (15 and 30 minutes respectively) and used the same methods to obtain vegetable consumption data. The researcher conducted the intervention by conveying the written message in both groups for consistency. All observations were captured on the data collection forms.

3.9.2 Validity

Validity is the dependability of interpretations or conclusions. Validity helps establish whether the interpretations or conclusions are valid and accurate. This can be applied through repeated encounters of interpretations with participants and data (Stiles, 1993). The extended discussion involves reading and hypothesising and repeating the process as interpretations (e.g., summaries and descriptions) change and develop as they become pervaded with observations. Validity of interpretation needs to be fair, internally consistent and useful (Stiles, 1993).

In this study, the experimental procedure consisted of pre-testing and post-testing to enable repeated exposure with participants. Lengthy dialogue with the data was implemented. We assessed face validity of the questionnaire to the parents and teachers having a registered dietician determining how suitable the questions were to reach the objective(s) of the research. Face validity deliberates on how appropriate the content of a test appears to be on the surface (Middleton, 2019).

CHAPTER 4: RESULTS

This research study aimed to examine the effect of a behavioural intervention on vegetable consumption in children 3-6 years at an Early Childhood Development (ECD) centre in Gaborone, Botswana.

The study results are presented in this chapter, starting with the description of nutrition education and lunchbox content provided to children at Dipeo Nursery School. Additionally, the teachers' responses on observations of the foods that were included in the children's lunchboxes are described as well.

The responses obtained from parents regarding their children's habitual vegetable intake are also presented. The results of the quasi-experimental study with the comparison of the pretest and posttest are reported towards the end of this chapter.

4.1 Nutrition education at Dipeo Nursery School

The population of the ECD centre Dipeo Nursery School was N=150 at the time of recruitment, while only 35 parents (23%) gave consent for their children to participate in the study. In total, results from 31 (21%) participants who attended the pretest, intervention and post-test were included, since the data of 4 children were removed due to absenteeism on some days.

Dipeo Nursery School uses various educational themes in each term and nutrition education is one of the themes that is included in the curriculum. Teachers (n=11) were asked about the frequency of nutritional education being offered to the children at the school. The teachers' feedback is presented in Figure 4.1. Most of the teachers (46%) indicated that nutrition education is offered once a week; however, 27% indicated that no nutrition education is provided at the school.

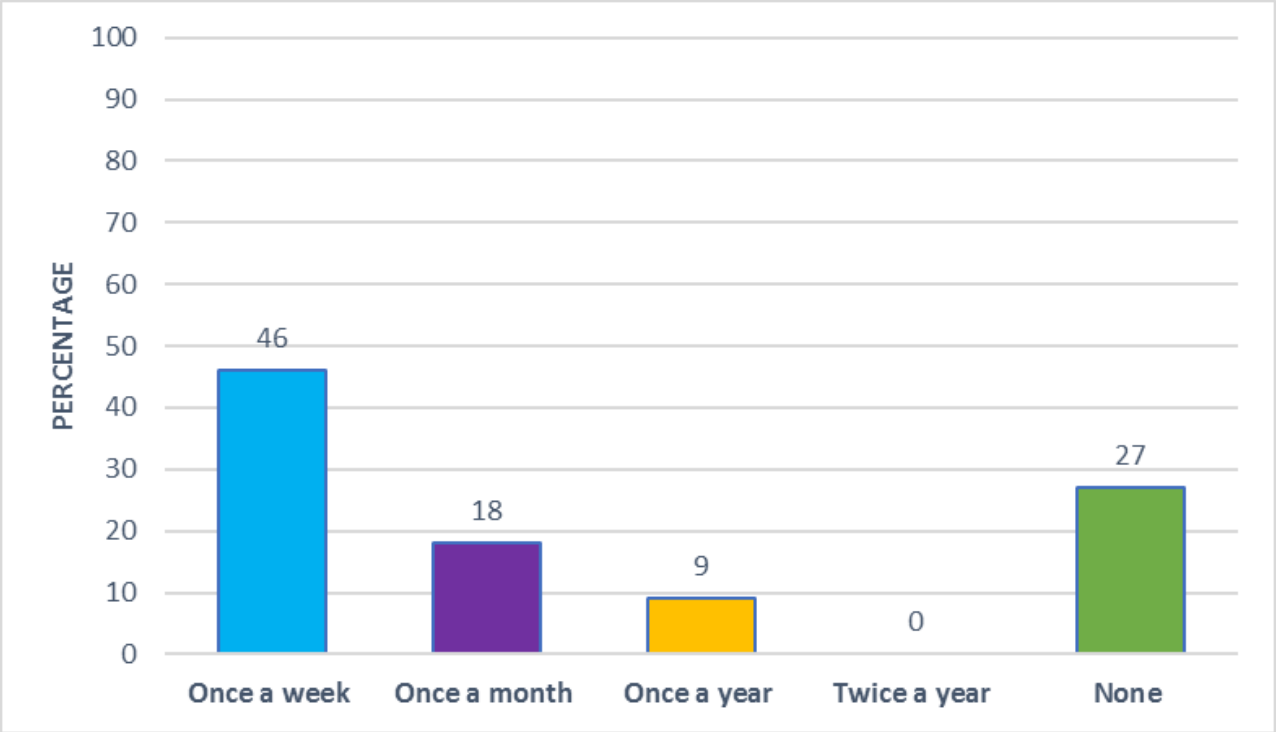


Figure 4. 1: Teachers' responses regarding frequency of nutritional education offered at the school

4.2 Teachers' observations of food consumed

Table 4.1 presents the teachers' responses in terms of their observations of foods and drinks packed by parents the preceding week. Each teacher completed the self-administered questionnaire individually at their own time. The teachers (n=11) indicated that they observed water (100%), juice (100%), flavoured yoghurt (91%) and fruits (64%) being packed 'every day' for the children's mid-morning snack. Only two teachers (18%) reported vegetables being packed every day. No one (0%) indicated observing granola bars, cookies/muffins, crackers, candy/sweets, or fizzy drinks being packed 'every day' for school. According to their observations, vegetables are packed sometimes (45%) or rarely (27%) for snack time.

Table 4. 1: Summary of teachers' (n=11) observation of the foods and drinks packed by parents for snack time in the preceding week

	Never, n (%)	Rarely, n (%)	Sometimes, n (%)	Often, n (%)	Every day, n (%)
Fruits	0 (0)	0 (0)	1 (9)	3 (27)	7 (64)
Vegetables	0 (0)	3 (27)	5 (45)	1 (9)	2 (18)
Plain yoghurt	3 (27)	4 (36)	0 (0)	2 (18)	2 (18)
Flavoured yoghurt	0 (0)	0 (0)	0 (0)	1 (9)	10 (91)
White bread	2 (18)	0 (0)	4 (36)	3 (27)	2 (18)
Brown bread	1 (9)	1 (9)	2 (18)	4 (36)	3 (27)
Sausages	1 (9)	1 (9)	7 (64)	1 (9)	1 (9)
Granola bars	9 (82)	0 (0)	2 (18)	0 (0)	0 (0)
Cookies/Muffins	0 (0)	2 (18)	5 (45)	4 (36)	0 (0)
Crackers	2 (18)	4 (36)	4 (36)	1 (9)	0 (0)
Crisps / Chips	0 (0)	5 (45)	3 (27)	2 (18)	1 (9)
Candy / sweets	6 (55)	2 (18)	2 (18)	1 (9)	0 (0)
Water	0 (0)	0 (0)	0 (0)	0 (0)	11 (100)
Juice	0 (0)	0 (0)	0 (0)	0 (0)	11 (100)
Fizzy drink	10 (91)	0 (0)	1 (9)	0 (0)	0 (0)

In addition, teachers were asked to report on a provided list of 14 vegetables which vegetables they observed being packed normally for the morning snack or lunch. The teachers' observations of the vegetables that were most frequently packed for the mid-morning snack or lunch were cucumber (91%), carrots (82%), corn (73%) and tomatoes (62%). The least packed vegetables were green beans (9%) beetroot (9%), spinach (9%), other vegetables (9%) and cabbage (0%).

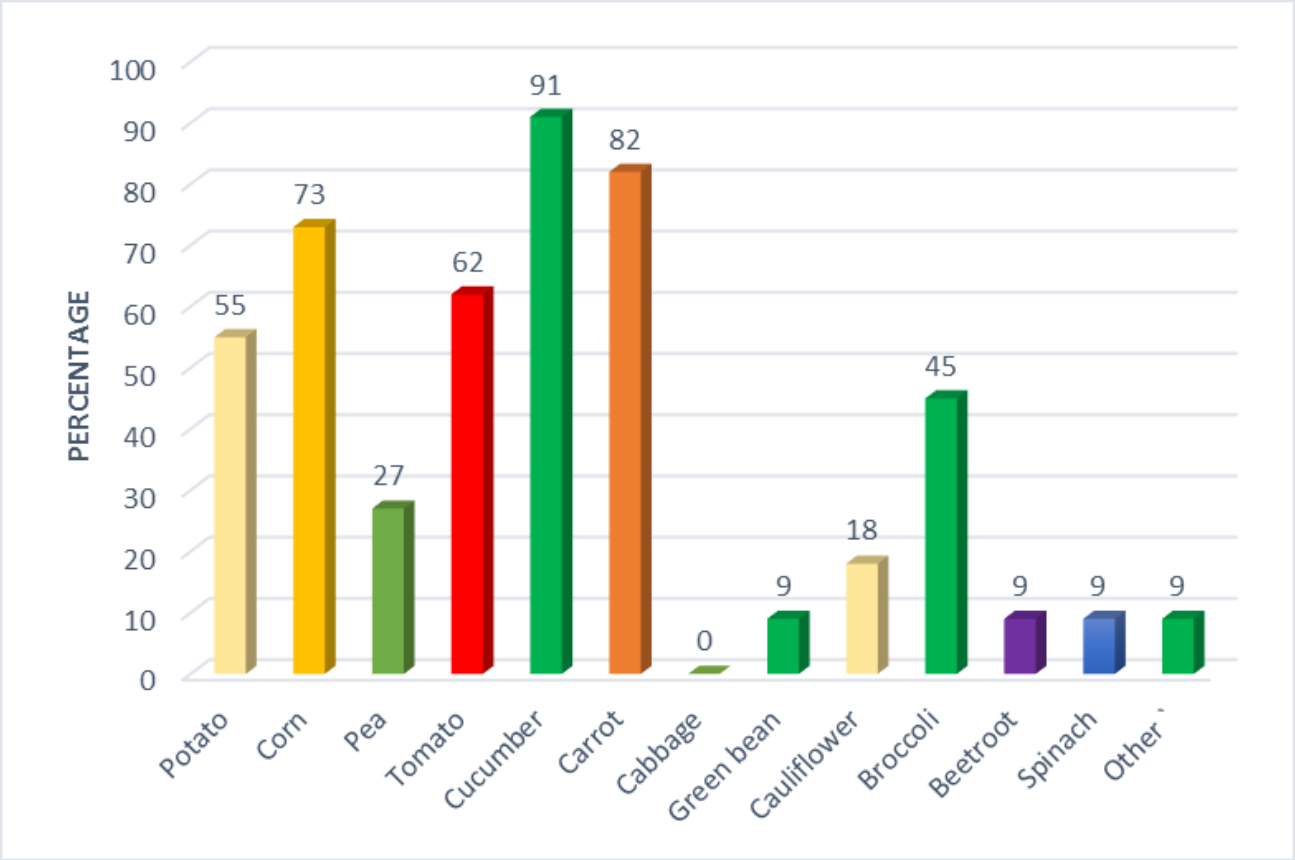


Figure 4. 2: Teachers' (n=11) observation of vegetables packed for children's morning snack or lunch

Teachers were asked to report, based on their observations, the frequency at which the children would consume the vegetables that were packed as part of their lunch boxes. Their responses are illustrated in Figure 4.3. Most of the teachers (45%) indicated that the children only sometimes consumed the packed vegetables, while 27% of the teachers said the children always consumed the packed vegetables.

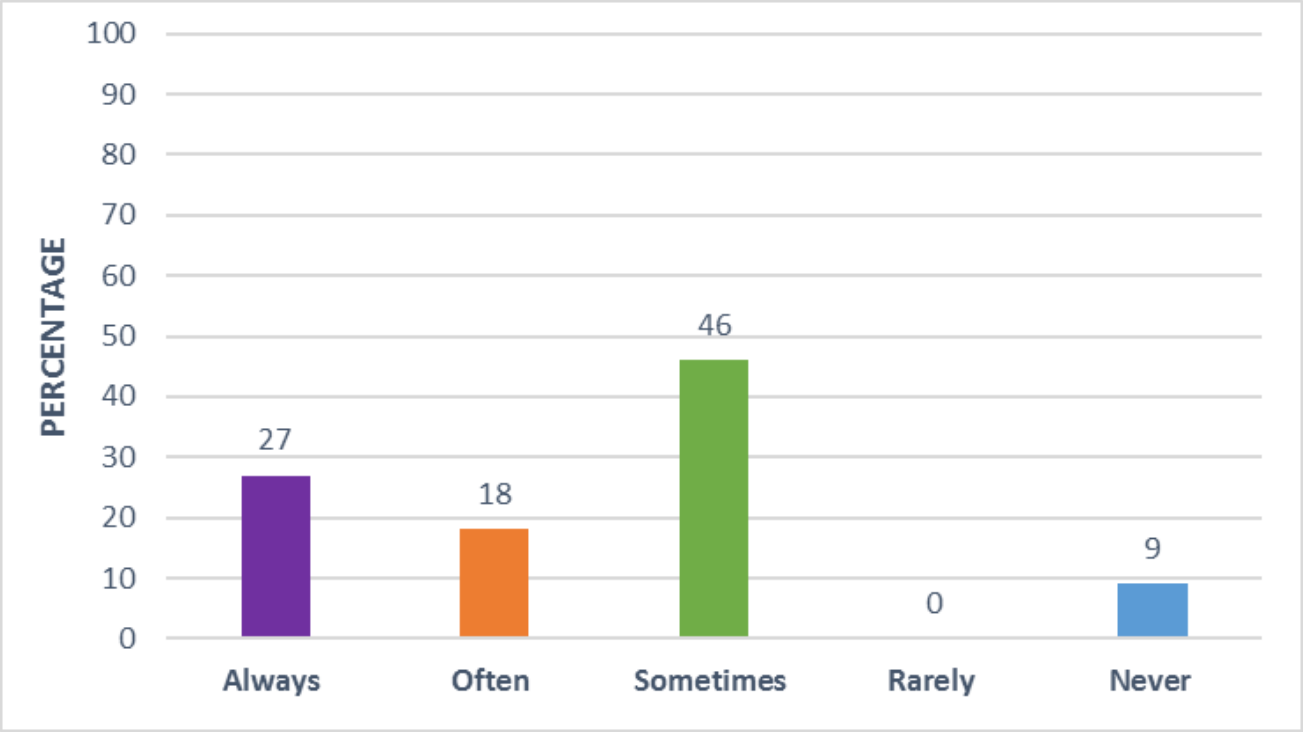


Figure 4.3: Teacher's observations of children's vegetable consumption when vegetables are provided in lunch boxes (n=11)

4.3 Participant sociodemographic data

Thirty-five parents gave consent for their children's participation in this study, while only 31 children's data were included for analysis due to absenteeism. Table 4.2 indicates the parents' and the children's sociodemographic characteristics.

There was a comparable number of children in the different age groups as 35.5% of children were aged 3-4 years, 35.5% were 4-5 years and 29.0% were aged 5-6 years. More participants (54.8%) were boys.

Most of the responding parents were female (90.3%) and were married (77.4%). In terms of the race, 64.5% were black African, 25.8% were White, 6.5% were Coloured and 3.2% were reported as other. Almost two thirds of the parents (64.5%) had a diploma or degree as the highest level of educational attainment and 29.0% of parents had post-graduate degrees. There was a comparable split in the household income levels from highest to the lowest percentage, with 35.5% of the parents earning between P11000 and P30000, 22.6% earning <P11000, 22.6% earning >P50,000 and

16.1% in the P30001 – P50000 income level. The Botswana pula to South African rand ratio was 1 BWP = 1.44430 ZAR at the time of the research.

Table 4.2: Participant characteristics (n=31)

Descriptor	n	%
Child characteristics		
Age group		
3-4 years	11	35.5
4-5 years	11	35.5
5-6 years	9	29.0
Child Gender		
Boy	17	54.8
Girl	14	45.2
Self-reported allergies		
Yes	3	9.7
No	28	90.3
Responding parent characteristics		
Gender		
Male	1	3.2
Female	30	96.8
Marital Status		
Single	7	22.6
Married	24	77.4
Ethnic Group		
Black African	20	64.5
Coloured	2	6.5
White	8	25.8
Other	1	3.2
Highest level of Education		
Gr12	1	3.2
Diploma/Degree	20	64.5
Postgraduate	9	29.1
Missing	1	3.2
Household income level, month		
<P11000	7	22.6
P11000 - P30000	11	35.5
P30001 - P50000	5	16.1
>P50000	7	22.6
Missing	1	3.2

* The Botswana pula to South African rand ratio was 1 BWP = 1.44430 ZAR at the time of the research

4.4 Children's vegetable consumption at home

Parents were asked to report on a provided list of 14 vegetables which vegetables were consumed in the preceding 24 hours at home (Figure 4.3). Vegetables that were consumed the most at home in the preceding 24 hours were carrots (65%), potatoes (61%), tomatoes (55%) and cucumber (42%). The least consumed vegetables in the

preceding 24 hours were other vegetables (6%), cauliflower (10%), beetroot (10%), spinach (10%) and green beans (13%).

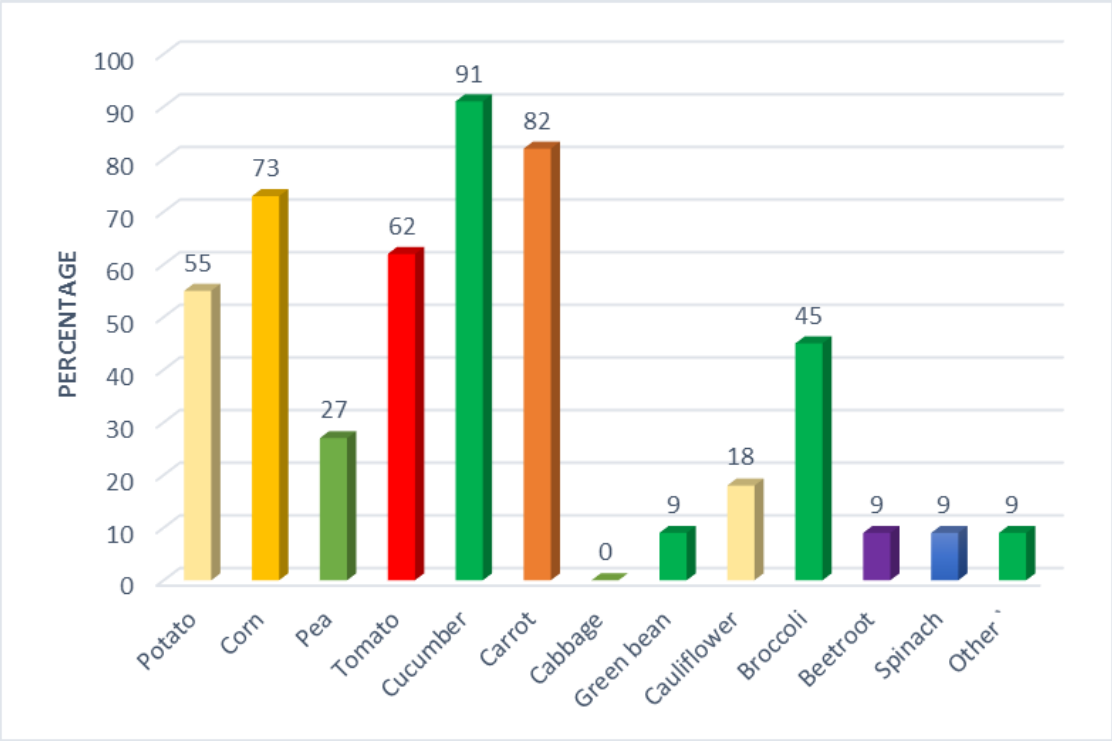


Table 4. 3: Children's reported vegetable consumption in the preceding 24 hours (n=31)

In addition, parents were asked to report on the same provided list the frequency their children consumed the vegetables (Table 4.4) in the preceding month. Vegetables that were mostly reported as 'never' eaten were beetroot (77.4%), cauliflower (70.9%), other vegetables (70.9%), green beans (58.1%), cabbage (58.1%) and peas (54.8%). Carrots (25.8%) and tomatoes (25.8%) were eaten 3 to 6 times per week by a quarter of the children. Potatoes (38.7%) were mostly reported to be consumed twice per week. Very few parents reported a specific vegetable to be consumed every day (carrots, 16.1%; potatoes, 9.7%, tomatoes, 6.5%, spinach, 3.2% and peas 3.2%).

Table 4. 4: Children's vegetable consumption frequency per week as observed by the parent in the preceding month (n=31)

	Never, n (%)	1x/week, n (%)	2x/week, n (%)	3-6x/week, n (%)	Every day, n (%)
Potatoes	2 (6.5)	11 (35.5)	12 (38.6)	3 (9.7)	3 (9.7)
Corn	7 (22.6)	12 (38.7)	8 (25.8)	4 (12.9)	0 (0)
Peas	17 (54.8)	8 (25.8)	2 (6.5)	3 (9.7)	1 (3.2)
Tomatoes	7 (22.6)	6 (19.4)	8 (25.8)	8 (25.8)	2 (6.5)
Cucumber	15 (48.4)	4 (12.8)	6 (19.4)	6 (19.4)	0 (0)
Carrot	9 (29.3)	4 (12.9)	5 (16.0)	8 (25.8)	5 (16.0)
Cabbage	18 (58.1)	5 (16.1)	4 (12.9)	4 (12.9)	0 (0)
Green beans	18 (58.0)	10 (32.3)	2 (6.5)	1 (3.2)	0 (0)
Cauliflower	22 (70.9)	5 (16.1)	1 (3.2)	3 (9.8)	0 (0)
Broccoli	14 (45.2)	10 (32.3)	4 (12.9)	3 (9.7)	0 (0)
Beetroot	24 (77.4)	1 (3.2)	4 (12.9)	2 (6.5)	0 (0)
Spinach	13 (41.9)	8 (25.8)	5 (16.1)	4 (12.9)	1 (3.2)
Other	22 (70.9)	2 (6.5)	2 (6.5)	5 (16.1)	0 (0)

Also, parents were asked to report on children's frequency of consumption of vegetables served on the plate. Most parents reported that the children at least 'often' (26%) or always (26%) ate their vegetables, with some 'never' eating their vegetables (7%).

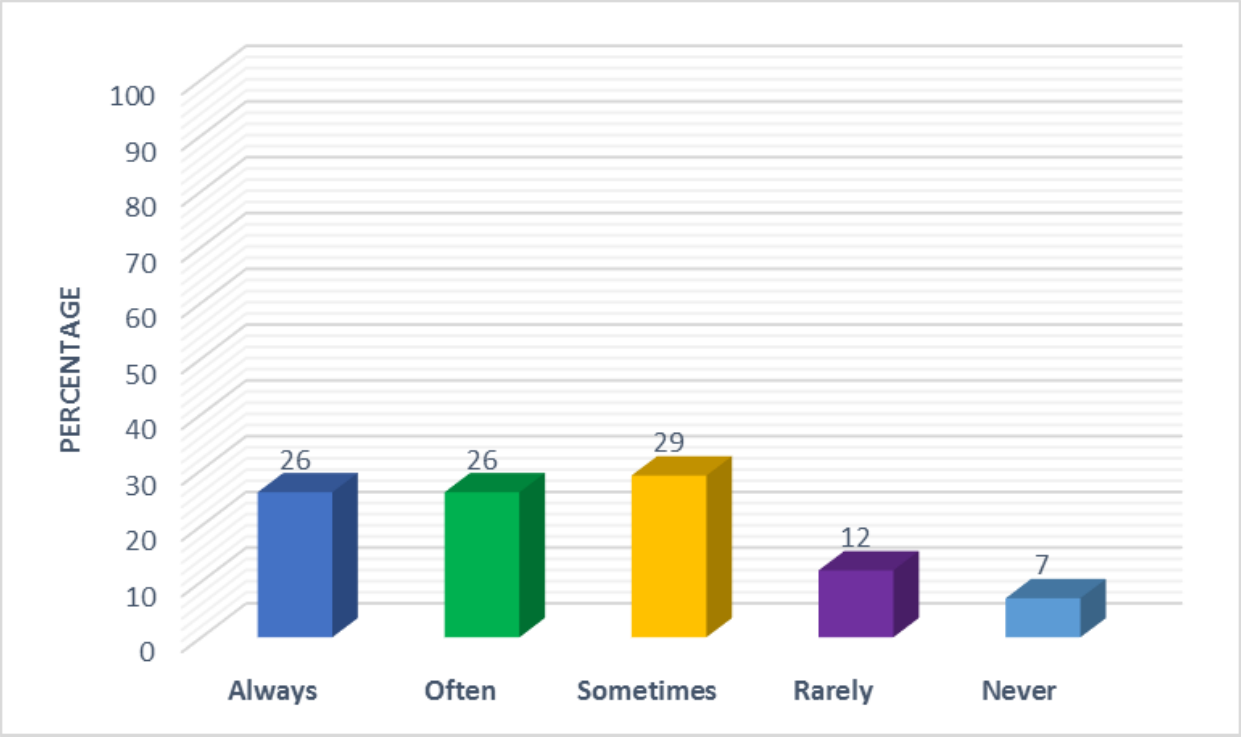


Figure 4. 4: Parents observations of the children's vegetable consumption when served on their plate (n=31)

Parents were asked to report on whether children were happy to eat their vegetables. Less than half of the parents (42%) reported that their children were happy to eat their vegetables (Figure 4.5).

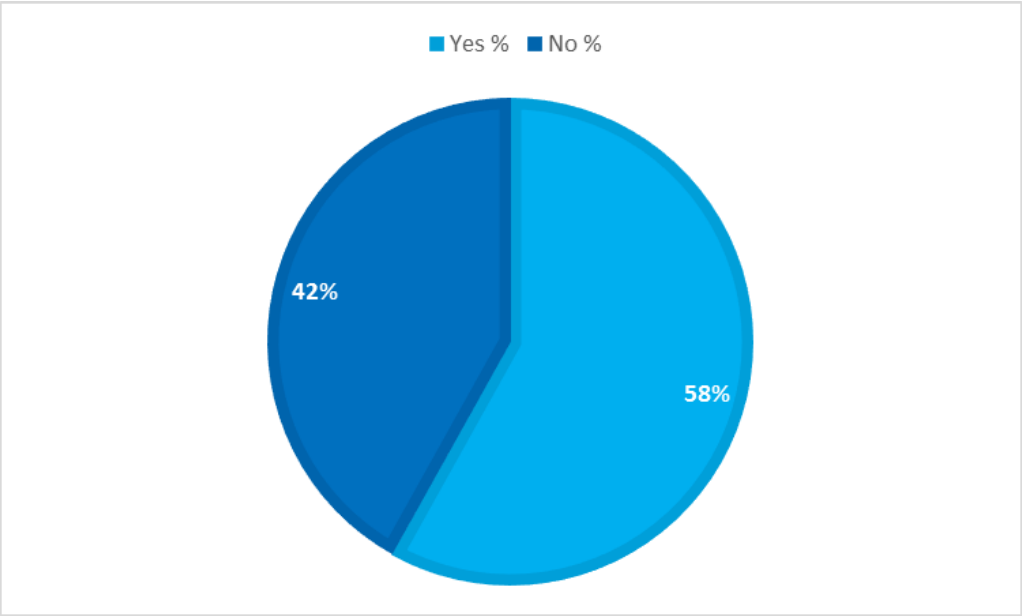


Figure 4. 5: Parents' responses on whether their children are happy to eat their vegetables

Lastly, parents were asked to describe the challenges they experienced when offering their children vegetables. Only n=16 parents responded to this question. The three main themes that were identified from the 16 parents that described their challenges when children are offered vegetables were that their child 'likes some of their vegetables and others not' (31%), 'do not like to eat vegetables' (31%) and the child 'dislikes the taste and texture of the vegetables' (19%).

Table 4. 5: Challenges parents reported when children eat their vegetables (n=16)

Comments / Theme	Frequency, n (%)	Percent, n (%)
Likes some vegetables, others not	5	31
Eats vegetables when presented in a new way.	1	6
Dislikes the taste and texture of vegetables	3	19
Does not like to eat vegetables	5	31
Challenge eating / some days are good and others bad.	2	13

4.5 Comparison of vegetable consumption before, during and after intervention

Children were provided with five pieces of softly cooked (using stovetop steaming method) carrots which were ±1cm thick coin cuts and green beans which were ±5cm cuts on the pre-test day on a labelled plate. Following the positive intake of the vegetables on the first pre-test day, the portion was increased to ten pieces of each vegetable on the intervention and post-test day to allow for better assessments of amounts consumed. Thus, the results are presented as a proportion consumed of the total amount provided (the formula used for calculating the proportion is provided in Chapter 3).

There was no significant difference in the mean vegetable consumption between the age groups on the pretest, intervention, or post-test days (Table 4.6).

Table 4. 6: Mean percentage carrot and green bean consumption

	Pre-test	*p**	Intervention	*p**	Post-test	
Carrots (%)						
Total group (n=31)	75.1 (±28.3)		69.0 (±32.1)		82.2 (±23.9)	
3-4 years (n=11)	82.7 (±28.2)		79.3 (±28.1)		84.5 (±22.9)	
4-5 years (n=11)	73.6 (±28.1)	0.502	67.8 (±27.1)	0.333	85.3 (±21.5)	0.637
5-6 years (n=9)	67.7 (±29.7)		57.7 (±40.8)		75.7 (±29.0)	
Green Beans (%)						
Total group (n=31)	55.5 (±36.6)		53.1 (±36.6)		62.1 (±35.0)	
3-4 years (n=11)	64.8 (±42.5)		70.6 (±33.8)		75.0 (±27.4)	
4-5 years (n=11)	59.5 (±34.2)	0.280	44.4 (±39.0)	0.141	57.5 (±40.0)	0.300
5-6 years (n=9)	39.3 (±29.4)		42.4 (±32.1)		51.8 (±35.8)	

*Independent t-test was used for comparing proportion consumed between age groups

There were no significant changes in carrot consumption from pre-test to intervention (Table 4.6 and Table 4.7). For the total group there was a significant increased carrot consumption of 13.3% (t (30) = -3.99, $p<0.001$) from intervention (69.0, ±32.1%) to post-test (82.2, ±23.9%), as well as an increase of 7.1% from pre-test (75.1, ±28.3%) to post-test (82.2, ±23.9%, t(30)=-2.09, $p=0.045$). Similarly, there was a 9% increase in green bean consumption (t (30) = -3.04, $p=0.005$) from intervention (53.1, ±36.6%) to post-test (62.1, ±35.0%).

Table 4. 7: Change in vegetable consumption at pre-test, intervention, and post-test (paired sample t-test)

	Pre-test vs Intervention		**Intervention vs Post-test**		**Pretest vs Post-test**	
	t-value	p	t-value	p	t-value	p
Carrots	1.73	0.09	-3.99	**<0.001**	-2.09	**0.05**
Green beans	0.62	0.54	-3.04	**0.005**	-1.56	0.13

*The pretest, intervention and post-test measures have been examined in the paired sample (dependant) t test below.

4.6 Conclusion

This study aimed to examine the effect of a behavioural intervention on the vegetable consumption of children 3-6 years at an ECD centre in Gaborone, Botswana. Thirty-five parents gave consent for their children to participate in the study. Only 42% of parents reported that their children were happy to eat their vegetables. A description of the types of foods and vegetables packed for morning snack and lunch was reported. Carrots were one of the most consumed vegetables while green beans were amongst one of the least consumed vegetables. There was a significant increase in the mean carrot and green bean consumption from the intervention to the post-test in the total group. In Chapter 5, these results are discussed.

CHAPTER 5: DISCUSSION

5.1 Introduction

The aim of the study was to determine the effect of a behavioural intervention on vegetable intake in children 3-6 years in Dipeo Nursery School in Gaborone, Botswana. In total, 31 children were included in the study (17 male, 14 female) where a pre-test-post-test design was employed. The intervention consisted of posters of animated superhero cartoon characters promoting vegetable intake along with a nutrition message since the children could not read the nutrition message on posters, this while the characters' song played in the background to set the scene and create excitement.

In this chapter, the results are discussed in more detail within the context of available literature.

5.2 Research findings

5.2.1 Teachers' observations

According to the Early Childhood Care and Education (ECCE) Policy of Botswana, ECD centres design their own individual learning framework to teach and prepare children for primary education. This learning framework is shaped by the primary school curriculum (ECCE, 2001). Owing to the unavailability of a standard curriculum, 62.5% of ECD centres in Botswana reported using either a South African Curriculum or a combination of curriculum prescribed by other countries (Bose, 2008). Additionally, 15% of ECD centres use self-made or adopted the Montessori method which incorporate developmentally appropriate practices (Bose, 2008). The South African National curriculum framework for children incorporates wellbeing and physical development as one of the early learning and developmental areas (Department of Basic Education, 2015). While nutrition education may feature in the curriculum as part of the learning themes, it was not deliberated as a learning and development area in the policy document.

In this study, teachers (n=11) were asked about the frequency of nutritional education being offered to the children at the ECD centre and most of the teachers (46%)

indicated that nutrition education was offered once a week, whereas 27% of the teachers stated that no nutrition education was provided at the school and 18% said that nutrition education was offered once a month. From this, one may assume that nutrition education at the centre was teacher dependent. The school environment is an incredibly valuable place to educate and influence the food behaviour of children (Prakash, 2013) since children's eating behaviours are developed in early childhood stage and can be associated with healthy or unhealthy eating behaviours in adulthood (Ramsay *et al.*, 2017). It is important for nutrition education interventions to be included regularly in the curriculum in ECD centres to have an impact on child nutrition.

The teachers (n=11) were also asked in a self-administered questionnaire from a list of food items, to report on their observations of food and drinks packed by parents in the preceding week for the children's mid-morning snack. In terms of drinks, water and juice/yogurt were observed as being packed every day, while fizzy drinks were observed to be never packed. This reflects the advice and suggestions the school provide parents on what to pack for school (personal communication with principle). In terms of snacks, flavoured yoghurt was most reported to be packed everyday (91%), followed by fruit (64%). Cookies/muffins and brown bread were observed to be packed often (36%). While only two teachers (18%) reported vegetables being packed every day, 45% said sometimes and 27% said rarely. It seems that most children do not receive vegetables in their packed lunchboxes every day. The lack of good nutrition has been widely seen in schools where children tend to consume more unhealthy foods that are lacking in micronutrients (Clark & Fox, 2009). Good nutrition is important for children; thus, nutrition intervention programs aimed at encouraging dietary diversity in school lunchboxes or snacks can have a positive impact (Prakash, 2013).

5.2.2 Children's habitual vegetable intake

Teachers' observations regarding specific vegetables packed for snacks or lunch were similar to parent observations on what their children consume, particularly for the vegetables most and least consumed (except for potatoes since they contribute to starch in the diet). Parents reported carrots (65%), tomatoes (55%) and cucumbers (42%) as the most frequently consumed vegetables in the preceding 24 hours, while teachers reported cucumbers (91%), carrots (82%), corn (73%) and tomatoes (62%) as most packed for school. According to the parents, the least consumed vegetables

in the preceding 24 hours were green beans (13%), cauliflower, beetroot, and spinach (10% respectively).

These findings indicate that children are not consuming a variety of vegetables. For instance, the reported data states green vegetables like spinach (10%) and green beans (13%) as the least consumed vegetables. This is concerning considering that vegetables are nutrient-dense and provide several micronutrients needed for growth and development (Naudé, 2013). Thus, increasing the consumption of a wide variety of vegetables is important to ensure that the micronutrient needs of children are met.

Lack of dietary diversity can increase the risk of insufficient micronutrient intake, playing a role in underweight, stunting and micronutrient deficiencies (Naudé, 2013). Moreover, orange and green vegetables are high in carotenoids which the body converts into vitamin A (Slavin & Lloyd, 2012). Vitamin A is important for growth and development. Globally, 33.3% of preschool aged children are vitamin A deficient (Faber *et al.*, 2014). Due to the favourable responses on carrot consumption, further investigation involving biochemical markers of vitamin A may reflect sufficient vitamin A levels in these children.

The parents' reported that vegetable intake for the children in the study appeared to be reminiscent of the reported vegetable consumption of children in South Africa (Faber *et al*., 2013). In a study in KwaZulu-Natal, 400 caregivers of randomly selected grade 6 and 7 learners and 2- to 5-year-old children in a household reported that the most frequently consumed vegetables were onion, tomato and carrot (Faber *et al*., 2013). Vegetables that were never consumed by most of the households (>80%) were broccoli, cauliflower, mushrooms, and gem squash. On the other hand, Naudé (2007) reported green leaves (marog, amaranth, beetroot, pumpkin), cabbage and pumpkin/butternut/squash (hubbard) as the three most frequently consumed vegetables in children 12 to 108 months old in South Africa.

The consumption results indicated that, on day one of the behavioural intervention, children consumed more carrots (75.1%) than green beans (55.5%). This reflects the teachers' and parents' observations of more frequent carrot intake than green beans, which could also illustrate that children had a preference to carrots either due to familiarity or preference also that carrots are naturally sweeter in taste. Parents

reported that carrots (65%) were amongst the most consumed vegetables in the preceding 24 hours.

Similarly, teachers' observations of vegetables packed for children's morning snack or lunch reported carrots (82%) as mostly packed.

There are some cases where the parent's reported data did not reflect the teachers' observations. For instance, parents reported that the frequency of cucumber consumption in the preceding 24 hours was 42%, while teachers observed that cucumber was the most packed vegetable (91%) for the children's morning snack or lunch. This could indicate dietary recall bias (Naska *et al*., 2017) in that parents only reported on what their children consumed at home and not necessarily what they packed for school. Also, teacher might have recalled packed lunches of specific children better than for other children. Reporting on behaviour of a group would therefore be biased in that way.

To determine whether children were happy to eat their vegetables, parents were asked in the self-administered questionnaire to describe the challenges they experienced when offering children vegetables. Only 42% of the parents stated that their children were happy to eat their vegetables. More than half of the parents (n=16) reported that their children were not happy to eat their vegetables. Of these 16, three responses were chosen as the most descriptive of the challenges they faced. The first descriptive response from the parents was that their child 'likes some of their vegetables and others not' (31%). The second was that the child 'does not like to eat vegetables' (31%). The third was that the child 'dislikes the taste and texture of the vegetables' (19%). This data contributes to a better understanding of the challenges parents face when offering their children vegetables. Humans by nature have a dislike of bitter tastes (Duffy *et al*., 2010). Some phytochemicals in vegetables contribute to a bitter taste (Poelman *et al.*, 2019). The bitter and at times unwanted taste of vegetables often works as a main barrier in vegetable consumption in young children. Taste preference acts as an important motivation to eat certain foods (Brug *et al.*, 2008). Also, taste, pleasure, individual cognitions, health beliefs etc. have been associated with low vegetable consumption (Appleton *et al.*, 2016). The three main factors that contribute to habitual vegetable intake are individual factors (e.g. demographics, dietary habits, health status, lifestyle and sensory appeal), household factors (e.g.

number of family members and children in the family, marital status and parenting practices) and environmental factors (e.g. food accessibility, food prices and food availability) (Qi Zhang *et al.*, 2011). Since associations between intake and socio-demographic factors were out of the scope of this study, these should be considered when developing interventions for behaviour change.

5.2.3 The effect of a behavioural Intervention on vegetable consumption

It has been suggested by Nekitsing *et al.*, 2018a that repeated exposure interventions produce the best results on vegetable consumption and that sensory learning strategies can have some success. Repeated exposure is important in encouraging children to increase their vegetable intake. The mere exposure theory states that a single exposure is adequate to produce a positive attitude towards a stimulus (Matwiejczyk *et al*, 2018). Thus, repeated taste exposure interventions promote positive acceptance over time. Research evaluating the effect of integrating taste exposure and sensory learning with nutrition education is needed (Nekitsing *et al*., 2018). The impact of repeated exposure can therefore not be ignored, neither can it be excluded from an intervention where consumption is assessed over time.

In this study, repeated exposure was not the intervention under investigation but was inherently applied since the children were exposed to vegetables on each test day (three time points). After three exposures to the carrots and green beans plus the behavioural intervention, intake increased significantly from pre-test to post-test. Figure 5.1 demonstrates the increase in carrot consumption from pre-test (75.1, ±28.3%) to post-test (82.2, ±23.9%). Similarly, green bean consumption increased from pre-test (55.5, ±36.6%) to post-test (62.1, ±35.0%). The behavioural intervention combined with repeated exposure resulted in changes in short-term eating behaviour.

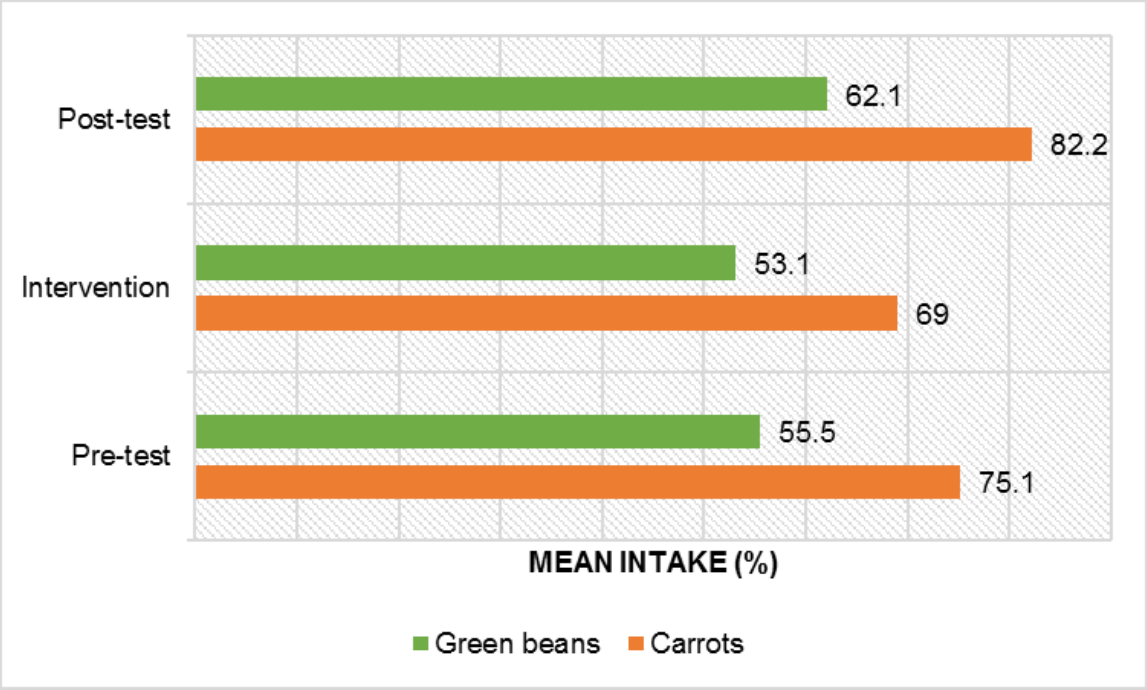


Figure 5. 1: Mean percentage carrot and green bean consumption

While the animated superhero character intervention had a positive outcome on the post-test, it appeared as a distraction on the intervention day (second exposure). There was a lower consumption of the carrots (69.0, ±32.1%) and green beans (53.1, ±36.6%) (see Tables 4.6 and 4.7) on the intervention day compared to the pre-test day since it was a new activity to the participants, and they had not been exposed to the posters and information with the music before. This therefore drew the children's attention away from the provided vegetables. The presence of distractions during mealtimes has been associated with problems with child feeding (Powell *et al*., 2017). Fiese *et al*. (2015) investigated the addition of a continual loud noise as part of an experiment versus the control group with no noise. The study found that children in the experimental group consumed more cookies and engaged in more activity and distractions than the control group. Similarly, distractions from TV viewing have also been associated with a higher energy intake at mealtimes and lower fruit and vegetable intake (Coon *et al.*, 2001). Thus, being distracted during mealtimes may be associated with the risk of obesity and increased consumption of unhealthy foods (Fiese *et al.*, 2015).

The results of the study support the findings of Fiese *et al*. (2015), in that the behavioural intervention was a distraction; hence, there was reduced intake for both vegetables on the intervention day.

However, the effectiveness of the behavioural intervention to promote vegetable consumption in children 3-6 years of age was evident from the pre-test to the post-test where there was a significant increase in carrot consumption (82.2, ±23.9%). Although an increase of green bean consumption was observed (55.5, ±36.6% to 62.1, ±35.0%) this increase was not statistically significant in this small group of children. Therefore, a tailored behavioural intervention employing animated superhero cartoons paired with repeated exposure can be considered as an effective method in promoting vegetable intake in children aged 3 to 6 years in an ECD centre even if it may function as a distraction on the intervention day. The timing at which the intervention is implemented as well as the duration of the intervention, may be important.

The results of a systematic review proposed that behaviour based interventions to promote intake of vegetables and fruits can result in significantly increased consumption (Thomson *et al*., 2011). In this study, the use of a behavioural intervention integrated with the SCT achieved a significant increase in the carrot consumption and an insignificant increase in the green bean consumption. For the green beans, there was a 9% increase ($t(30) = -3.04$, $p=0.005$) from intervention (53.1, ±36.6%) to post-test (62.1, ±35.0%), even though green beans were, according to the parents, one of the vegetables least consumed at home.

At the beginning of the study, 58% of parents reported that their children were not happy to eat their vegetables. The use of fun interventions such as the behavioral intervention used in this study has the potential to change that. The results of this study indicated that a behavioural intervention integrating animated superhero cartoon characters (e.g., Paw Patrol) (inherently combined with repeated vegetable exposure) may be used as an effective tool to promote vegetable consumption in other ECD centers. Further investigation in a larger study population is required to also determine the lasting effect of the intervention.

Since children's eating behaviours are developed in early childhood stage and are associated with food preferences and intake in adulthood, it is important to discover

how children can acquire healthy eating habits from an early age (Ramsay *et al*., 2017). Applying a variety of health promoting strategies is necessary to achieve and sustain vegetable and fruit intake at the recommended levels across the population (Thomson *et al*., 2011).

5.2.3 Social Cognitive Theory (SCT)

The application of the SCT in the behaviour-based intervention promoted greater intake of vegetables in children 3-6 years of age. According to this theory, the individual is influenced by environmental factors which assist the internal decision-making process that is determined by cognitive and behavioural factors. Environmental factors (namely the posters of animated superhero cartoons with vegetables, information, and music) were created to influence the children's decision to consume the vegetables. They were also in an environment where all children received the same vegetables (not their own packed lunchboxes) and were influenced by their social environment. The SCT involves important paths of influence to tailor behavioural targets to fit a participant's knowledge and efficacy level while observing progress that they are making and employing social support to improve learning and motivation (Wong *et al*., 2020). Additionally, a systematic review reported that self-efficacy promoted greater intake than change in intake (Thomson *et al*., 2011). The behavioural intervention in the study was shared in a fun way. This was tailored and suitable for the age group of the children. This study supports the findings of the systematic review in that behaviour-based interventions integrating behavioural theories produce positive results.

5.3 Conclusion

This study demonstrated that a behavioural intervention employing animated superhero cartoons paired with taste/repeated exposure is effective in promoting vegetable intake in children 3-6 years of age at an ECD centre. While carrots were reported to be the most consumed vegetables at home, green beans were reported to be one of the least consumed vegetables. However, through the behavioural intervention, there was a significant increase in consumption from intervention to post-test and pre-test to post-test. The results of this study can positively contribute to interventions to increase the vegetable consumption behaviour of children.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter incorporates a summary of the main findings of the study. The findings are presented in conjunction with the objectives of the study. Additionally, the limitations within the study are examined, followed by with the contributions and recommendations of the study.

6.2 Background

Fruits and vegetables contain a wide variety of vitamins, minerals, antioxidants, phytochemicals and fibres that are vital for health (Liu, 2013). Yet, three quarters of the global population consume less than the minimum recommended quantity of vegetables and fruits (Padrão et al., 2012). Children in particular are not reaching the daily recommended consumption for fruit and vegetables (Nekitsing *et al*., 2018). Since eating behaviours are developed in childhood and follow into adulthood, it is important to address it early in childhood to increase dietary diversity and establish healthy eating behaviours into adulthood.

6.3 Purpose of the study

This research aimed to investigate the effect of a behavioural intervention on vegetable intake in children 3-6 years of age in an ECD centre in Gaborone, Botswana.

Based on the consumption results in response to the behavioural intervention, it can be concluded that a behavioural intervention employing animated superhero cartoons, inherently paired with repeated exposure, can be considered effective in promoting vegetable intake in the short-term and can have the potential of increasing vegetable consumption in children aged 3-6 years in an ECD centre.

A summary of the results of the study is demonstrated in Figure 6.1 below.

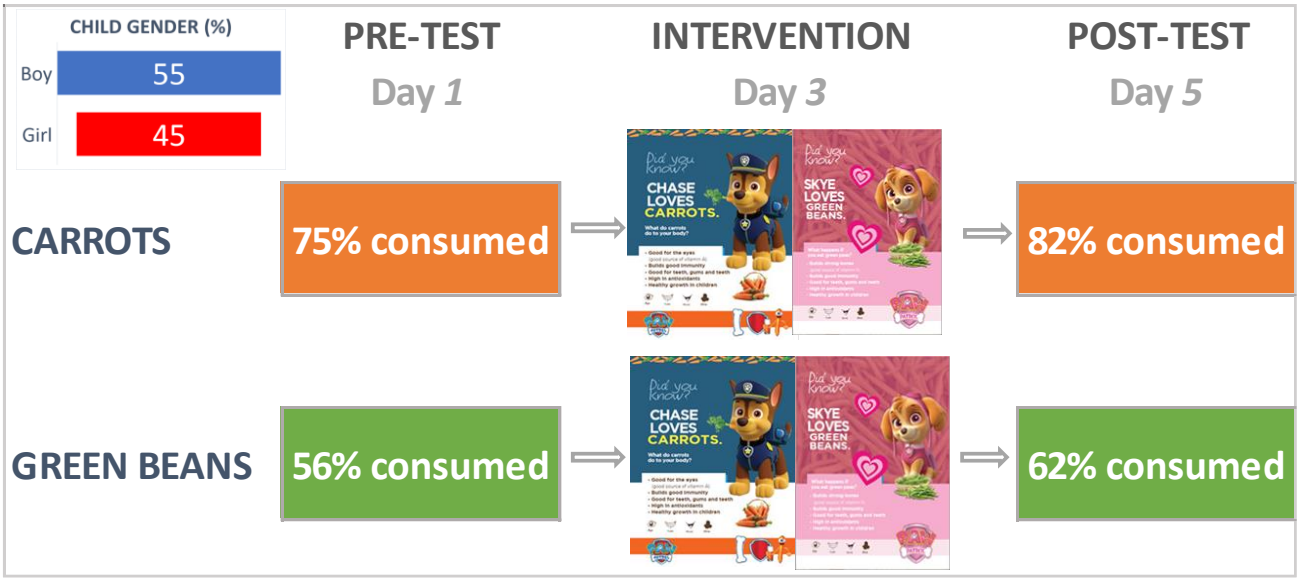


Figure 6. 1: Mean percentage of carrot and green bean consumption on pre-test and post-test days (n=31)

6.4 Synopsis of the findings per objectives of the study

A summation of the findings in conjunction with the objectives are presented below to determine the impact of the study on increasing vegetable consumption in children.

6.4.1 Objective 1

Objective 1 set out to describe current practices in terms of nutrition education and children's lunch box content at the ECD centre in, Gaborone, Botswana.

Schools offer a suitable setting to promote healthy eating behaviours as all children can get the advantage of a nutrition curriculum regardless of their parents' attitudes, skills and food choices (Poelman *et al*., 2019). In this study, it was assumed that the guidelines and suggestions offered by the ECD centre to parents to limit unhealthy drinks in lunchboxes were effective. As such, teachers reported observing no fizzy drinks to be packed in children's lunch boxes.

A similar result could be achieved with nutritional interventions that promote compulsory packing of vegetables in lunchboxes. From the teachers' observations as reported in the self-administered questionnaire, the minority reported observed vegetables in the packed lunchboxes every day.

Children's lunch boxes were described to include unhealthy foods such as flavoured yogurt, cookies, and muffins etc. This is similar to what other studies have identified in schools universally. Children tend to consume more unhealthy, processed foods that are lacking in micronutrients and little vegetables (Prakash, 2013; Raza et al., 2020).

6.4.2 Objective 2

Objective 2: To describe the children's habitual vegetable intake.

While several global studies have established that the general population consumes a diet low in vegetables and fruits, there are limited studies that describe children's habitual intake and that promote nutrition interventions to help increase vegetable consumption in ECD centres in Southern Africa. The findings from the parents' and teachers' responses on self-administered questionnaires demonstrated that children were not consuming a variety of vegetables. Furthermore, most children (58%) were not happy to eat their vegetables. The vegetables that were consumed more frequently were carrots, tomatoes, cucumber, and corn, whereas green beans, cauliflower, beetroot, and spinach were the least consumed. Similarly, parents stated that children were selective about the types of vegetables they would eat, which is a universal challenge. These findings contribute to the limited literature on children's habitual vegetable intake and support the need for an effective behavioural intervention aimed at promoting vegetable intake in children. Also, more information regarding the possible barriers to vegetable intake is required.

6.4.3 Objective 3

Objective 3 was to assess the effect of an on-site behavioural intervention, consisting of a cartoon character of vegetables in conjunction with accessibility, on children's vegetable consumption using the dependent t-test to assess differences pre- and post-test

A quasi-experimental study (pre-test and post-test design) was employed with the advantage that the dependent variable was tested before and after the intervention with an independent variable to determine the effect of the study (Stratton, 2019).

Children were provided with set portions of same-sized carrots and beans on three respective days (pre-test, intervention, and post-test).

Thus, inherent accessibility and repeated exposure can also influence children's intake. Children's vegetable intake was assessed on all three sessions (day 1, 3 and 5) and captured on a data sheet. The direct observation of the children's vegetable intake added to the strength of the study as error in reporting, unlike recall bias. Recall or information bias has been classified as participants' varied responses depending on their ability to remember past events (Althubaiti, 2016).

The study resulted in a significant increase in carrot consumption of 13.3% ($t(30) = -3.99$, $p<0.001$) from intervention (69.0, ±32.1%) to post-test (82.2, ±23.9%), as well as an increase of 7.1% from pre-test (75.1, ±28.3%) to post-test (82.2, ±23.9%), ($t(30) = -2.09$, $p=0.045$). Similarly, there was a 9% increase in green bean consumption ($t(30) = -3.04$, $p=0.005$) from intervention (53.1, ±36.6%) to post-test (62.1, ±35.0%). Thus, a behavioural intervention employing animated superhero cartoons, inherently including repeated exposure, is effective in promoting vegetable intake in children aged 3-6 years in an ECD centre.

6.5 Limitations of the study

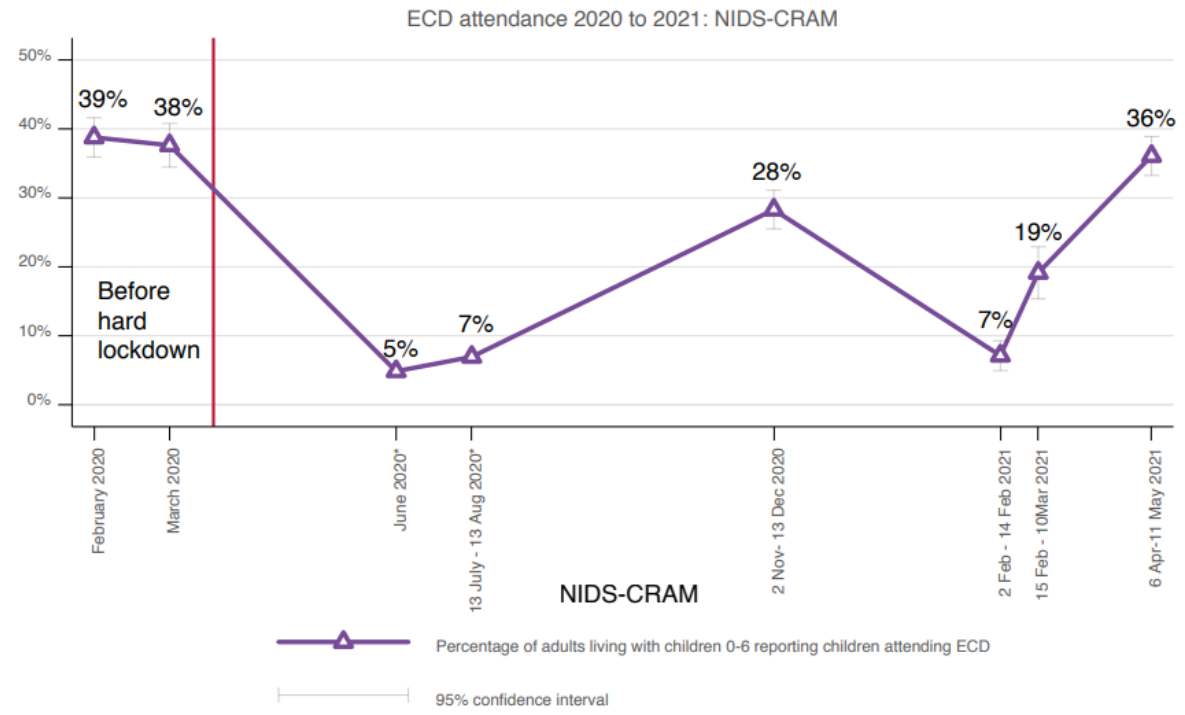
Dipeo Nursery School, which is in the Maruapula suburb of Gaborone, caters for the middle class. Although the ECD centre does have children from other cultural groups, the most dominant cultural group is black African children. Only children within the 3-6-year age group were included in the study findings. Therefore, study results cannot be extrapolated to other ages and population groups.

Due to time and financial constraints, the dietary recall on children's vegetable intake was not validated or quantified and results of children's habitual vegetable intake should be interpreted with caution.

Since children learn by observing others (Social Learning Theory), they may be influenced by peer behaviour, depending on the peers' responses to the provided vegetables/interventions. The Social Learning Theory relates to how people learn new behaviours, values and attitudes by observing others (Schiffman *et al*., 2010).

The Corona virus pandemic (COVID-19) had many unforeseen implications, regulations and lockdowns which meant that research that was intended to be done in March 2020 was only implemented in October 2020. The option to also implement research at other pre-identified nursery schools to enlarge the sample was no longer viable. Furthermore, due to COVID-19, recruitment and parental consent were affected. There was a limited response of only 35 parents from a population of 150 who provided permission for their children to participate in the research study.

The COVID-19 pandemic resulted in a low attendance in ECD centres; therefore, reducing the pool of possible participants. A study conducted in the second half of 2020 in South Africa demonstrated the low attendance in ECD centres. It was reported that, before the pandemic, an estimated 39% of the National Income Dynamics (NIDS) - Coronavirus Rapid Mobile survey (CRAM) respondents residing with children aged 0-6 years had attended an ECD centre curriculum in February 2020. Attendance went down to as low as 7% in July/August 2020 (Figure 6.2) (Wills *et al*., 2021). It can be assumed that the pandemic had a similar impact on the attendance in ECD centres in Botswana.



Source: NIDS-CRAM wave 2, 3, 4 & 5.
Notes: Weighted, clustered, stratified. Sample includes respondents living with children aged 0-6 by wave.

Figure 6. 2: ECD attendance estimates from the NIDS-CRAM waves 1 to 5 and the General Household Survey (Source: Wills *et al*., 2021)

6.6 Recommendations of the study

It is important to consume a variety of colourful vegetables as different types of vegetables offer various health benefits. There is extensive data that indicates that children who consume an adequate amount of vegetables may be protected against a number of illnesses (Knai et al., 2005).

Serving a variety of vegetables as a snack is likely to increase intake. In a study involving 61 children at an ECD centre, children were offered a variety or single type of vegetable(s) (cucumber, sweet pepper, or tomato) and fruits (apple, peach, or pineapple). The results were positive in that there was an increased consumption of both vegetables and fruits (Roe *et al*., 2013). Therefore, serving a variety of vegetables and fruits as a snack at pre-school can be used as a strategy to help children at ECD centres increase and meet the recommended intakes.

Also, there are several other health promoting strategies that can be investigated to support behavioural interventions for a greater reach. Even though this was not the scope of this study, public marketing can be used as an alternative tool to support the behavioural intervention involving animated superhero cartoon characters.

This research study can positively contribute to foundational data for behavioural interventions in young children. There is a need for further investigation into the topic for implementation on a larger scale and long-term effect.

6.7 Contributions of the study

Even though the results of the study cannot be generalised to all ECD centres in Botswana, it can positively contribute to foundational data for nutrition interventions in ECD centres around the consumption of vegetables which may ultimately contribute to children's increased preference of eating vegetables and possibly other healthy foods.

6.8 Conclusion

This study demonstrated that a behavioural intervention employing animated superhero cartoons paired with repeated exposure is effective in promoting vegetable intake in children 3-6 years of age at an ECD centre.

The data also contributes a clearer understanding of how animated superhero characters can be incorporated as part of health promoting interventions.

There are still limited studies on health promoting strategies or interventions to help increase vegetable consumption in children at early childhood development (ECD) centres, especially in Southern Africa. These results demonstrate the effect of implementing behavioural intervention in ECD centres. The results of this study positively contribute to the literature and demonstrate the need for further research on interventions on a larger scale.

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APPENDICES

Appendix 1: Permission letter to conduct a study at Dipeo Nursery School

Leesha St. Quintin
Group Operations Director
Peo Nursery Schools Group & Monkeynastix Botswana
S.R.S. (Pty) LTD & Anchor Free Investments (PTY) LTD
Plot 61542, Maruapula
Tel: 390 9639

REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN NURSERY SCHOOL

Dear Mrs. Quintin

With reference to previous verbal communications, I am a Masters in Consumer Science student at the University of South Africa and the research I wish to conduct for my master's dissertation is titled "*Increasing young children's vegetable consumption: effectiveness of behavioural interventions in an early childhood development centre in Botswana*." This research will be led under the supervision of Dr. Elize Symington (PhD (Nutrition)). The research entails the exposure of 3 to 6-year-old children to two types of vegetables (beans and carrots) on three occasions. Every attempt will be made not to disrupt the school programme, and therefore, the interventions will take place during morning snack times.

I am hereby seeking your consent to conduct the research at Dipeo Nursery School. Upon approval from the Research Ethics Committee at UNISA, I will provide you with a copy of my dissertation proposal which includes copies of the measure, consent and questionnaire forms that will be used in the research process. We aim to start the study mid-March 2020.

Should you require any further information, please do not hesitate to contact me on 76 245 981 or athusini@gmail.com/ 53257642@mylife.unisa.ac.za.

Thank you for your time and consideration in this matter.

Yours sincerely,

Ayanda Gumede

PERMISSION TO CONDUCT THIS STUDY AT NURSERY SCHOOL

I, _____ (name), hereby give permission for Ayanda Gumede to conduct the research at Dipeo Nursery School, Gaborone, Botswana.

…….. ……

Signature Date

Appendix 2: Informed Consent Form

PARENT/GUARDIAN INFORMATION SHEET

Ethics clearance reference number:

Research permission reference number:

09 March 2020

Title: Increasing young children's vegetable consumption: effectiveness of behavioural interventions in early childhood development centres in Botswana

Dear parent/guardian

My name is Ayanda Gumede and I am doing research with Dr. Elize Symington, a Nutrition Lecturer, in the Department of Life and Consumer Sciences towards a Masters in Consumer Science at the University of South Africa. We are inviting you and your child to participate in a study entitled: Increasing young children's vegetable consumption: effectiveness of behavioural interventions in early childhood development centres in Botswana

WHAT IS THE PURPOSE OF THE STUDY?

I am conducting this study to determine the effect of two behavioural interventions on vegetable consumption in children 3 to 6 years of age. This will involve describing the current food practices as well as assessing the effect of praise and use of cartoon characters on vegetable consumption. The findings of the study will contribute towards improving nutrition interventions in early childhood development centres and contribute to children's preference for eating vegetables and possibly other healthy foods.

WHY IS MY CHILD BEING INVITED TO PARTICIPATE?

We have identified Dipeo Nursery School as a study site and your child is within the age range of 3 to 6 years. We are hoping to include at least 150 children at age 3 to 6 years at Dipeo Nursery School.

WHAT IS THE NATURE OF MY CHILD'S PARTICIPATION IN THIS STUDY?

Should you agree to have your child participate in the study, it will involve a questionnaire (attached) that will be handed to parents for completion. Two interventions will be administered to participating children at Dipeo Nursery School. Your child will be presented with a plate of cooked vegetables (green beans and carrots) and will be invited to eat as many as they like on 2 to 3 occasions, depending on the group that they will form part of.

The vegetables will be prepared using a stovetop steaming method. The researcher will prepare the vegetables with the assistance of a fieldworker in a fully equipped kitchen. The following precautions will be applied to ensure food safety standards:

- Hands will be washed with soap under clean running water
- Utensils and surfaces will be washed with soap before and after food preparation
- The fresh vegetables will be rinsed thoroughly
- Carrots will be separated from the green beans during the stovetop steaming.
- Vegetables will be cooked at the right temperature
- Vegetables will be chilled promptly after preparation until served

There are no consequences if they do not wish to eat the vegetables, we will merely observe. Participation in this intervention will require 15 minutes of your child's time in 2 to 3 sessions that will be conducted on separate days, depending on the group that your child will form part of. Strict COVID-19 protocols will be adhered to throughout the research process.

CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?

Participating in this study is voluntary and you are under no obligation to consent to participation. If you decide to take part and allow your child to participate, you will be given this information sheet to keep and be asked to sign a written consent form. You and your child are free to withdraw at any time and without giving a reason and no consequences. Personal data submitted in the questionnaire will be anonymous, withdrawal of the questionnaire by parents can be done at any time.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

Your child may possibly wish to eat vegetables after the study.

Also, no such studies have been conducted in early childhood development centres in Southern Africa. There is limited scientific data that is available on child nutrition interventions to help improve healthy choices. Your child's participation in the study will contribute to determining which nutrition interventions are effective in early child development centres as well as contribute to children's increased preference for eating vegetables. Thus, participation may benefit your child as well as other children.

ARE THEIR ANY NEGATIVE CONSEQUENCES FOR ME IF I PARTICIPATE IN THE RESEARCH PROJECT?

The are no negative consequences for you and your child. You are only expected to complete the short questionnaire and your child will only be exposed to eating vegetables and information about vegetables which they may choose to partake in or not.

WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER AND MY IDENTITY BE KEPT CONFIDENTIAL?

The identity of the child and parent will be protected and treated as confidential. No names or pictures of children will be used in the data. You have the right to insist that your name will not be recorded in the questionnaire and that no one, apart from the researcher and identified members of the research team, will know about your child's involvement in this research. Children's response to the intervention will be given a code number or a pseudonym and they will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings.

Parents answers on the questionnaire may be reviewed by people responsible for making sure that research is done properly e.g. members of the Research Ethics Review Committee. Otherwise, records that identify you as the parent will be available only to people working on the study, unless you give permission for other people to see the records.

HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?

Hard copies of your answers on the questionnaire and assessment of interventions will be stored by the researcher for a period of five years in a secure filing cabinet for future research or academic purposes; electronic information will be stored on a password protected computer. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable. If necessary, hard copies will be shredded and electronic copies will be permanently deleted from the hard drive of the computer using a relevant software program.

WILL I RECEIVE ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?

A documented summary of the results of the study along with nutritional advice and tips on how to make vegetables more palatable will be made available to the school 6 months after data collection.

HAS THE STUDY RECEIVED ETHICS APPROVAL?

This study has received written approval from the Research Ethics Review Committee of the College of Agriculture and Environmental Sciences, Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.

If you require any further information or want to contact the researcher about any aspect of this study, please contact Ayanda Gumede, including 53257642@mylife.ac.za or athusini@gmail.com, +267 76 245 981.

Should you have concerns about the way in which the research has been conducted, you may contact Dr. Elize Symington: syminea1@unisa.ac.za, +2711 471 3438. Contact the research ethics chairperson of the CAES General Ethics Review Committee, Prof. EL Kempen on 011-471-2241 or kempeel@unisa.ac.za if you have any ethical concerns.

Thank you for taking time to read this information sheet and for participating in this study.

Thank you.

Ayanda Gumede

CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ (parent name), confirm that the person asking my child's consent to take part in this research has informed me about the nature, procedure and potential benefits in the information sheet.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had the opportunity to ask questions and am prepared for my child to participate in the study.

I understand that my child's participation is voluntary and that we are free to withdraw at any time.

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I have received a signed copy of the informed consent agreement.

Parent Name & Surname…… (please print)
Child Name & Surname …… (please print)

Participant Signature…….. Date……

Researcher's Name & Surname……Ayanda Thusini Gumede……..……

Researcher's signature……. Date……

Appendix 3: Questionnaire 1

Research title:

Increasing young children's vegetable consumption: effectiveness of behavioural interventions in early childhood development centres in Botswana.

Dear parent,

Thank you for taking the time to share information on the vegetable consumption of your child. This questionnaire is part of a study that will form part of a research project to determine the effect of two behavioural interventions on vegetable consumption in children. Kindly note that you and your child's participation is voluntary, however; this does not in any way release the researchers from their legal or professional responsibility. All the information that you will submit will be treated as highly confidential and your identity will not be made known.

Student:	Ayanda Thusini Gumede	Contact details:	267 76 245 981
Lecturer:	Dr Elize Symington	Contact details:	27 11 471 3438

Section A: Child's eating behaviour

			For office use
Date			
Participant Number			
What is your relation to the child?			A1
Who regularly packs the snack and lunch for the child?	Mother	1	A2
	Father	2	
	Caregiver	3	
In the last 24 hours, which vegetables have your child consumed? You may tick more than one box.	Potatoes	1	A3
	Corn/maize	2	
	Peas	3	
	Tomatoes	4	
	Avocado	5	
	Cucumber	6	
	Carrot	7	

Cabbage	8
Green beans	9
Cauliflower	10
Broccoli	11
Beetroot	12
Spinach	13
Other	14

In the past month, how often did your child eat the selected vegetables in a week? Please provide a response for each vegetable.

	Never	1x/week	2x/week	3-6x/week	Everyday	
Potatoes						A4
Corn						A5
Peas						A6
Tomatoes						A7
Avocado						A8
Cucumber						A9
Carrot						A10
Cabbage						A11
Green beans						A12
Cauliflower						A13
Broccoli						A14
Beetroot						A15
Spinach						A16
Other						A17

Does your child normally eat all the vegetables served on their plate?

Always	1	A18
Often	2	
Sometimes	3	
Rarely	4	
Never	5	

Is your child happy to eat their vegetables?	Yes			No		A19

If no, what are the challenges?

A20

Kindly state if your child has any allergies?

A21

Section B: Demographics (Please tick or write in the relevant box)

			For office use			
What is your gender?	Male	1	B1	Female	2	
What is your child's gender?	Boy	1	B2	Girl	2	
What is the age of your child?			1			B3
What is your child's date of birth?			2			B4
What is your marital status?	Single	1	B5	Married	2	
What ethnic group do you belong to?			Black African		1	B6
			Coloured		2	
			Indian		3	
			White		4	
			Other		5	
What is your highest level of education?			Higher than grade 12		1	B7
			Grade 12		2	
			Diploma / Degree		3	
			Postgraduate		4	

What is your average monthly income?	Unemployed	1	B8
	P 10,000 and under	2	
	P 10,000 - P 10,999	3	
	P 11,000 - P 20,000	4	
	P 20,001 - P 30,000	5	
	P 30,001 - P 40,000	6	
	P 40,001 - P 50,000	7	
	P 50,000 - above	8	

How many children (younger than 18 years) currently live in your household? 1 B9

Thank you very much for participating in this study.

Appendix 4: Questionnaire 2

Research title:

Increasing young children's vegetable consumption: effectiveness of behavioural interventions in early childhood development centres in Botswana.

Dear teacher,

Thank you for taking the time to share information on the vegetable consumption and the current food practices of children at Dipeo Nursery School. This questionnaire is part of a research project to determine the effect of two behavioural interventions on vegetable consumption in children. Kindly note that your participation is voluntary; however, this does not in any way release the researchers from their legal or professional responsibility. All the information that you will submit will be treated as highly confidential and your identity will not be made known.

Student:	Ayanda Thusini Gumede	Contact details:	267 76 245 981
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Section A: Children's eating behaviour

How many children are in your current class? [ ] C1

From your observation in the past week, what type of foods or drinks were packed by parents for snack time? Please provide a response next to each food item by ticking the relevant box.

For office use

	Never	**Rarely**	**Some times**	**Often**	**Every day**	
Fruit						C2
Vegetable						C3
Chips / Crisps						C4
Plain yoghurt						C5
Flavoured yoghurt						C6
Granola bars						C7
White bread						C8
Brown bread						C9

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Sausages						C10
Cookies / Muffin						C11
Crackers						C12
Candy sweets						C13
Juice						C14
Fizzy drink						C15
Water						C16

From your observation, which vegetables are normally included in children's morning snack or lunch? You may tick more than one box

Potatoes	1	C17
Corn	2	C18
Peas	3	C19
Tomatoes	4	C20
Avocado	5	C21
Cucumber	6	C22
Carrot	7	C23
Cabbage	8	C24
Green beans	9	C25
Cauliflower	10	C26
Broccoli	11	C27
Beetroot	12	C28
Spinach	13	C29
Other	14	C30

When vegetables are included in the snack or lunch, do children normally eat all the vegetables?

Always	1	C31
Often	2	
Sometimes	3	
Rarely	4	
Never	5	

Is there any nutritional education offered at the school?

Once a week	1	C32
Once a month	2	
Once a year	3	

Twice a year	4
None	5

Thank you very much for your participation in this study.

Appendix 5: Data collection form

Vegetable Consumption Data Collection Form

Location: ___________________________

Group Number: _____________________

Observer: ___________________________

Instruction: Record the number of food items left on each plate with each assessment. When one or more bites have been taken from a food item, it can be recorded as 0.5.

Participant Number	**Pre-intervention assessment** **Date:**	**Intervention** **Date:**	**Post-intervention assessment** **Date:**
	Carrots - Beans -	Carrots - Beans -	Carrots - Beans -
	Carrots - Beans -	Carrots - Beans -	Carrots - Beans -
	Carrots - Beans -	Carrots - Beans -	Carrots - Beans -
	Carrots - Beans -	Carrots - Beans -	Carrots - Beans -
	Carrots - Beans -	Carrots - Beans -	Carrots - Beans -
	Carrots - Beans -	Carrots - Beans -	Carrots - Beans -
	Carrots - Beans -	Carrots - Beans -	Carrots - Beans -
	Carrots - Beans -	Carrots - Beans -	Carrots - Beans -
	Carrots - Beans -	Carrots - Beans -	Carrots - Beans -
	Carrots - Beans -	Carrots - Beans -	Carrots - Beans -
	Carrots - Beans -	Carrots - Beans -	Carrots - Beans -