South African dietitians' practices and perceptions regarding food exchange lists, as part of the food exchange system, in the nutrition care process

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DECLARATION

I, Desiré Brand, declare that the Master's Degree research dissertation or interrelated, publishable manuscripts/published articles, or coursework Master's Degree mini-dissertation that I herewith submit for the Master's Degree qualification, MSc Dietetics at the University of the Free State is my independent work, and that I have not previously submitted it for a qualification at another institution of higher education.

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LIST OF ABBREVIATIONS

ADA	American Diabetes Association
ADSA	Association for Dietitians in South Africa
AIDS	Acquired immunodeficiency syndrome
AND	Academy of Nutrition and Dietetics
DA	Dietary analysis
DAEK	Dietary assessment and education kit
DIP	Dietetics-Nutrition is a Profession
DM	Diabetes mellitus
e-DIA	Electronic dietary intake assessment
FEL	Food exchange list
HIV	Human immunodeficiency virus
HPCSA	Health Professions Council of South Africa
HSREC	Health Sciences Research Ethics Committee
ICDA	International Confederation of Dietetic Associations
ICFC	Interdepartmental Committee on Food Composition
MAFF	Ministry of Agriculture, Fisheries and Food
NCD	Non-communicable diseases
NCP	Nutrition care process
NIRU	Nutritional Intervention Research Unit
POPI	Protection of Personal information act

SAFCoD	South African Food Composition Data committee
SAFDAG	South African Food Data Advisory Group
SAFOODS	South African Food Composition Database System
SAMRC	South African Medical Research Council
UFS	University of the Free State
UK	United Kingdom
USA	United States of America
USPHS	United States Public Health Service
WHO	World Health Organization

GLOSSARY

Dietitians are health care professionals specialising in the field of nutrition (McClinchy et al., 2015:65).

A **food exchange system** encompasses the use of food exchange lists, in written or electronic format, along with the calculation of the dietary prescription and distribution of exchanges, i.e. for dietary assessment, meal planning, and counselling.

A **food exchange list (FEL)** is a list of foods commonly consumed by a specific population, that are classified based on similar energy and macronutrient value per serving size, thereby enabling the exchange of foods within the same food group (Wheeler et al., 2008:884).

An **electronic food exchange list** is a food exchange list that will automatically calculate the number of food exchanges, either from a diet history or from the nutrition prescription calculated.

The **nutrition care process (NCP)** is a standard systematic approach which assists dietitians with the application of evidence-based practice by providing a framework of methods and outcomes to guide practice and policy (Swan et al., 2017:2003; Hammond et al., 2014:1893).

Dietitians' **practices** in this study will refer to the integration and application of knowledge and skills (HPCSA, 2018: online; International Confederation of Dietetic Associations (ICDA), 2010:online).

Dietitians' **perceptions** in this study will refer to how something is understood based on the interpretation of past experiences, thereby taking into account views and opinions (Martin, 2007:169).

Ethnicity in this study will refer to culture, language and religion, which impacts dietary food patterns and indigenous foods used by a specific population group (Creswell, 2007:71; Dekker et al., 2015:1; Beyers, 2017:1; Rashid et al., 2018:9; Brown, 2019:11).

SUMMARY

The nutrition care process (NCP) is a standardised method to apply nutritional therapy, followed by dietitians to promote evidence-based practice. While various tools can be used by dietitians as part of the NCP, the decision to use a certain tool is based on relevance, convenience, and trustworthiness. As food exchange lists (FELs) can be used in multiple phases of the NCP, and in light of the significance of targeted nutrition therapy and the appropriate use of tools on the nutritional outcome, it is essential to describe dietitians' practices and perceptions regarding the use of FELs as part of the NCP. Particularly, as limited literature is available on the use of FELs by dietitians in practice, especially in South Africa, where population specific FELs are lacking.

This cross-sectional survey aimed to determine South African dietitians' practices and perceptions regarding the use of FELs as part of the NCP. All dietitians and community service dietitians residing in South Africa who were registered at the Health Professions Council of South Africa (HPCSA), were eligible to participate in this study. Dietitians' socio-demographic information and practices and perceptions regarding the use of FELs within the NCP were determined using an online survey, created with Evasys Software®. The link to the survey was shared through e-mail newsletters to Association for Dietitians in South Africa (ADSA) members and on *Dietetics-Nutrition is a Profession (DIP)* and *Dietetic Services* Facebook pages. The survey was open for completion for a duration of two months, from February to April 2020.

Dietitians in the current study were mainly female (96.2%; n = 126), with the greater proportion of dietitians being between 25-30 years of age (42.8%; n = 56), speaking Afrikaans (53.4%; n = 70) or English (50.4%; n = 66) as a home language, practising for one to four years post community service (34.4%; n = 43), based in Gauteng (29.8%; n = 39), and employed in private settings (53.4%; n = 70). Dietitians in South Africa are using FELs for different purposes in the nutritional management of various population groups, throughout all phases of the NCP, although 67.7% of dietitians applied FELs in dietary counselling and 92.1% in meal planning as part of the NCP. More dietitians employed in private settings used FELs (86.3%) compared to

government (55.3%) or tertiary education/ research/ pharmaceutical sectors (64.7%). This significant association may partly be ascribed to a greater proportion of dietitians who self-designed FELs in private settings (42.5%), which appeared to have been associated with dietitians' perceived knowledge of FELs. Also, a significantly larger proportion of dietitians employed in government settings compared to private practices considered patients' language (25.0%; 5.8%) and literacy level (92.9%; 67.3%) in the decision to provide patients with FELs. Overall, 78.7% of dietitians obtained FELs from universities and most FELs currently in use have been updated in the past five years. Even so, the greater proportion of dietitians (46.6%) reported the lack of South African specific foods as the main reason why FELs are due for an update. Dietitians acknowledged the importance of population-specific FELs with the majority (85.3%) advocating for FELs that are specific to various ethnic groups, mainly cultural (61.9%) and language groups, as well as different literacy levels (65.4%), mostly grade 8-9 level. While a smaller percentage (39.7%) indicated that FELs should be adapted for different religions, the majority (68.3%) reported that vegetarianism / veganism should be considered. Adapting FELs according to socio-economic status was not perceived as essential to most dietitians. Majority of dietitians recommended FELs should be adapted for different stages of the life cycle, especially given the lack of resources on portion sizes in paediatric patients. Given the convenience of use, dietitians reported using alternative tools to the FELs, but also supported the idea of an electronic FEL. Main concerns affecting the use of health applications, comprised dietitians' doubts about accessibility, ease of use, trustworthiness and costs involved.

The use of a comprehensive FEL that is relevant and evidence-based, which dietitians find convenient to use, may improve nutritional outcomes in dietetic practices and promote the dietetics profession.

Key terms: Food exchange list (FEL); nutrition care process (NCP); meal planning; dietary analysis; dietary assessment tool; dietitians' practices and perceptions; South Africa; population-specific; health application; food composition

CHAPTER 1: INTRODUCTION TO THE STUDY AND PROBLEM SETTING

1.1 Introduction

The nutrition care process (NCP) is a standard systematic approach assisting dietitians, who are health care professionals specialising in the field of nutrition, with the application of evidence-based practice by providing a framework of methods and outcomes to guide practice and policy (Swan et al., 2017:2003; McClinchy et al., 2015:65; Hammond et al., 2014:1893). As the foundation of the NCP, nutritional assessment comprises an accurate estimation of dietary intake by using various methods, either alone or in combination (Vila-Real et al., 2018:1012; Cederholm et al., 2017:56 Bonilla et al., 2016:79; Bueche et al., 2008:1114). McCance and Widdowson (1940:378) reported that detailed information on the chemical composition of food is essential in the management of nutrition in health and disease. This is especially true, as nutrient values interpreted in light of specific standardised criteria allow priority areas to be addressed, which is known to be an effective nutritional management approach (Kane et al., 2017:7; Mitchell et al., 2017:1942; Phing, 2017:67; Bonilla et al., 2016:77, 80; Forster et al., 2016:96; Duffrin et al., 2015:127; Bueche et al., 2008:1114).

As part of the first step in the NCP, dietary analysis (DA) requires measurements from an individual's diet history to first be converted to suitable formats using the South African food quantity tables, after which the nutrient values are calculated from food composition databases (South African Medical Research Council (SAMRC), 2018:online). Chemical analysis is the golden standard used in nutrient analysis; however this is not always economically feasible, hence the wide use of estimated nutrient values calculated from food composition tables and conversion factors (Wolmarans & Danster, 2008:311; Schakel et al., 1997:102; Whiting & Leverton, 1960:815). Seeing as dietary habits and indigenous foods consumed by a population, the prevalence of nutrient deficiencies, disease states, and research concerns specific to a certain country, are taken into account when compiling a food composition database, a country-specific database is warranted (Vila-Real et al., 2018:1019; SAMRC, 2018:online; Wolmarans & Danster, 2008:309). As electronic databases display various advantages over printed versions, the South African food composition

tables were made available on the South African Food Composition Database System (SAFOODS) website in 2010 (SAMRC, 2018:online; Church, 2006:18). Due to advancements in technology and research, DA has become quicker, easier and much more detailed than initially described by Hawley (1929:5).

Apart from the original food composition tables, other products such as dietary analysis software and food quantity tables, that are based on or related to food composition databases, are available and can be used in DA (Church, 2006:18). The most commonly used dietary analysis software in South Africa is 'FoodFundi' and 'Foodfinder', which first became available in 1992 (SAMRC, 2018:online; Vila-Real et al., 2018:1014; Wolmarans et al., 2009:59; Wolmarans & Danster, 2008:309).

The food exchange list (FEL) contains information on portion sizes and it is often used as a dietary assessment tool, similar to food composition tables, to estimate energy, macronutrient, and even in some instances, certain micronutrient values from a diet history (Kimura et al., 2018:183; Russolillo-Femenías et al., 2018:2029; Cade, 2017:276; Cho et al., 2011:174; Fadupin, 2009:15; Geil, 2008:282). Seeing as DA informs dietary intervention to some extent, the same tools, particularly FELs, are often used in the nutrition assessment and intervention phases of the NCP, as part of the food exchange system (Swan et al., 2017:8; Wheeler et al., 2008:888; Wheeler et al., 1996:1167). Although the literature on the use of FELs by dietitians is limited, Marques-Lopes et al. (2018:1161) and Cho et al. (2011:175) confirmed that dietitians use FELs in dietary counselling. Additionally, a Nigerian FEL was developed to simplify counselling and also to assist with developing meal plans from nutrition prescriptions (Fadupin, 2009:15,18).

The FEL is well known for its use in the treatment of overweight and diabetes mellitus (DM), and seeing as the prevalence of both these conditions and their comorbidities continue to rise, new disease-specific lists are being developed (Khan et al., 2017:1276; WHO, 2017:31; Spires et al., 2016:36). However, the use of FELs is not limited to non-communicable diseases (NCDs), but can also be applied to the following areas: dietary management of healthy individuals in various life cycles (e.g. children; pregnancy; lactation); ensuring adequate intake while following a restricted (e.g. vegan; allergies; inborn error of metabolism) or modified (e.g. dysphagia) diet; or, in the management of malnutrition (e.g. micronutrient imbalances; underweight) (Menal-

Puey et al., 2019:2; Russolillo-Femenías et al., 2018:2029;. Khan et al., 2017:1276; Marques-Lopes et al., 2017:9; Ong et al., 2014:186).

Apart from the aforementioned influences, indigenous foods used by specific communities is another contributing factor to the development of population-specific FELs (Cade, 2017:276; Khan et al., 2017:1276). Dietitians often need to incorporate meals or products into the FEL using recipes or nutrition labels, as FELs and food composition databases, the source on which the FEL is based, does not contain all food items on the market. As a result, many countries have started to develop population-specific FELs (Khan et al., 2017:1275; Marques-Lopes et al., 2017:1; Lim et al., 2012:560; Djuric et al., 2008:2061). Besides the renal FEL, South Africa does not have a standardised population-specific FEL, thus leaving South African dietitians with unstandardised, possibly unsuitable tools; or more complicated and time-consuming methods to DA and meal planning (Kirkpatrick et al., 2017:281; Fadupin, 2009:15).

According to Hawley (1929:16), quicker methods, such as the use of FELs could save up to 42.0% time. However, whether this still holds true, considering the advancements in technology and resources, is uncertain. In light of the need for less time-consuming methods to nutrition therapy, the use of electronic resources are increasing, especially in developed countries such as the United Kingdom (UK), although the literature on its use in South Africa is limited at this point (McCullough, 2018:1; Pisa et al., 2018:58; Cade, 2017:277; Albar et al., 2016:1679; Carter et al., 2016:2; Hong et al., 2008:121). Bonilla et al. (2015:1) mentioned various types of electronic tools available, including, smartphone applications, cameras, scanners, and internet-based aids. According to Chen et al. (2018:751), health applications can be incorporated into the NCP, particularly given the significant increase in smartphone use, enabling the use of health applications for diet history and analysis (Ambrosini et al., 2018:9; Chen et al., 2018:751). Not only could the use of health applications be more convenient and ensure a reliable diet history, it can also reduce the workload of dietitians, thereby allowing more time to be allocated to counselling (Chen et al., 2018:751; Forster et al., 2016:96). In support of this, more dietitians from developed countries are recommending the use of health applications (83.0 - 84.0%) to patients, and some of these dietitians are also using health applications in practice (57.0 -

62.0%) (Chen et al., 2018:751). On the contrary, Pisa et al. (2018:39) found that African countries do not use electronic tools, despite it being a more convenient, time-efficient system to use, compared to traditional tools (Cade, 2018:76; Albar et al., 2016:1679). Although the availability of health applications, FELs, and electronic-based food composition databases could provide dietitians with the opportunity to simplify nutrition therapy, the literature on dietitians' practices and perceptions regarding the use thereof during various steps of the NCP is limited.

1.2 Problem Statement

The use of tools and methods to research nutrition is well known; however, evidence of methods and tools used by dietitians in practice, as part of the NCP, is limited (Pisa et al., 2018:38; Vila-Real et al., 2018:1012; Bonilla et al., 2016:79; Bonilla et al., 2015:9; Mulligan et al., 2014:1). As literature shows that FELs are not only used in the NCP to estimate energy and macronutrient intake but can also be used during meal planning and counselling, as part of the food exchange system (Kimura et al., 2018:183; Cade, 2017:276; Ong et al., 2014:186; Cho et al., 2011:174; Wheeler et al., 2008:888; Wheeler et al. 1996:1167), it is imperative to assess South African dietitians' practices and perceptions on the use of FELs. Data from this study can therefore be used to improve or adapt the food exchange system used by dietitians as part of the NCP in the South African setting, thereby optimising nutrition care.

1.3 Aim and objectives

1.3.1 Aim

This study aimed to investigate South African dietitians' practices and perceptions regarding FELs, used as part of the food exchange system, in the NCP.

1.3.2 Objectives

The objectives of this study were to:

i. Determine the socio-demographic information of dietitians;

ii. Establish dietitians' practices, the integration and application of knowledge and skills (HPCSA, 2018: online; ICDA, 2010:online) with regards to FELs, used as part of the food exchange system, in the NCP;

iii. Establish dietitians' perceptions, how something is understood based on the interpretation of past experiences, thereby taking into account dietitians' views and opinions (Martin, 2007:169) regarding FELs, used as part of the food exchange system, in the NCP;

iv. Investigate associations between socio-demographic factors and dietitians' practices and perceptions regarding FELs, used as part of the food exchange system, in the NCP; and,

v. Determine the feasibility of an electronic FEL by establishing dietitians' practices and perceptions of health applications.

1.4 The layout of the thesis

This dissertation is divided into six chapters:

Chapter 1: An introduction to the study, explaining the problem statement, aims and objectives.

Chapter 2: A literature review on the use of FELs and health applications as part of the NCP.

Chapter 3: The methodology used for this study.

Chapter 4: The results of the study.

Chapter 5: Discussion of the results.

Chapter 6: Conclusion and recommendations.

1.5 Research team

The research team for this study is described in Table 1.1.

Table 1.1: Research team

Team member	Responsibility
Ms D. Brand	Researcher
Ms L. Robb	Supervisor
Dr E. Du Toit	Co-supervisor
Ms R. Nel	Biostatistician

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Dietitians are health care professionals specialising in the field of nutrition (McClinchy et al., 2015:65). Upon completion of a four-year Baccalaureus (B.Sc.) degree in dietetics, South African dietitians are required to register with the Health Professions Council of South Africa (HPCSA) (Gallagher et al., 2018:4; Hammond et al., 2014:1879). As of 4 August 2020, there were 5262 dietitians registered with the HPCSA, of which 3461 were classified under independent practice, 256 community service and 1545 student dietitians (HPCSA head office, 2020). As per Figure 2.1, the majority of registered dietitians were situated in Gauteng province with the Northern Cape accommodating the lowest number (HPCSA head office:2019).

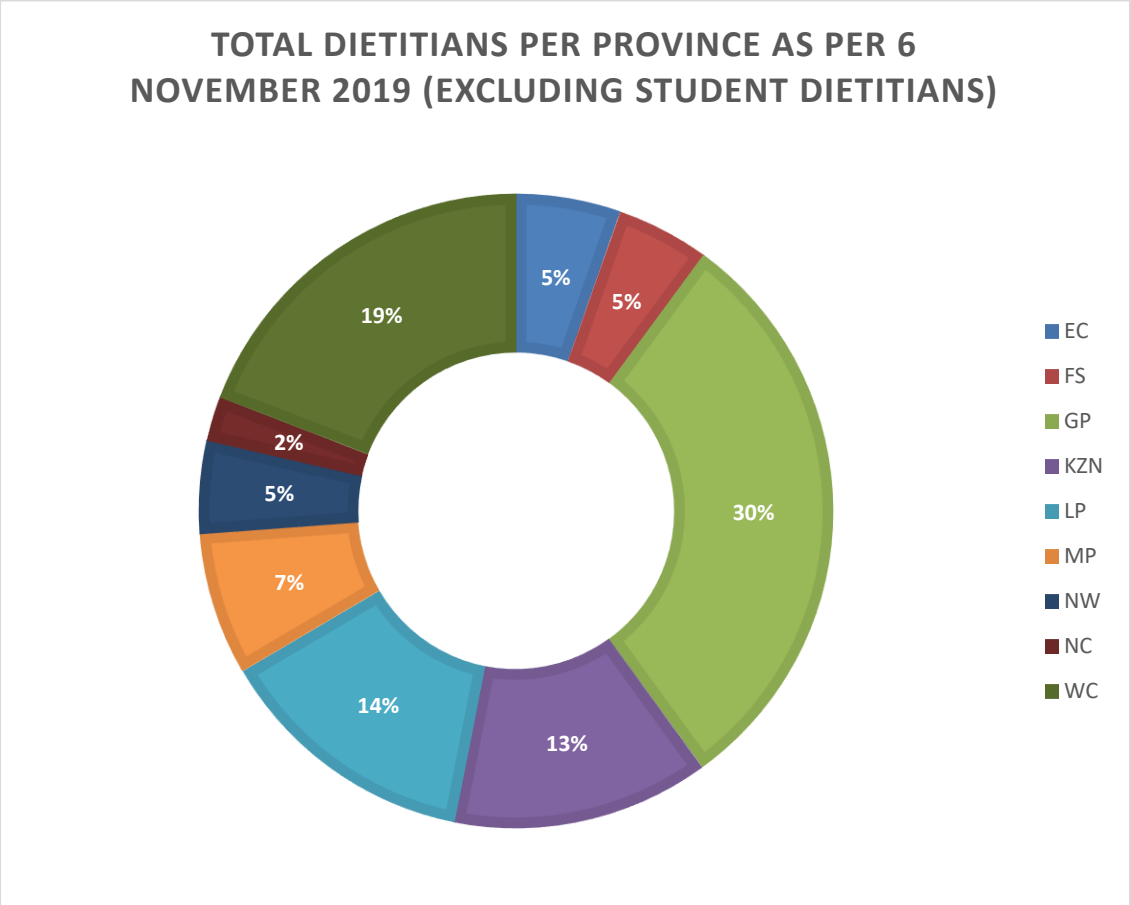

Figure 2.1: Breakdown of registered South African dietitians per province (Source: HPCSA head office:2019).

For registered dietitians it is mandatory to adopt evidence-based practice, defined as the assessment of valid and suitable research and the application thereof, using one's expertise and judgement, while taking into account the context of the research (HPCSA, 2018: online; International Confederation of Dietetic Associations (ICDA), 2010:online). Consequently, the ability of dietitians to recommend appropriate health applications to patients constitutes an expanding proportion of evidence-based practice.

2.2 The nutrition care process

The NCP is a standard systematic approach which assists dietitians with the application of evidence-based practice by providing a framework of methods and outcomes to guide practice and policy (Swan et al., 2017:2003; Hammond et al., 2014:1893). As all essential components for effective nutrition care are incorporated into the NCP, dietitians can apply it to any health care setting (Splett and Myers, 2001:358). The NCP consists of four distinct, interrelated steps including evaluation, identification, management, and monitoring of nutrition-related complications (Figure 2.2) (Swan et al., 2017:2003; Cederholm et al., 2017:62; Bonilla et al., 2016:77; McClinchy et al., 2015:65).

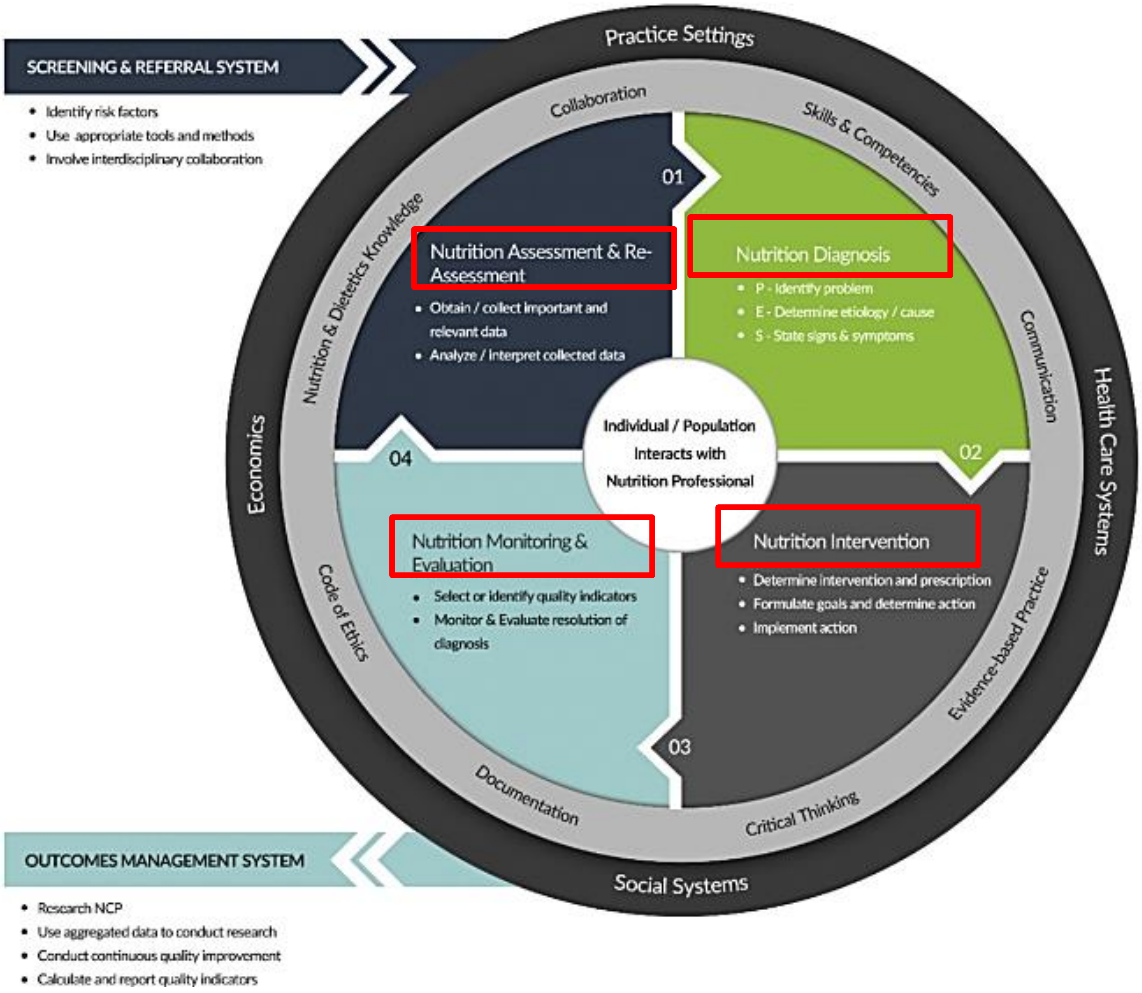

Figure 2.2: Nutrition care process (Source: Swan et al., 2017:6)**.**

The Hammond model, on which the NCP is based, was developed in 1970 to provide a visual diagram for dietetic students of the relationship between various components of nutrition care, by integrating practice and theory (Hammond et al., 2014:1879). Since 1970 the Hammond model evolved with the growing dietetic profession (Hammond et al., 2014:1893). In 1994 Gates and Meyer investigated the need for an efficient process of nutrition care that is patient specific (Gates & Meyers, 1994:81). With the input from focus groups, consisting of approximately 40 registered dietitians based at four different locations, the Health Services Research (HSR) Task Force formed by the American Dietetic Association developed the NCP model in 1999 (Splett & Myers, 2001:357). The Academy of Nutrition and Dietetics (AND), previously known as the American Dietetic Association, first implemented the NCP in 2003 (Swan et al., 2017:2003). The NCP model is updated every five years, and as the Hammond- and

NCP model are very similar, Hammond was invited to provide input to the NCP update in 2008 (Hammond et al., 2014:1891; Swan et al., 2017:2003).

2.2.1 Nutritional assessment

Nutritional assessment, the foundation of the NCP, is a continuous process comprising the gathering, documentation and interpretation of medical, physical, social, psychological, anthropometrical, biochemical, and dietary information (Figure 2.3) (Cederholm et al., 2017:56; Bueche et al., 2008:1114).

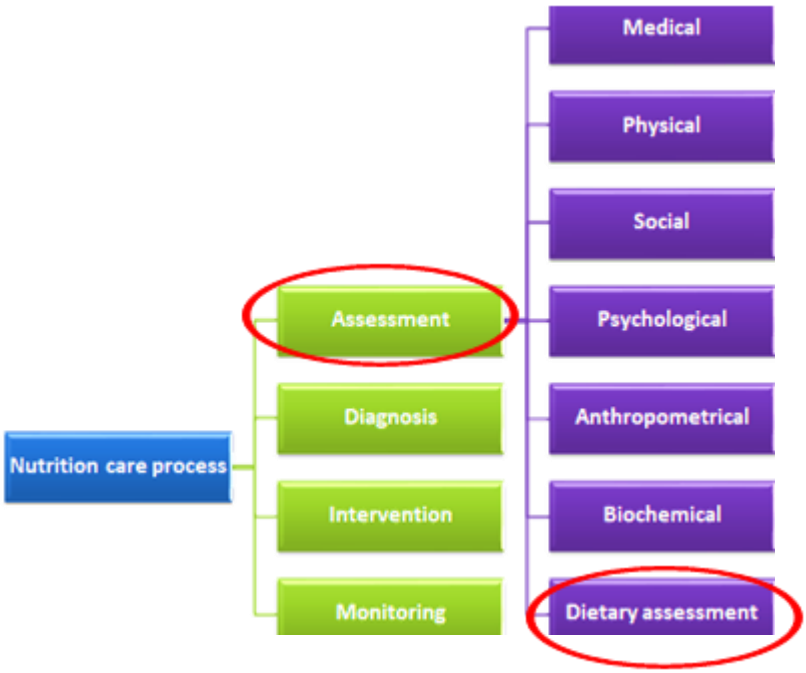

Figure 2.3: Dietary assessment as part of the nutrition care process (Cederholm et al., 2017:56).

The first step of dietary assessment (Figure 2.3) comprises an accurate estimation of dietary intake by incorporating a variety of methods (Vila-Real et al., 2018:1012; Bonilla et al., 2016:79; Bueche et al., 2008:1114). Methods used by 90.0% of a sample of dietitians (n=73) from Canada included weighed or estimated food records (82.0%), usual dietary intake (77.0%), 24-hour recall (60.0%), and food frequency questionnaires (33.0%) (Bonilla et al., 2016:80). In South Africa the 24-hour dietary recall and food frequency questionnaires are predominantly used, however, it should be noted that this is mainly representative of the tools or methods used in epidemiology studies (Vila-Real et al., 2018:1012; Bonilla et al., 2016:80; Wolmarans et al., 2009:59). Therefore, even though dietary assessment tools or methods used in

research studies are well known, research on tools or methods used by dietitians in practice, both globally and in South Africa are limited (Bonilla et al., 2016:77).

As seen in Figure 2.4, units of food intake from a diet history are translated into nutrient values using tools based on food composition databases (Wolmarans et al., 2009:65; Bueche et al., 2008:1114). Additionally, nutrient values in food composition databases are based on the analysis of food commonly consumed by a population, which has been determined by diet history (Wolmarans et al., 2009:59). Hence, to fully understand DA, it may be reasoned that DA is a process in itself.

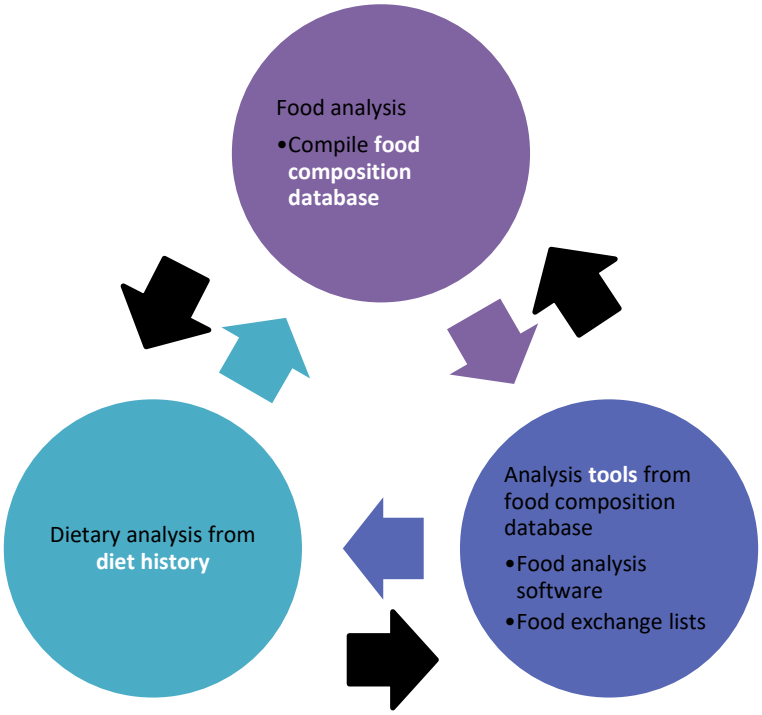

Figure 2.4: Dietary analysis as a hypothetical process.

Often diet histories convey information on food intake in household measures, which first need to be converted to suitable formats for nutrient analysis to be completed. The South African food quantity tables, first published in 1986 and last updated in 2018, can be used for this purpose (SAMRC, 2018:online).

McCance and Widdowson (1940:378) reported that detailed information on the chemical composition of food is essential in the management of nutrition in health and disease. This is especially true, as nutrient values interpreted by considering specific standardised criteria, assist with targeted nutrition therapy, which has proved to be an

effective nutritional management approach (Kane et al., 2017:7; Mitchell et al., 2017:1942; Phing, 2017:67; Bonilla et al., 2016:77, 80; Forster et al., 2016:96; Duffrin et al., 2015:127; Bueche et al., 2008:1114).

Apart from dietitians individualising dietary counselling based on DA, several other processes make use of DA to guide decision making, including the formulation of ration scales for emergency food parcels; providing nutritional training; epidemiology researchers compare disease risk and prevention with certain nutrient consumption; the food industry design food labels; food service managers from various settings plan menus; recipe and product design or formulation; establishing serving sizes from recipes; policy-making with regards to consumer safety and food trading; and, improving food supply (Seljak et al., 2018:2; Vila-Real et al., 2018:1002; Duffrin et al., 2015:127; McClinchy et al., 2015:65; Church, 2006:15; Greenfield & Southgate, 2003:1; Schakel et al., 1997:102).

2.3 Food composition databases

Different methods of DA exist, of which the use of food composition databases is one (Seljak et al., 2018:2; Carter et al., 2016:2; Carter et al., 2015:4028).

2.3.1 History of the food composition database

Interest in food composition started as early as 1818 when the nutritional content of food provided to prisoners was investigated (Church, 2006:15). However, food composition tables were first developed in 1878 by Konig in Germany, followed by the more widely known tables developed in 1896 in the United States of America (USA) by Atwater and Woods (Church, 2006:16; McCance & Widdowson, 1940:378). The Atwater tables were updated in 1906 by Atwater and Bryant to include the fibre content of food (Church, 2006:17). The Atwater tables contained information on the energy, water, nitrogen, ash, and fat values of almost 2600 commonly used foods in the USA (Church, 2006:17). The protein content was calculated by multiplying nitrogen by 6.25, and the carbohydrate percentage was calculated by subtracting the total percentage of water, protein, ash and fat from 100 (Finglas et al., 2015:6; Church, 2006:16). In 1921, Plimmer developed the first British food composition tables, consisting of 900 foods, as a result of food shortages in World War I (Church, 2006:16).

The carbohydrate content of food was further investigated in 1926 and published in 1929 by Lawrence and McCance, who had a special interest in DM, especially as insulin first became available in 1922 (Church, 2006:16). The British Medical Research Council supported McCance's research proposal, as the carbohydrate values used from the more comprehensive Atwater tables only applied to raw food and the values included fibre, which at that time was found to be of less importance in the management of DM (Finglas et al., 2015:9). Since the 1920's, McCance's research, with the assistance of several research partners, led to the first edition of 'The composition of foods' published in 1940 (Church, 2006:16). The second edition was published in 1946 followed by the third edition in 1960, as a result of the change in food availability during and after World War II (Finglas et al., 2015:xi). In 1966, the Interdepartmental Committee on Food Composition (ICFC), consisting of the SAMRC, the Ministry of Agriculture, Fisheries and Food (MAFF) and the Laboratory of the Government Chemist, took over the responsibility of updating the food composition tables (Finglas et al., 2015:xi). The ICFC, led by Southgate as the chairman of the panel, published the fourth edition in 1978, as a result of advancements in butchery methods and the associated increase in processed food availability (Church, 2006:17). After the fifth edition, the Food Standards Agency took over the responsibility of updating the UK food composition tables (Church, 2006:17).

In 1970 South African researchers started investigating food composition and the first edition of the South African food composition tables, containing 31 nutrients, was printed in 1981 (Figure 2.5) (SAMRC, 2018:online; Wolmarans & Danster, 2008:308). The food database was updated in 1986 followed by another update in 1991; however, supplements on fatty acid and amino acid data, shortly followed each update in 1987 and 1992 respectively (Wolmarans & Danster, 2008:308). During this time, the Nutritional Intervention Research Unit (NIRU) was responsible for compiling the database (Wolmarans & Danster, 2008:308). However, in 1995 the NIRU formed the South African Food Composition Data (SAFCoD) committee, who worked in collaboration with other stakeholders in an attempt to expedite the growth of the South African food composition database (Wolmarans & Danster, 2008:308). Also, the electronic management system, South African Food Data System (SAFOODS) was designed for improved documentation and organisation of data (Wolmarans & Danster, 2008:308). The vegetable and fruit group were updated in 1998, followed by

meat, milk and eggs in 1999 (SAMRC, 2018:online). Seljak et al. (2018:2) stated that due to lifestyle changes and changes in food sources, periodic revision of a food composition database is necessary. For this reason, the South African Food Data Advisory Group (SAFDAG) was launched in 2008, to work in collaboration with the Agriculture Research Council, Department of Health, Association of Dietetics South Africa (ADSA), the South African Bureau of Standards, Consumer Goods Council of South Africa, the South African Association for Food Sciences and Technology, researchers from tertiary teaching institutions, and members of the food industry, to ensure that the South African database is kept up to date (SAMRC, 2018:online; Wolmarans & Danster, 2008).

In 2010 a summarised version of the food composition tables was published, followed by the fifth edition in 2017. Currently, the South African food composition database consists of 36 nutrients, 16 food groups, and a total of 1667 food items (SAMRC, 2018:online).

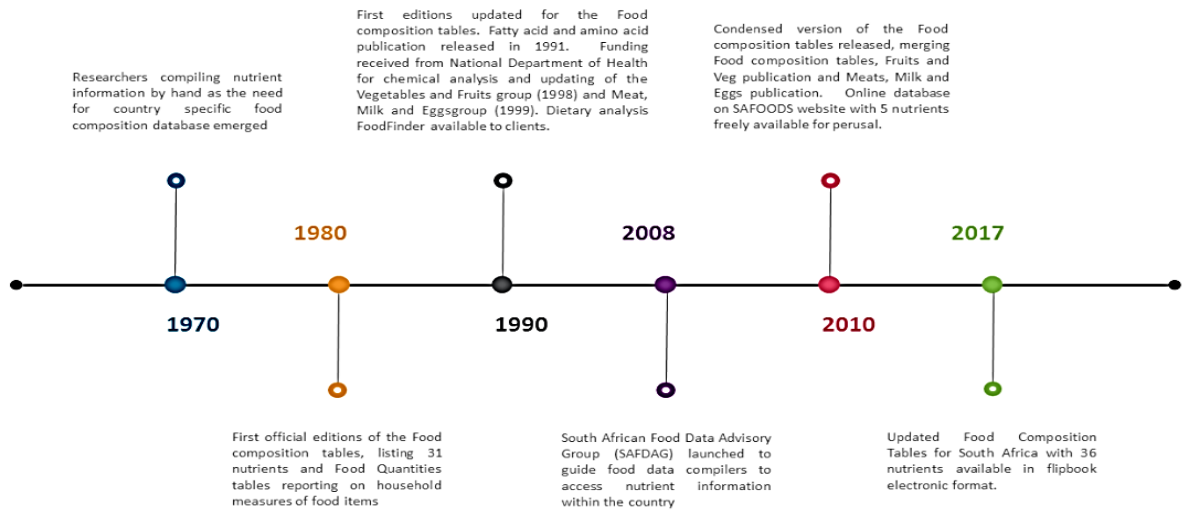

Figure 2.5: The history of the South African food composition tables (SAMRC, 2018:online).

2.3.2 Methods of obtaining nutrient values

The South African database makes use of various methods to obtain nutrient values and is representative of 44.0% South African data, 24.0% USA, 6.0% UK, and 26.0% of data calculated from recipes (SAMRC, 2018:online). Due to different methods or

reference sources used, it is recommended that this be taken into account when using food composition tables (Wolmarans & Danster, 2008:312).

The nutrient values in food composition databases can be determined using methods other than chemical analysis, which is not always possible due to the high costs involved (Schakel et al., 1997:102). Although chemical analysis is the most reliable method to determine nutrient values, estimated nutrient values can be calculated using food composition tables and conversion factors (Wolmarans & Danster, 2008:311; Whiting & Leverton, 1960:815). However, calculating nutrient values of mixed meals can be challenging, especially when meals are commercially prepared. As for mixed meals prepared at home, not only is a detailed description of food items important, but knowledge on the type of food and preparation methods used by different ethnic groups is also essential (Whiting & Leverton, 1960:817).

Regarding the limitations of nutrient analysis, using different methods, Whiting and Leverton (1960:816) reported that carbohydrates could affect the chemical analysis of fat, whereas food composition tables only represent average values (Wolmarans et al., 2009:66)(Wolmarans et al., 2009b). When comparing chemical analysis with estimates from food composition tables, Whiting and Leverton (1960:818) reported that more than 50.0% of cases resulted in a 10.0% agreement between the two methods for energy (n=378) and protein (n=318) content, while for fat (n=259) a 10.0% agreement was found for only 25.0% of cases. However, more recently Chiplonkar and Agte (2007:229) found a ± 5.0% agreement for energy and macronutrients between the two methods. Furthermore, calculations from food composition databases overestimated the values obtained through chemical analysis with more than 10.0% in 32.0%, 16.0% and 49.0% of cases for energy, protein, and fat respectively (Whiting & Leverton, 1960:819). The higher variability in energy and fat than protein between the two methods could partially be explained by differences in preparation methods of meat. Firstly, food composition tables represent nutrient data on raw, wholesale cuts of meat, whereas chemical analysis is done on cooked or retail cuts of meat. Secondly, heat and the cut of meat would affect the fat, and thus the energy content, more than it would the protein content. Therefore, nutrient values obtained through chemical analysis may be less than values calculated from food

composition tables, further highlighting the importance of detailed product description in food composition databases (Whiting & Leverton, 1960:821).

Likewise, differences in micronutrient values range from 20.0% to 55.0%, with a positive correlation between the number of ingredients in a recipe and the variability (Chiplonkar & Agte, 2007:231). Chiplonkar and Agte (2007:231) concluded that independent of the method used for analysis, the exact micronutrient values cannot be guaranteed due to influences from external factors. Micronutrient losses of 25.0% to 40.0% can be expected depending on the method, time, and temperature of the cooking process (Chiplonkar & Agte, 2007:231). Therefore, to estimate nutrient values from different forms of the same food, retention and yield factors, published in the USA, can be used to account for moisture and nutrient losses that occur in the cooking process (Wolmarans & Danster, 2008:311; Schakel et al., 1997:113). However, to limit differences in nutrient analysis ascribed to external factors, Chiplonkar and Agte (2007:231) recommended the use of standardised recipes. Additionally, the values of nutrients in databases are expressed as the mean or average value of each nutrient analysed per 100 gram (97 - 103 gram) edible material (SAMRC, 2018:online).

2.3.2.1 Nutrient estimation

One method to estimate nutrient values from food composition databases includes calculation from known components of the same product as seen in Table 2.1.

Table 2.1: Nutrient values estimated from other components of the same product (Schakel et al., 1997).

Known component	Nutrient value that can be calculated
Macronutrients	Energy
Nitrogen	Protein (conversion factor 0.65)
Protein, fat, alcohol, ash, water	Carbohydrates
Soluble and insoluble fibre	Total dietary fibre
Retinol, beta-carotene equivalents	Vitamin A

Carotenoids	Beta-carotene equivalents
Alpha-tocopherol equivalents	Vitamin E
Tocopherols, tocotrienols	Alpha-tocopherol equivalents
Single fat source	Fatty acids
Single protein source	Amino acids

Furthermore, nutrient values of multi-component products can be estimated from recipes by adding the nutrient values of all the individual ingredients (Schakel et al., 1997:108). Alternatively, the nutritional information found on labels of commercially prepared products can be converted into nutrient values (Schakel et al., 1997:110). Regarding food products that are fortified or enriched, a country-specific product standard can be used to estimate micronutrients. As opposed to estimated nutrient values, a zero value can be assumed if a product is expected to contain none or an insignificant amount of a specific nutrient (Schakel et al., 1997:111). Another method, known as imputation, entails using the nutrient values of a different, yet similar food product (Wolmarans & Danster, 2008:311). However, when this method is used, the characteristics, environmental factors and processing of the product need to be considered (Schakel et al., 1997:103). Lastly, information from another database can be used, but limitations of this method include the lack of detailed description of products and different meanings associated with product names from various countries (Wolmarans & Danster, 2008:311).

2.3.3 Need for a population-specific database

Several factors influence the nutritional value of food, including, differences in food items, types of species and cultivars, climate, soil composition, agricultural practices, stage of ripeness, methods and conditions under which food is processed, transported, and stored, as well as, fortification of staple food, with varying nutrients and levels of fortification (SAMRC, 2018:online; Vila-real et al., 2018:1018; Wolmarans & Danster, 2008:309).

Cade (2017:276) reported that food composition databases could seem outdated, with limited food sources, often not representative of the latest products on the market or foods that are indigenous to certain communities. Likewise, Wolmarans and Danster (2008:313) pointed out the limited information on indigenous and fast food products in the South African food composition database. Similarly, Vila-Real et al. (2018:1013) reported that African countries either lack population-specific food composition databases or are using outdated databases. However, given the growing food industry and high cost of analysis, databases usually only consist of foods most often consumed by a population group and do not include all food items on the market (SAMRC, 2018:online; Wolmarans & Danster, 2008:309).

Nevertheless, a country-specific database is warranted, seeing as dietary habits and indigenous foods consumed by a population, the prevalence of nutrient deficiencies, disease states, and research concerns specific to a certain country, are taken into account when compiling a food composition database (Vila-Real et al., 2018:1019; SAMRC, 2018:online; Wolmarans & Danster, 2008:309).

2.3.4 Electronic nutritional databases

Compared to printed versions, electronic databases have the advantage of easy access, the process to update data is simpler, and storage space is less limited (Church, 2006:18).

In 1978, the fourth edition of the British food composition tables was the first electronic database available, followed by the USA tables in 1996 (Church, 2006:18). The South African food composition tables were only made available on the SAFOODS website in 2010 (SAMRC, 2018:online).

2.4 Dietary analysis software

Apart from the original food composition tables, other products like nutritional analysis software and food quantity tables, that are based on or related to food composition databases, are available and can be used in DA (Church, 2006:18). The most commonly used dietary analysis software in South Africa is ‘FoodFundi’ and ‘Foodfinder’, which first became available in 1992 (SAMRC, 2018:online; Vila-real et al., 2018:1014; Wolmarans et al., 2009:59; Wolmarans & Danster, 2008:309).

2.5 Research preceding the official food exchange list

Due to advancements in technology and research, DA is quicker, easier, and much more detailed. Previously, analysis of a diet history comprising 45 to 55 food items required between 250 and 350 calculations (Hawley, 1929:5).

In 1918, Hunt was the first to seek a quicker method to estimate the energy and protein value of dietary intake. Consequently, based on the composition and type of products, Hunt suggested that foods are grouped into five main groups including, protein, vegetables and fruit, cereal, bread and other baked products, fatty food, and sweets. Each main group was subdivided, based on the energy concentration of foods within the specific group. Energy and protein values were allocated to each group, and by using weight factors, the analysis of total dietary intake was less time consuming (Hawley, 1929:5). Likewise, Rose developed another method in 1920, however, foods were classified into seven main groups, each with multiple subgroups. Rose's method comprised total energy as well as percentage energy attributed to protein and fat, allowing the estimated carbohydrate value to be calculated (Hawley, 1929:6). It should be noted that carbohydrate content described in these lists refer to available carbohydrate, which is starch and sugar content combined (Caso, 1950:575). Furthermore, a third method was designed, consisting of 10 food groups, to include nutrient values for phosphorus, iron, and calcium content of food (Hawley, 1929:7).

Likewise, in 1947 Caso and Stare (1947:169) identified the need for a simplified method to calculate meal plans specifically for people with DM, focussing on the carbohydrate content of food, that is more practical to implement and nutritionally adequate (Marques-Lopes et al., 2017:1161). A list of foods commonly found in the USA were initially described in household measures and divided into six groups (Table 2.2) (Caso, 1950:575; Caso & Stare, 1947:169).

Table 2.2: Foods grouped according to average macronutrient content per serving size (Caso & Stare, 1947:169).

Food group	Portion size	Carbohydrate (g)	Protein (g)	Fat (g)
List 1: Protein equivalents	28 g	Negligible	7	5
List 2: Vegetables	-	Negligible	Negligible	Negligible
List 3: Vegetables	½ cup	7	2	Negligible
List 4: Fruits	Vary	10	Negligible	Negligible
List 5: Carbohydrate equivalents	Vary	16	3	Negligible
List 6: Fat equivalents	Vary	Negligible	Negligible	4

Foods were grouped according to similarities in macronutrient content, with starches equivalent to one slice of bread; proteins similar to 28 grams (one ounce) of meat; dairy products comparable to one cup of milk; fat equivalents, providing four grams of fat per portion, which was later changed to five grams of fat; and lastly, fruit providing 10 grams of carbohydrates (Caso, 1950:575; Caso & Stare, 1947:171).

Although, the classification of vegetables was more controversial, as some authors who shared the idea of food equivalents have previously subdivided vegetables into either two or three groups, based on the percentage carbohydrate content. However, Caso and Stare (1947:171) classified vegetables with the highest carbohydrate content, like potatoes, corn and legumes, under starches. Thus, leaving two vegetable

groups, namely, group A with limited to no carbohydrates, and group B, providing seven grams of carbohydrates per serving (Caso, 1950:575). Diet histories taken over one year from patients attending a diabetic clinic in the USA indicated that vegetables that comprised 5.0% carbohydrate were consumed more often (54.0%; n=562) compared to vegetables with 10.0% carbohydrate, hence the vegetable group providing 7 gram carbohydrate per serving was created for simplicity (Caso & Stare, 1947:171).

2.6 The food exchange list

The preliminary work by Caso and Stare (1947) and Olmsted (1949), assisted the AND, in collaboration with the United States Public Health Service (USPHS), and the American Diabetes Association (ADA), to develop the first official FEL in 1950 (Russolillo-Femenías et al., 2018:2029; Marques-Lopes et al., 2017:1; Wheeler et al., 2008:883; Wheeler et al., 1996:1168). Ever since, this ADA FEL has been revised five times (1976, 1986, 1995, and 2003) with the latest revision in 2008 (Marques-Lopes et al., 2017:1; Geil, 2008:281).

The 1976, revision focussed on adapting the FEL to make it suitable for meal planning in health and disease (Marques-Lopes et al., 2017:1161). As some authors claimed the FEL underestimated the energy value, Wyse (1979:238) evaluated the first revised FEL for accuracy by comparing nutrient values from the USA food composition database and food labels with the values used in the FEL. Wyse (1979:242) confirmed that the milk group in the FEL (80 kcal) underestimated energy (± 13.5 kcal; 82.4 to 100.1 kcal), and thus suggested that this group be subdivided according to the fat content. The other food groups were in agreement with the nutrient values found in the food composition database, however, it is recommended that dietitians account for routine consumption of foods providing nutrient values of higher-end ranges to prevent a significant underestimation of energy consumption (Wyse, 1979:242). Likewise, Wheeler et al. (2008:886) reported that even foods listed under the ‘free food group’, when consumed often in one day, could add up and contribute to energy intake. However, due to the FEL not being precise but rather using ranges, it was recommended that 50 kcal / day (209.2 kJ) or more can be allocated to the consumption of free foods, with one exchange from the free food group providing less than 20 kcal (83.7 kJ) and less than 5 g carbohydrate (Wheeler et al., 1996:1168).

With the second revision in 1986, averages were published, followed by the third revision in 1995 that included standard deviations and ranges for energy and macronutrients (Marques-Lopes et al., 2017:1). With the third revision in 1995, Wheeler et al. (1996:1178) reported that fast foods and combined food groups were not included in the exchange list as separate groups, seeing as the values can be estimated by adding nutrient values of food items from the existing groups.

Contrariwise, in 2003 Wheeler (2003:894) however stated that wide variations exist between the standard deviations, which is especially significant when foods from different food groups are combined or multiplied. Hence, it is recommended that instead of adding the counterparts of a combined food together, the exchange list should contain groups with nutrient values of the complete food (Wheeler, 2003:894). Therefore, the 2003 update of the FEL involved the expansion of processed food such as canned, frozen, cooked, and fast food, and also expressed food serving sizes in household measures as well as per weight (grams) to assist with meal planning methods (Marques-Lopes et al., 2017:1). According to Wheeler (2003:894), the 2003 version of the FEL comprised nutrient values of approximately 500 foods.

As with previous versions, the USA food composition database and average values from various product brands, obtained from nutrition labels, were used to revise the FEL in 2008 (Wheeler et al., 2008:885). The 2008 revision was grounded on results from a survey, completed by 3088 (22.0%) members of the American Dietetic Association, ADA and the American Association of Diabetes Educators (Wheeler et al., 2008:884).

One of the modifications comprised the change in title to ‘Choose your foods: Exchange list for Diabetes’ after the word ‘exchanges’ was found to be outdated, however, as this was an update and not a new concept, the word exchanges remained in the subtitle (Wheeler et al., 2008:885). Additionally, there were several modifications to the food groups, including, the removal of starches with an added fat group; addition of a group for dairy alternatives; relocating green leafy vegetables to the free food group; subdividing sweets and desserts, fast food, and combination food groups; and, incorporating very lean meat group into the lean meat group (Wheeler et al., 2008:885). Further, a plant-based protein group was added; however, even though the protein content is similar to meat per serving, plant-based proteins also contain

carbohydrates, which should be taken into account during meal planning (Wheeler et al., 2008:886). In the 1995 version, legumes were classified under starch; however, when used as a side dish the protein exchange would not be counted as in the case of vegetarianism, where these foods would be consumed more often and comprise the main meal (Wheeler et al., 1996:1168). Another addition to the 2008 FEL is an alcohol group, containing beverages that provide 100 calories as pure alcohol, which translates to 12 oz (~330 ml) beer, 5 oz (~150 ml) wine, or 1½ oz (~45 ml) distilled spirits (Wheeler et al., 2008:886).

The layout of the latest revision of the FEL comprises a colour coded table format, written at a grade 6 level, containing nutritional information of over 700 food items (Wheeler et al., 2008:886). Also, the FEL now makes use of flagging to identify foods high in sodium (> 480 mg per serving) and fibre (> 3 gram per serving), as well as to alert consumers of starches that contain additional fat, enabling better food choices (Wheeler et al., 2008:886).

2.6.1 Adding to the food exchange list

As previously mentioned, FELs and food composition databases, the source on which the FEL is based, does not contain all food items on the market, therefore users are often forced to incorporate meals or products into the FEL using recipes or nutrition labels. Wheeler et al. (2008:887; 1996:1170) realised this limitation to using FELs and thus, to provide uniformity in calculating exchanges, supplied the user with guidelines which can be used when adding foods to a FEL (Table 2.3) (Wheeler et al., 2008:887).

Table 2.3: Converting nutrient values from nutrition labels or recipes into a food exchange list (Wheeler et al., 2008:887).

Steps	Suggestions
Food serving contains ≥ ⅓ carbohydrates as sugars	Classify the food as a carbohydrate

More than half of the fat content is attributed to one specific fatty acid	Specify the fatty acid contributing to the majority of the fat content.		
Adjusting carbohydrate grams	Food with > 5 g sugar alcohols or insoluble fibre per serving	Subtract half the grams sugar alcohols or insoluble fibre from total carbohydrate to get the total adjusted carbohydrate. Insoluble fibre and sugar alcohols contain half the amount of energy compared to other carbohydrates.	
Rounding	Carbohydrates (range ± 5 g)	15 g per starch, sweets, and fruit exchange 12 g per milk exchange 5 g per non-starch vegetable exchange	≤ 5 g do not count as a serving > 5 g and ≤ 10 g count as half a serving > 10 g and ≤ 20 g count as one serving
	Protein (range ± 3 g)	7 g per meat or meat alternative serving	≤ 4 g do not count as a serving > 4 g and ≤ 10 g count as one serving
	Fat (range ± 2 g)	5 g per fat serving	≤ 2 g do not count as a serving

			> 2 g and ≤ 4 g count as half a serving > 4 g and ≤ 7 g count as one serving
	Energy (range ± 20 kilocalories / 83.7 kilojoule)		Do not make use of ¼ or ⅓ exchanges for any of the food groups. Half exchanges may be used for some food groups, but not for vegetable or meat exchanges.

When calculating exchanges from labels or recipes, the priority is to ensure the carbohydrates match the amount of the exchange group, followed by the energy (Wheeler et al., 1996:1170). However, when the energy is not an exact match the fraction of protein found in fruit and fat exchanges, or carbohydrate found in meat exchanges, could explain the discrepancy, even though the mean value per exchange is zero (Wheeler et al., 1996:1170). Another limitation of calculating exchanges from food labels are ascribed to rounding of energy on food labels to the nearest 5 kcal (20.9 kJ) and macronutrients to the nearest one gram, thereby having a significant effect if the consumption or usage is much greater than the serving on the food label (Wheeler et al., 1996:1171).

2.6.2 The food exchange list as a dietary analysis tool

As the FEL contains information on portion sizes, it is often used as a dietary assessment tool, similar to food composition tables, to estimate energy, macronutrient, and in individual cases, also specific micronutrient values from a diet history (Kimura et al., 2018:183; Russolillo-Femenías et al., 2018:2029; Cade, 2017:276; Cho et al.,

2011:174; Fadupin, 2009:15; Geil, 2008:282). Energy consumption can be calculated from the total macronutrient intake, as each gram of protein or carbohydrate provides 4 kcal (16.7 kJ), while fat provides 9 kcal (37.7 kJ) per gram and alcohol 7 kcal (29.3 kJ) per gram (Wheeler et al., 1996:1170).

2.6.3 The food exchange list as part of the nutrition care process

Hawley (1929:17) stated that even though shorter methods of DA could save time, the reason for DA should ultimately determine the method used, especially as DA assists in making the nutrition diagnosis.

Once a nutrition diagnosis has been made, the nutrition intervention is formulated based on dietary guidelines and reference standards (Swan et al., 2017:8). Seeing as DA informs dietary intervention to some extent, the same tools, particularly FELs, are often used in the nutrition assessment and intervention phases of the NCP, as part of the food exchange system.

Nutrition intervention can comprise one or more of the following: prescription of certain products, supplementation of specific nutrients, referring to other members of the medical team, translation of a nutrition prescription into meal plans, modification of dietary intake with regards to consistency or composition, or counselling to bring about lifestyle or dietary change (Splett & Myers, 2001:358).

When calculating a meal plan using a FEL, Wheeler et al. (2008:886) suggested that estimated energy be rounded to the nearest 50 to 100 kcal (209 to 418 kJ), due to the FEL being based on ranges. Seeing as dietary intake is often underreported, Wheeler et al. (1996:1168) suggested that energy be rounded up instead of down. As for calculating the exchanges available for use (e.g. 10), the amount of macronutrients already used (e.g. 30) is subtracted from the nutrition prescription (e.g. 190) and the surplus (e.g. 160) divided by the macronutrients (e.g. 16) of each specific food group (Caso & Stare, 1947:171). It is recommended that the starch exchanges are determined first, followed by protein and finally fat, as the starch group includes protein and fat apart from carbohydrates and the meat group includes fat apart from protein (Wheeler et al., 2008:887). With regards to the vegetable group, Wheeler et al. (1996:1168) suggested that even though vegetable exchanges are included in a meal plan, the energy and macronutrient contribution could only be taken into consideration

when more than two exchanges are used, seeing as three exchanges are equivalent to one starch exchange.

While a FEL enables the exchange of foods within a food group, based on similar energy and macronutrient value per serving size, the carbohydrate and energy content of the milk, starch and fruit groups are similar per serving, also making these groups interchangeable (Marques-Lopes et al., 2017:1; Fadupin, 2009:15; Geil, 2008:282; Wheeler et al., 2008:884). However, the differences in protein and micronutrient values between these groups must take priority when calculating a meal plan (Wheeler et al., 2008:886).

In addition to its use in meal planning and dietary assessment, Wheeler et al. (1996:1167) reported that the FEL is often used in nutrition counselling (Wheeler et al., 2008:888). Apart from a few selected studies, there is limited literature available on the use of FELs as part of the NCP by dietitians globally and in South Africa. Cho et al. (2011:175) reported that 89.1% (n=55) of dietitians in Korea make use of FELs in dietary counselling. Additionally, a Nigerian FEL was developed to simplify counselling and also to assist with developing meal plans from nutrition prescriptions (Fadupin, 2009:15,18). However, whether dietitians still make use of FELs in practice, considering the advancements in technology, is unclear. Therefore, not only is it necessary to investigate the need for an updated, population-specific FEL but also to determine whether FELs are still relevant within the dietetic practice.

2.6.4 Population-specific food exchange lists

Various factors impact the development of a FEL, including indigenous foods used by a specific community (Cade, 2017:276; Khan et al., 2017:1276). Consequently, many countries have started to develop population-specific FELs, with the following examples of FELs available: Mexican FEL, Asian expedited 10 gram protein (EP-10) counter FEL, Southeast Asian renal FEL, South African renal FEL, Fat portion FEL, Mediterranean FEL, African American FEL, Korean FEL, and Spanish FEL (Khan et al., 2017:1275; Marques-Lopes et al., 2017:1; Lim et al., 2012:560; Djuric et al., 2008:2061). However, as South African dietitians do not have a standardised population-specific FEL available, besides the renal FEL, individual FELs are developed based on the ADA FEL and American guidelines as described by Wheeler

et al. (2008:886). Thus, leaving South African dietitians with unstandardised, possibly irrelevant tools; or more complicated and time-consuming methods to DA and meal planning (Kirkpatrick et al., 2017:281; Fadupin, 2009:15).

2.6.5 The use of food exchange lists for various conditions

The FEL is well known for its use in the treatment of overweight and DM, and the rising prevalence of both these conditions and their comorbidities is another contributing factor to the development of new disease-specific FELs (Khan et al., 2017:1276; WHO, 2017:31; Spires et al., 2016:36). Even so, the use of FELs are not limited to NCDs, but can also be applied to the following areas: dietary management of healthy individuals in various life cycles (e.g. children; pregnancy; lactation); ensuring adequate intake while following a restricted (e.g. vegan; allergies; inborn error of metabolism) or modified (e.g. dysphagia) diet; or, in the management of malnutrition (e.g. micronutrient imbalances; underweight) (Menal-Puey et al., 2019:2; Russolillo-Femenías et al., 2018:2029; Khan et al., 2017:1276; Marques-Lopes et al., 2017:9; Ong et al., 2014).

2.7 Electronic resources as part of the nutrition care process

Given the ageing population and the subsequent increase in morbidity from NCDs, more practical and time conscious treatment methods within the dietetics profession is needed (Zhao et al., 2018). Consequently, in 2017 the ADA recommended the use of technology in the management of NCDs, such as DM (Karduck & Chapman-Novakofski, 2018). Likewise, the AND suggested that dietitians make use of technology as part of the NCP, to obtain, store, and use nutritional information appropriately and reliably, to promote efficient task completion (Rusnak & Pamela, 2019).

2.7.1 Advantages of health applications

According to the Pew Research Center (2016), 43.0% of the global population and 37.0% of South Africans owned a smartphone in 2015, thus health applications are ubiquitous (Karduck & Chapman-Novakofski, 2018). Additionally, literature shows a significant increase in the general use of health applications, with over 259 000 applications available and more than half of mobile owners in the USA having downloaded at least one of these applications (Zhao et al., 2018; Chen et al.,

2018:750). According to health care practitioners, the use of health applications have many advantages, of which convenience may be one of the greatest, as reported by Jospe et al. (2015) (26.0%, n=14) and Karduck and Chapman-Novakofski (2018) (61.0%, n=436).

Even though health applications could be viewed as a threat to the dietetics profession, when used effectively, the accuracy and efficiency of nutrition management can be optimised (Chen et al., 2018:750). The accuracy of dietary assessment is reliant on memory, adequate knowledge, and ability to estimate and accurately report portion sizes. Apart from being more susceptible to errors, traditional dietary assessment methods are also more complicated, seeing as the conversion of food to nutrients is done manually (Jospe et al., 2015). Similarly, Karduck and Chapman-Novakofski (2018) and Jospe et al. (2015) reported that health applications may improve dietary monitoring (62.0%, n=447) and the accuracy of dietary assessment (13.0%, n=7), given that dietary intake can be logged immediately and not rely on memory. Furthermore, both Jospe et al. (2015) and Karduck and Chapman-Novakofski (2018) mentioned that with using health applications, patients can receive feedback instantaneously (19.0%, n=10; 59.0%, n=425), which overall contributes to patients being more aware of their dietary choices (15.0%, n=8); hence, assisting patients in adopting a healthier dietary lifestyle (51.0%, n=367).

2.7.2 Dietitians' role in health applications

Dietitians could play a vital part in improving patient outcomes by adopting health applications. Firstly, the health application retention rate is higher when recommended by health care practitioners. Additionally, improved patient outcomes have been associated with health application use exceeding six months (Chen et al., 2018). What is more, Karduck and Chapman-Novakofski (2018) reported that dietitians were more likely to use applications compared to other healthcare professionals, including nurses and diabetes nurse educators. Also, dietary interventions by dietitians are more effective compared to other health care practitioners, thus making dietitians key players in the use of health applications (Sun et al., 2017). This is relevant, as a patient-centred electronic FEL in the form of a health application, recommended by a dietitian, could potentially enhance patient compliance and result in improved health outcomes.

2.7.3 The use of health applications by dietitians

Dietitians from various countries have accepted health applications, with 83.0% (n=62) of dietitians in the US and 84.5% (n=322) in UK, Australia and New Zealand recommending applications (Chen et al., 2018:751; Chen et al., 2017:440). In 2015, a multi-country study found that between 23.0 – 36.0% of sports dietitians recommended applications to patients, of which 56.0% recommended MyFitnessPal (n=32) and 8.7% MyNetDiary (n=5) (Jospe et al., 2015:e7). Chen et al. (2017b:442) reported that 62.0% (n=353) use health applications for patient care while 84.0% (n=478) recommended applications to patients. However, only 57.0% to 62.7% (n=239) of dietitians from the respective countries used applications as part of the NCP (Chen et al., 2018:440). Accordingly, Jospe et al. (2015:e7) reported that sports dietitians perceived health applications highly effective in assisting patients with dietary assessment; conversely, applications were perceived only moderately effective when the nutritional assessment was completed by a dietitian.

2.7.4 Factors affecting the use of health applications

The intention to accept health applications is influenced by attitude, which in turn is determined by perceived usefulness and ease of use. Perceived usefulness can be defined as the extent to which an individual is of opinion that the implementation of an idea or object will improve a task (Zhao et al., 2018:343). While perceived ease of use refers to the extent to which an individual regards the use of an object or an idea to be effortless (Zhao et al., 2018:343).

With regards to ease of use, health applications that are time-consuming, unstandardised, and not user friendly, add to the reluctance of use (Karduck & Chapman-Novakofski, 2018:63). Although ease of use showed less significance in the younger population, the moderating effect of age on the use thereof is influenced by factors respective of the age group (Zhao et al., 2018:349). However, despite popular belief, Karduck and Chapman-Novakofski (2018:66) found no statistically significant association between application use and demographic information including age, years practising, gender or level of education. Likewise, Jospe et al. (2015:e7) also found no significant association between dietitian age and the use of health applications. Even so, seeing as confusion may detract from the benefits of applications, Chen et al. (2017a:e40) recommended that simplicity should be one of

the main objectives when designing health applications. Strategies to enhance the ease of use include bar code scanners, ability to log meals utilising photos, and saving favourite food items (Chen et al., 2017a:e40).

Apart from usability and value, Lieffers et al. (2014:41) mentioned that quality, compatibility, and access to applications influence its use. According to Chen et al. (2017a:e40), applications should be independent of internet access and compatible with various platforms. Not only should applications be flexible with regards to platform compatibility, but also allow modifications to a certain extent to increase its relevance to the specific user (Karduck & Chapman-Novakofski, 2018). Additionally, some dietitians preferred applications with multiple functions while others recommended applications that are patient and goal-specific (Chen et al., 2017a:e40). Likewise, the fact that the nutritional database, on which health applications are based, included inaccurate, incomplete foods that are not population specific, was among the obstacles reported by 41.0% (n=22) of sports dietitians from five countries (Jospe et al., 2015:e7), thereby highlighting the need for population specific and relevant nutritional databases.

Particularly when health applications are used by patients, inadequate knowledge of various food items (19.0%) and portion sizes (22.0%) within the database could result in incorrect diet histories being logged (Jospe et al., 2015:e7). Further supporting the statement that health applications should not be viewed as a threat to the dietetics profession, seeing as dietitians would still be required to counsel patients accordingly; however, the accuracy and efficiency of nutritional care can be optimised by using health applications effectively (Chen et al., 2018:750).

Consequently, dietitians' knowledge regarding health applications affects the enthusiasm in which it is used and recommended to patients (Lieffers et al., 2014:46). According to Karduck & Chapman-Novakofski (2018) health care practitioners who learned about applications from colleagues or patients were more likely to use applications. However, only 36.0% (n=258) of healthcare practitioners learned about applications through patients (Karduck & Chapman-Novakofski, 2018). Therefore, improving dietitians' knowledge on applications, through workshops or continuous professional development activities, could enhance the confidence with which dietitians recommend and use applications in practice (Chen et al., 2017a:e40).

Apart from attitude and the opinion of others (subjective norm), trust in health application security settings and perceived risks (e.g. financial or physical risks) impact on the intention to adopt health applications (Zhao et al., 2018:348). Likewise, Lieffers et al. (2014:41) reported that individual elements affecting application use included dietitians' willingness to incur financial expenses.

Similarly, according to Chen et al. (2017a:e40), applications should be without charge. Also, motivations for choosing applications in dietary assessment above other methods firstly included cost-effectiveness, followed by patient accountability, and usability in patients with various literacy levels (Karduck & Chapman-Novakofski, 2018). Likewise, Chen et al. (2017a:e40) reported that dietitians preferred the format of applications to be predominantly visual, with limited, easy-to-read text.

Other prerequisites for recommending health applications to patients included the possession of a smartphone (13.0%), being tech-savvy (13.0%) and able to share results from the application with the dietitian (13.0%) (Jospe et al., 2015:e7). However, as previously discussed, statistics have shown that almost half of the population already owned a smartphone in 2015, thereby moderating the effect smartphone ownership might have on health application use (Pew Research Center, 2016:3).

In conclusion, the use of health applications is influenced by various factors including application-related factors, individual, and environmental factors (Lieffers et al., 2014:46). Specifically, the country of residence significantly influenced application use, with 56.0% of US sports dietitians using applications compared to 25.0% of sports dietitians from other countries (Jospe et al., 2015:e7). Therefore, the use of relevant, user-friendly health applications, with the support of dietitians, can not only improve communication channels between patient and health care practitioner and among health care practitioners, but may also aid in improved patient outcomes. Through the incorporation of health applications into the NCP, the accuracy, efficiency and the standard of interventions may be enhanced (Chen et al., 2018:750; Jospe et al., 2015:e7).

2.8 Conclusion

Tools and methods to estimate the composition of food became more simplified with the advancements in technology and the growing dietetics profession. Although the

availability of health applications, FELs and electronic-based food composition databases could provide dietitians with the opportunity to simplify and optimise nutrition therapy, the literature on dietitians' practices and perceptions of their use during various steps of the NCP is limited.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter describes the processes or approaches involved in addressing the research problem, which will include the study design, sampling, data gathering, analysis and interpretation, as well as ethical considerations.

3.2 Study design

This study was designed as a quantitative descriptive cross-sectional study.

Quantitative research is an objective approach to measure variables, providing numerical data for analysis (Mertler, 2016:108; Creswell, 2014:4). There are different approaches to quantitative research, as seen in Figure 3.1.

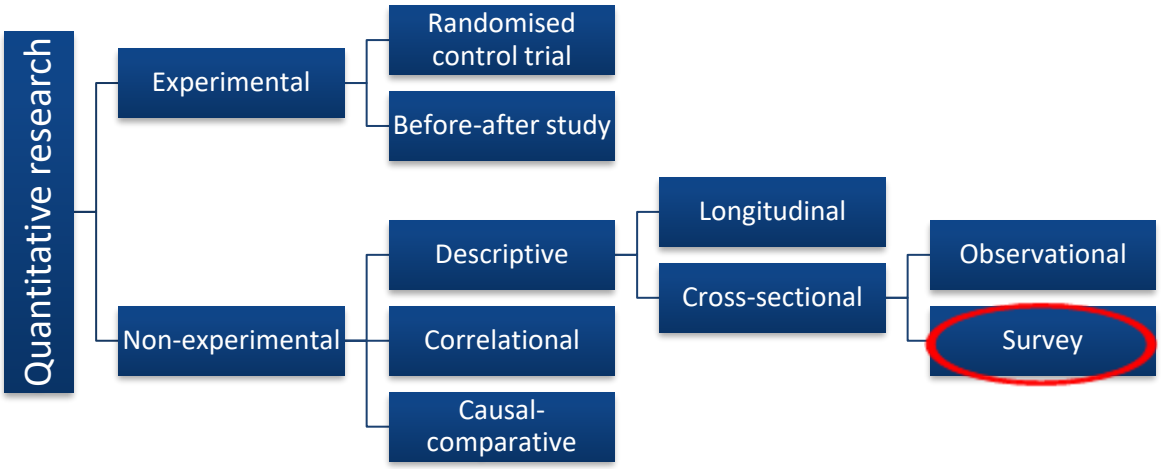

Figure 3.1: Approaches to quantitative research (Creswell, 2014:12).

For this study, the quantitative approach was that of a cross-sectional web-based survey. A cross-sectional descriptive study describes and interprets a phenomenon as it occurs naturally, between various samples of a population at a given time; thereby, describing the prevalence and distribution of a phenomenon (Drummond & Murphy-

Reyes, 2018:171; Mertler, 2016:111, 116). As the objective of this study was to describe current practices and perspectives on the use of FELs by dietitians, a cross-sectional descriptive study design was found to be the most appropriate study design. Figure 3.2 illustrates the process that was followed in this study.

Figure 3.2: Process of survey research (Mertler, 2016:117).

A survey is a method used for data gathering, which comprises the answering of questions by a sample population, in such a manner, that data obtained can be transformed into numerical data for analysis (McPeake et al., 2014:24; Ponto, 2015:168). The purpose of using a survey design was to gain insight into the current practices and perspectives of dietitians on the use of FELs, as part of the NCP in South Africa (McPeake et al., 2014:24). By making use of a survey, information on opinions and perspectives can be obtained, which could be generalisable to a population, given that the sample is representative of that population (Mertler, 2016:116; Creswell, 2014:155).

There are two types of electronic surveys, namely, e-mail surveys and web-based surveys, of which this study made use of the latter (McPeake et al., 2014:24).

3.3 Study population

A study population is a group of units or people with mutual, distinct features to which the study results apply (Polit & Beck, 2010:1452). The study population for this study included all dietitians and community service dietitians registered at the HPCSA, who were practising in South Africa at the time of data collection. Nortjé & Hoffmann (2015:78) reported an average of 2117 practising dietitians in South Africa, compared to 1628 dietitians in 2005 (Martin et al., 2008:28). According to the statistics by the HPCSA (2018:online), which was last updated on the 5th of May 2018, there were 3418 dietitians registered at the HPCSA. However, the latest statistics requested from

the HPCSA in August 2020, indicated that there were currently 3717 registered dietitians at the time.

Dietitians work in various fields, including, therapeutic, community, academia, private, research, and food service (Gallagher et al., 2018:4). Steyn et al. (2005:55) reported that 37.1% of dietitians (n=367) worked in private practice, followed by 27.8% working in hospitals, 15.2% in primary healthcare settings, 10.9% in foodservice, and 16.3% in academia. While Visser et al. (2012:114) reported a similar percentage (37.1%) of dietitians working in private practice, Joyner (2015:58) found a higher percentage (40.9%) of dietitians employed in private practice. Martin (2007:51) indicated that the majority of dietitians in South Africa (97.8%; n=309) were female of which 31.5% (n=91) worked in hospitals, 25.3% (n=73) had a private practice, 5.2% (n=15) worked in food service, and 6.6% (n=19) worked in academia. However, a recent study by Ebrahim et al. (2020:E722) reported a lower percentage of private practising dietitians (21.0%; n=27) compared to other studies. Not many recent national studies in South Africa involving dietitians have determined various areas of employment and given the discrepancies between studies it is unclear what the current percentages per area of employment are among dietitians in South Africa.

3.4 Sampling

Sampling is a systematic approach, in which the researcher selects a more manageable, yet representative group of units or subjects from the study population, for whom data will be collected (Sharma, 2017:749). For this study, all dietitians and community service dietitians registered at the HPCSA, who were practising in South Africa, were eligible to participate.

Due to the known low response rates to web-based surveys, concerns with the generalisability of findings, and limited approaches available to reach the target population because of the Protection of Personal information act (PoPi), this study made use of convenience sampling, which is a non-probability sampling method (Sharma, 2017:752; Etikan et al., 2016:2; Mertler, 2016:109; Gheondea-Eladi, 2014:118,123). Convenience sampling comprises the inclusion of participants with similar characteristics, based on accessibility (Etikan et al., 2016:2). The sample size

could therefore not be predetermined. However, a total of 100 to 500 participants were suggested by Tait & Voepel-Lewis (2015:660).

ADSA is a South African non-profit organisation and a member of the International Confederation of Dietetic Associations (ICDA). ADSA was chosen as the main distribution channel for the survey, given the number of members affiliated with the association (1603 members with 1246 full members as on 24 May 2018), as well as the association's vision, which is to represent and develop the dietetic profession in South Africa. The member distribution, as provided by ADSA, is illustrated in Figure 3.3. The Facebook page, *Dietetics-Nutrition is a Profession (DIP)*, is a closed group with 3048 dietitian and nutritionist members as on 23 June 2019. The page *Dietetic Services* is a public group with 801 members. Jospe et al. (2015a:e7) recommended that surveys be distributed by means of social media to increase the response rate and as only 36.5% of registered dietitians at the HPCSA, are ADSA members, additional distribution methods enabled dietitians who are not members of ADSA to also participate in the study.

Dietitians who were members of ADSA were reached by:

- Sharing the link to the survey in the weekly ADSA e-newsletter; and,
- At ADSA branch meetings, members might have been reminded of the link shared in the e-newsletter.

Dietitians who were not members of ADSA may have received the link to the survey through:

- ADSA members sharing the link with colleagues who are non-members;
- The link may have been shared with dietitians whose contact details were available online; and,
- The link to the survey was shared by the researcher on *Dietetics-Nutrition is a Profession (DIP)* and *Dietetic Services* Facebook pages.

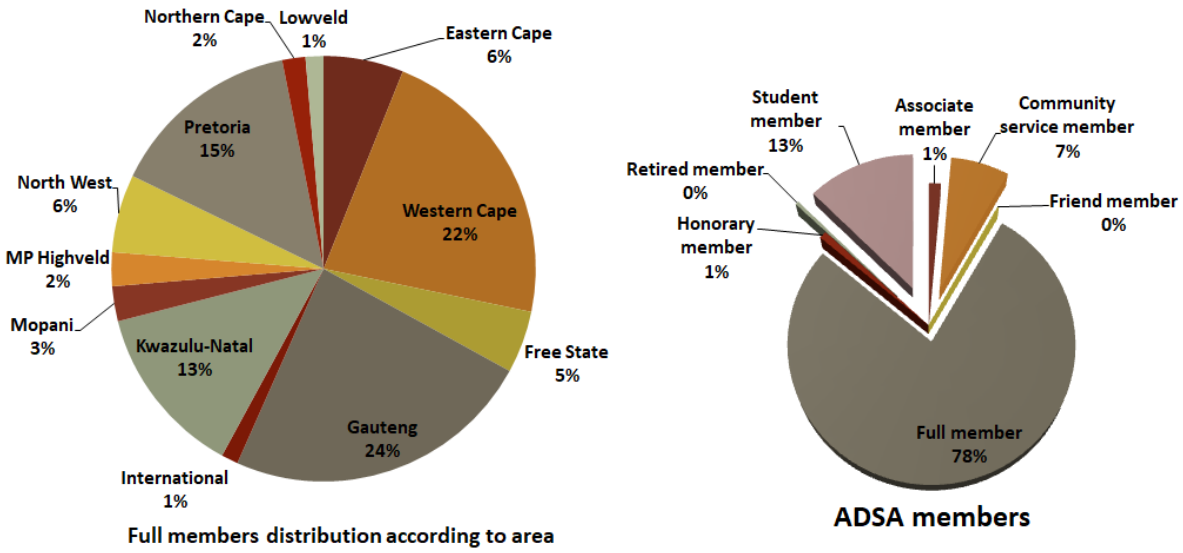

Figure 3.3: Distribution of ADSA members (ADSA head office, 2018).

Response rates for online surveys are generally considered lower than other types of surveys. In American and Icelandic studies where online surveys were distributed to nurses through nursing associations, response rates were 18 and 19% respectively (Chizawsky et al., 2011:38). Martin (2007:51), who had shared a survey to South African dietitians through both, e-mail, and post had a response rate of 20%. A similar response rate would have produced approximately 615 (i.e. 18% of the 3418 dietitians registered at the HPCSA) responses form dietitians in South Africa for the current study.

3.4.1 Inclusion criteria

All dietitians and community service dietitians registered at the HPCSA, who were residing in South Africa, who were willing to participate, and provided consent, were eligible to complete the survey.

3.4.2 Exclusion criteria

This study excluded student dietitians, dietitians not residing in South Africa, and any person who was not registered as a dietitian or community service dietitian at the HPCSA.

3.5 Measurements

Data collection is a systematic process in which information is obtained on variables or operational definitions of interest, from appropriate sources, to address a specific research question (Dudovskiy, 2019).

3.5.1 Operational definitions

To address the research question, the following operational variables were investigated.

3.5.1.1 Socio-demographic information

For this study, socio-demographic information included information on the participants' age, gender, language, geographic location, area of employment, and years of expertise.

3.5.1.2 Dietitians' practices and perceptions regarding the use of food exchange lists, used as part of the food exchange system, within the nutrition care process

For this study, dietitians referred to health care professionals specialising in the field of nutrition and dietetics, who have completed a four-year Baccalaureus (B.Sc.) degree in dietetics, and who are registered with the HPCSA (Gallagher et al., 2018:4; McClinchy et al., 2015:65; Hammond et al., 2014:1879). Questions relating to the completion of studies, years of experience and registration with the HPCSA were used in this study to ensure validity of the data gathered and determine associations between dietitians' experience and the use of FELs.

Dietitians' practices referred to the integration and application of knowledge and skills, while perceptions referred to how something is understood, based on the interpretation of past experiences, thereby taking into account views and opinions (Martin, 2007:169; ICDA, 2010:online; HPCSA, 2018: online).

A FEL enables the exchange of foods within the same food group, as it comprises a list of foods commonly consumed by a specific population that are classified according to similar energy and macronutrient value per serving size (Wheeler et al., 2008:884).

Therefore, to determine dietitians' practices and perceptions regarding the use of a FEL, encompassed by a food exchange system, the following areas were assessed:

- If and how dietitians use FELs, taking into account the advantages, limitations, and factors affecting the use of FELs, the use and effectiveness of FELs in different stages of the NCP, the population for whom FELs are used, the frequency of usage, and other aids used instead of FELs.
- Which FELs are used, concerning FELs given to patients, the update status, origin, and resources used to develop FELs, as well as limitations to developing FELs.
- The relevance of FELs, considering the use of FELs for various population groups including, different religions, cultures, languages, stages of the life cycle, socio-economic status, literacy levels, and restricted diets.
- The expectations and characteristics of FELs.
- The use, advantages, limitations, and format of nutrition-related health applications as part of the NCP.
- The acceptability, advantages, limitations, value, and expectations of electronic FELs.
- The need for nutrient values of additional elements and micronutrients in the FEL.
- The need, advantages, and limitations for / of mixed or combined meals and fast food in the FEL.

3.5.2 Techniques

After an appropriate questionnaire had been developed, a pilot study was first executed, which ensured that correct and complete data were gathered in the study (Castillo-Montoya, 2016:827; Tait & Voepel-Lewis, 2015:659).

3.5.2.1 Developing the questionnaire

Based on the objectives of this study, with the use of available literature and practice experience, an appropriate, structured questionnaire was designed to conduct the survey. A structured questionnaire is a document comprising a series of predetermined questions, used to gather data on perceptions, behaviour, attitudes, and knowledge of a sample population (Arora et al., 2017:7; Tait & Voepel-Lewis, 2015:656; Martin, 2007:159; Steyn et al., 2005).

The questionnaire followed a logical progression and format, and was only available in English, as this is the lingua franca.

The questionnaire consisted of 10 online pages, with only selected questions being marked as mandatory. This prevented participants from pretermitting the survey, hence limiting incomplete questionnaires. However, only certain questions were mandatory to allow participants to answer questions they felt more comfortable answering. Furthermore, conditional branching, also known as skip logic, was used to prevent survey fatigue, as this allowed participants to only answer applicable questions based on the previous answers.

The layout of the survey was as follow:

1. Page one: the consent form, which contained information about the study and entailed only one closed question, obtaining consent.

2. Page two: six general questions (66.0% closed questions), including HPCSA number and registration, which served to ensure the validity of the data collected.

3. Page three: socio-demographic data, as these nine questions (56.0% closed questions) were considered non-threatening and familiar.

4. Page four: dietitians' practices regarding the use of FELs, as part of the food exchange system, in the NCP, which consisted of 19 questions (58.0% closed questions).

5. Page five: dietitians' perceptions regarding FELs used as part of the food exchange system, in the NCP, comprising 30 questions (67.0% closed questions).

6. Page six: alternatives used instead of or in combination with FELs, as part of the NCP were investigated by using 17 questions (41.0% closed questions). This section comprised more open-ended questions, seeing as there is limited literature available on this topic.

7. Page seven: dietitians' perceptions regarding electronic FELs, used as part of the food exchange system, in the NCP, which consisted of ten questions (50.0% closed questions).

8. Page eight: dietitians' preferred specifications of FELs, used as part of the NCP, comprising 31 questions (52.0% closed questions). The open-ended questions in this section mainly served to provide richer data to form a better understanding of the preferred specifications.

9. Page nine: this page only had one open-ended question, which allowed dietitians to share any additional comments or feedback they might have had on the research topic.

10. Page ten: the last page of the survey was a reminder to save the data entered before leaving the site, which would otherwise have resulted in data being lost. This page also served to thank dietitians for their participation in the study.

A clear explanation with instructions accompanied each question, with fixed-choice questions preceding open-ended questions, to encourage participants to share opinions and perceptions more spontaneously. This study used fixed-choice questions to measure nominal variables (Phellas et al., 2011:198; Tait & Voepel-Lewis, 2015:658; Bryman, 2016:54). Even though literature states that neutral options should be limited, to encourage participants to share opinions, this study also included these options to prevent incomplete questionnaires. Regarding open-ended questions and questions to which there are not applicable options to choose from, open spaces were allocated for participants to fill in any additional motivations or responses. The use of diverse types of data provides a significant, purposeful, and comprehensive

understanding of the research problem, which can be generalised to a specific population (Schneider & Whitehead, 2012:264; Tariq & Woodman, 2010:3). Furthermore, steps were taken to avoid double-barrelled questions, keep questions unambiguous, non-leading, phrased in a simple language, free from double negatives, emotional speech, abbreviations, and prestige bias. The researcher attempted to make questions mutually exclusive, exhaustive, and balanced.

3.5.3 Conducting the survey

Two types of surveys exist, namely, paper-based surveys and web-based surveys, of which this study made use of the latter (McPeake et al., 2014:24). The survey comprised a self-administered questionnaire, as described above, which was open for completion from 10 February 2020 to 14 April 2020.

Proof of ethics approval (Appendix A), the study advertisement (Appendix B), and the link to the online questionnaire were sent to ADSA. The study advertisement comprised a summary of the study and participants were encouraged to share the link with colleagues. ADSA shared the advertisement and the link to the online questionnaire, created with Evasys Software® (Appendix C), through e-mail newsletters to ADSA members on two occasions, four weeks apart (18 February and 18 March). The ADSA branch committees would have been contacted to request that ADSA members be reminded of the link shared in the e-newsletter at branch meetings, however, during the time of the survey, meetings were prohibited due to the COVID-19 pandemic.

Furthermore, the link to the survey was shared on *Dietetics-Nutrition is a Profession (DIP)* and *Dietetic Services* Facebook pages on 11 February 2020, followed by two reminders eight to twelve days apart. Dietitians who were neither members of ADSA nor the Facebook pages may have received the link to the survey through colleagues. The link was also shared with dietitians whose contact information could have been obtained through Universities' websites, Medpages and online searches.

When participants opened on the shared link, they were directed to the survey. The first part of the survey comprised an explanation of the purpose and procedures of the study, which represented the information document (Appendix C). Participants were able to start the survey once consent had been granted, by explicitly choosing the

option to consent. Should participants have chosen not to give consent, they were unable to complete the questionnaire, but instead redirected to the end of the questionnaire. Participants were required to provide their HPCSA registration numbers (DT numbers), which served two functions: firstly, to prevent multiple entries by the same participant and secondly, to confirm that participants were registered dietitians by verifying DT numbers on the HPCSA website. However, all information was kept confidential, and DT numbers did not form part of the data analysis.

3.6 Study procedures

The researcher followed the subsequent steps in conducting the study, as seen in Figure 3.4.

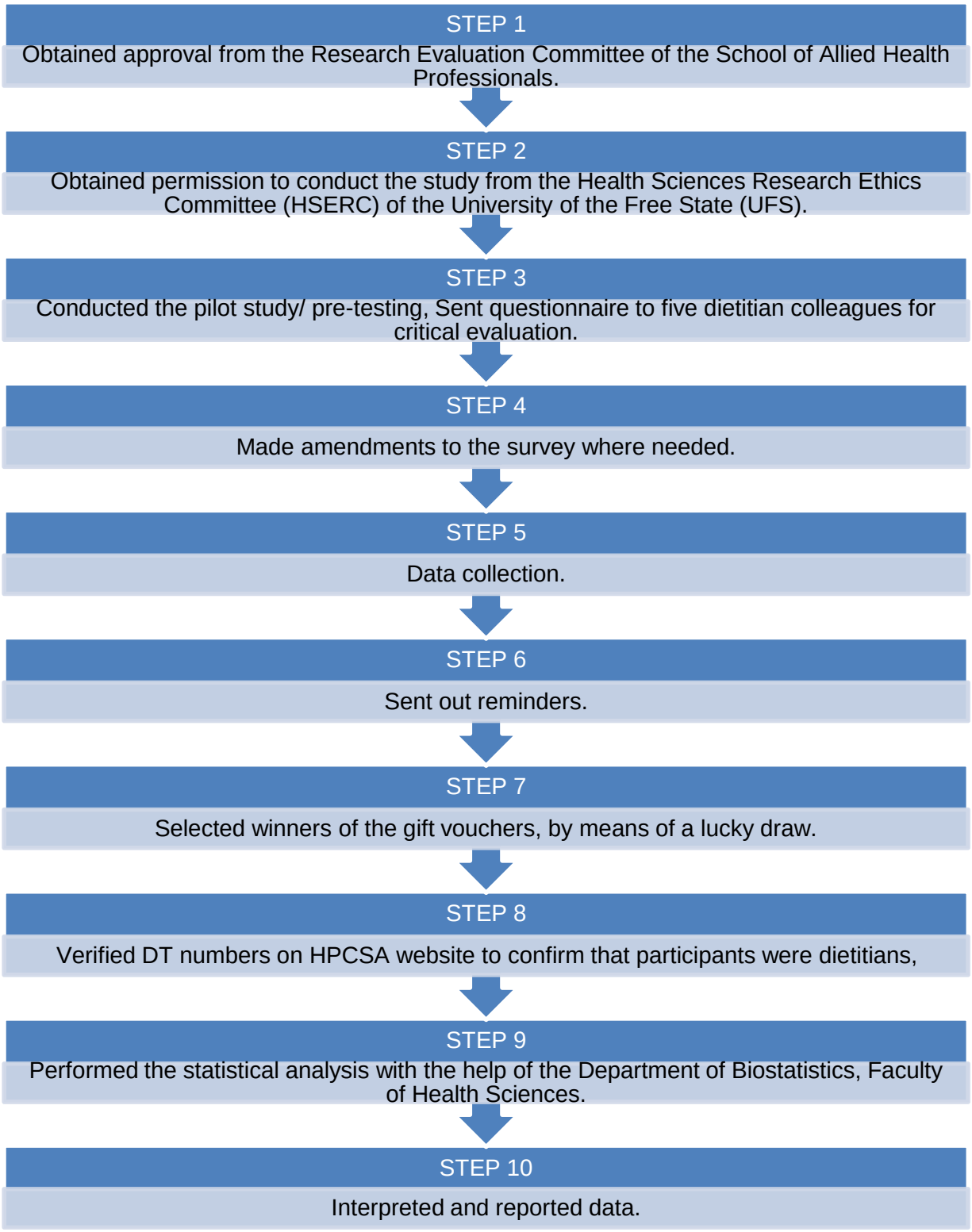

Figure 3.4: Steps followed in conducting the study.

3.6.1 Pilot study

For the pilot study, the researcher shared the link to the survey, created with Evasys Software®, directly via e-mail to five conveniently selected dietitians who are registered at the HPCSA. The questionnaire was reviewed for content / face validity, the sequence of questions, as well as user-friendliness and organisation. Feedback from the pilot study was used to make amendments to the questionnaire and estimate the duration of completing the survey. Seeing as modifications mainly comprised grammar adaptations and no major changes were made to the questionnaire, data from these surveys were included for analysis.

3.6.2 Measurement and methodology errors

Possible barriers, which might have affected the results of the study, have been identified and all efforts were made to limit methodology errors throughout the study, thereby ensuring quality research.

Online surveys are known to have low response rates, and as a list of contact details for dietitians had not been obtainable from the HPCSA, the response rate was expected to be even lower. In an attempt to increase the response rate, incentives, in the form of five online Woolworths gift vouchers, worth R250 each, were available for participants who were willing to leave an e-mail address, which had only been used for the lucky draw. Also, it was requested that ADSA send out one or more reminders of the survey in the e-newsletter, one week apart; however, it was agreed upon to send one reminder four weeks after the initial link was sent out. Additionally, the survey was shared on the Facebook pages, DIP and Dietetic Services, followed by two reminders one to two weeks apart. Finally, the link was also shared with dietitians whose contact details were obtainable through University webpages, Medpages or online searches.

Participants might have been unwilling to complete a questionnaire of unknown length. Hence, the researcher informed participants of the duration for completion of the questionnaire, and the Evasys® programme indicated the participants' progress in the survey to motivate participants to finish.

The Evasys® programme notified participants of empty areas before the questionnaire could be submitted, to prevent the submission of incomplete questionnaires.

Participants might have completed the questionnaire more than once to increase their chances of winning a prize or change answers that were previously submitted; however, to overcome this, the researcher verified and inspected DT numbers for repetition, and only the first completed questionnaire for each participant was used for data analysis.

3.6.3 Validity and reliability

Quantitative research makes use of validity and reliability to provide quality research.

3.6.3.1 Validity

Validity refers to the ability of research, or an instrument to measure what it was designed for, taking into account the accuracy of the measurement (Bashir et al., 2008:36; Ponto, 2015; Van der Merwe, 2011; Tait & Voepel-Lewis, 2015:661). Statistical conclusion validity refers to the degree to which inferences about the association between variables is accurate (Drost, 2011:115). Two types of errors may occur, namely, finding a correlation where none exists or finding no relationship where one exists (García-Pérez, 2012:4). The researcher was assiduously attentive to sampling procedures, statistical analysis of data, and reliable measurement techniques, including the use of DT numbers to verify the registration of participants at the HPCSA, to ensure conclusion validity.

Translation validity includes face validity and content validity. Content validity refers to whether concepts under investigation are measured, and face validity refers to whether questions are making sense (Drost, 2011:116). Content and face validity were ensured by creating questions based on an in-depth literature review, and by receiving input through evaluation by five dietitians, as part of the pilot study, regarding the questionnaire before it was used in the main study for data collection.

3.6.3.2 Reliability

Reliability refers to the consistency, accuracy, and reproducibility of research (Bashir et al., 2008:36).

Systematic and random errors can influence the reliability of the results (Drost, 2011:110). The questionnaire consisted of an adequate number of questions in the form of open and closed questions (alternative forms) to limit random errors, thereby

increasing reliability, seeing as the use of two separate approaches at the same time can measure one component. The data was electronically captured via EvaSys® software and exported as an Excel spreadsheet to the biostatistician, thus preventing coding errors and ensuring data integrity. Questions were kept unambiguous by using simple language and clear instructions preceded each question, as discussed under variables.

3.6.4 Statistical analysis

Descriptive statistics, including frequencies and percentages (for categorical data) and medians and percentiles (for skew numerical variables), were calculated per group. Differences between groups were assessed by means of p-values, Kruskal-Wallis tests (for skew numerical variables), chi-squared tests (for categorical variables), or Fisher's extract test (for categorical variables with sparse data). A p-value < 0.05 was considered as statistically significant.

3.7 Ethical considerations

Before conducting the study, the researcher obtained approval from the Health Sciences Research Ethics Committee (HSREC) of the University of the Free State (UFS) +27(0)51 401 7795 / 4 (UFS-HSD2019 / 1317 / 0110). The survey started with a description of the purpose and the procedures of the study. Participants were only able to start the survey once consent was granted, by explicitly choosing the option to consent. Participation in the study was voluntary and refusal to participate involved no penalty or loss of benefits to which the subject was otherwise entitled. Participation in the study was of no cost and participants did not receive remuneration for participation. However, five Woolworths gift vouchers, each worth R250, were offered as an incentive to participants, who were selected through a lucky draw using e-mail addresses provided. All information were kept confidential, and to protect participants' privacy, the e-mail addresses and DT numbers were removed from the data set before data analysis was performed, which made it impossible to link answers to specific participants.

CHAPTER 4: RESULTS

4.1 Introduction

With the NCP providing a framework to guide dietitians through the process of nutritional management, thus supporting evidence-based practice, consistency in the quality of care can be enhanced (Bueche et al., 2008: 1117; Splett and Myers, 2001; Gates and Meyer, 1994). Furthermore, Gardner-Cardani et al. (2007:1429), suggested that standardised, high quality methods or tools can serve as benchmarks for evaluating the dietetics profession. Therefore, tools and methods used by dietitians in the dietary management of patients should be evidence-based, population specific and strive to ensure accurate and consistent results (Vila-real et al., 2018:1003). One such tool comprises the FEL, which incorporates both portion sizes and nutritional information, thereby making it suitable for use in various steps of the NCP (Wheeler et al., 2008:888). However, whether dietitians use FELs in practice was unclear, therefore, this study aimed to determine South African dietitians' practices and perceptions regarding the use of FELs as part of the exchange system in the NCP.

The results of this study are presented according to the operational definitions described in the methodology section of this dissertation. This section will thus report on dietitians' socio-demographic information; dietitians' practices and perceptions regarding the use of FELs, used as part of the food exchange system, within the NCP; and associations between the operational definitions.

4.2 Socio-demographic background

A total of 131 participants completed the survey, which relates to a response rate of 3.8%. Even though this study included community service dietitians, as displayed in Table 4.1, 96.2% of participants were registered under independent practice at the HPCSA, with only five participants falling within the community service category.

Furthermore, 96.2% of the dietitians in this study were female, with the largest proportion aged 25-30 years (42.8%). Also, a greater percentage of dietitians have been practising for one to four years after completing community service, which will

henceforth be referred to as “years of practice”, “practising experience”, or “years of experience”.

Participants were mainly from Gauteng province (29.8%). The settings in which dietitians practice varied greatly, with 65.8% of participants reported working in heterogeneous settings. Although, 53.4% of dietitians in this study worked in private practice, only 18.3% of dietitians reported exclusively working in private practice, while 5.3% worked in private practice as well as a private general hospital. Of 45 dietitians working in the government setting, 27.0% reported only working in a district hospital, whereas the rest also worked in either food service, the community setting, regional hospitals, or private practice. An equal number (13.7%) of dietitians worked in either research or tertiary education compared to corporate- and pharmaceutical settings; however, fewer dietitians worked in the food industry / food service (6.0%). Of the study sample, three dietitians (2.3%) reported not currently practising.

Table 4.1: Dietitians’ demographic information

Variable	N	%
Health Professions Council of South Africa registration (N = 131)		
Independent Practice	126	96.2
Community Service	5	3.8
Gender (N = 131)		
Male	5	3.8
Female	126	96.2
Age in years (N = 131)		
<25	12	9.2
25-30	56	42.8
31-40	35	26.7
41-60	27	20.6
>60	1	0.8

Years practising post community service (n = 125)		
<1	6	4.8
1 – 4	43	34.4
5 – 10	36	28.8
11 – 20	26	20.8
>20	14	11.2
Provincial representation (N = 131)		
Eastern Cape	22	16.8
Free State	22	16.8
Gauteng	39	29.8
KwaZulu-Natal	14	10.7
Limpopo	1	0.8
Mpumalanga	2	1.5
Northern Cape	5	3.8
North West	3	2.3
Western Cape	23	17.6
Area of work (N = 131)		
Government hospital (District)	18	13.7
Private general hospital	21	16.0
Private practice	70	53.4
Consultancy	16	12.2
Tertiary education	16	12.2
Other[#]	86	65.8

Categories which comprise responses with less than 10%: Food service management (4.6%); Food industry (2.3%); Not currently practising / unemployed (2.3%); Pharmaceutical company (4.6%); Corporate health (9.2%); Research (4.6%); Private clinic (3.8%); Private specialised hospital (8.4%); Government hospital (Regional) (6.9%); Government hospital (Tertiary) (6.1%); Government specialised hospital (1.5%); Public sector (Other) (2.3%); Public sector (Community setting) (9.2%).

As per Table 4.2, the median age of participants was 30 years with a median of six years' experience post community service. However, the median number of years

practising, varied between areas of employment, with dietitians in the public sector having the least number of years practising experience.

Table 4.2: Age and years practising as a dietitian

Variable	Median (p25; p75)	Minimum	Maximum
Current age (N = 131)	30 (26; 38)	21	65
Age when qualified (n = 125)	23 (23; 24)	20	52
Years post community service (n = 125)	6 (3; 14)	0	45
Number of years practising within various areas of employment			
Government sector (n = 33)	5 (4; 8)	0	24
Private sector (n = 72)	7.5 (3; 15.5)	0	45
Research / tertiary education / pharmaceutical (n = 17)	8 (3; 20)	1	30

As presented in Table 4.3, the greater part of the sample (53.4%) reported Afrikaans as their home language, while nearly all (97.7%) chose English as one of the languages used in practice. Although only 9.9% of the dietitians selected both Afrikaans and English as their home language, 46.6% of dietitians practiced in both these languages. Also, only one dietitian reported having three home languages and 12.0% of the dietitians had two native languages, however, 9.9% reported practising in three or more languages.

Table 4.3: Languages spoken by dietitians in South Africa (N = 131)

	Home language		Language used in practice	
Language	**n**	**%**	**n**	**%**
isiZulu	1	0.8	8	6.1
isiXhosa	5	3.8	8	6.1
Afrikaans	70	53.4	71	54.2
English	66	50.4	128	97.7
Sesotho	1	0.8	7	5.3
Other	5[##]	3.8	7[#]	5.3

Other [#]Portuguese (0.8%); Siswati (0.8%); Xitsonga (0.8%); Setswana (0.8%); Sepedi (2.3%)

Other [##]Mandarin (0.8%); German (0.8%); Xitsonga (1.5%); Sepedi (0.8%)

4.2.1 Associations between various aspects of dietitians' socio-demographic information

For statistical analysis on associations, two age groups were used, above 30 years and ≤30 years to allow for better comparison between studies, as these age groups were used by the majority of authors. As evidenced by Table 4.4, there was a statistically significant association between dietitians' age as well as years of experience and the area of employment ($p < 0.05$). A larger proportion of dietitians working in the private sector were older with more years practising experience. There was a statistically significant association between dietitians' area of work and their geographical location ($p = 0.0131$). A larger proportion of private practising dietitians resided in Gauteng province compared to the other provinces.

Table 4.4: Associations between area of employment and dietitians' age, years of experience and geographical location

	Government		Private		Tertiary/ pharmaceutical/ research		p-value
	n	%	n	%	n	%	
Years of practice (n = 122)							**0.0230**
<1 year	2	6.1	2	2.8	0	0.0	
1 - 4 years	10	30.3	26	36.1	6	35.3	
5 - 10 years	17	51.5	15	20.8	4	25.5	
11 - 20 years	3	9.1	20	27.8	3	17.7	
> 20 years	1	3.0	9	12.5	4	23.5	
Age (n = 128)							**0.0179**
<25 years	4	10.5	4	5.5	1	5.9	
25 - 30 years	21	55.3	30	41.1	5	29.4	
31 - 40 years	12	31.6	19	26.0	4	23.5	
41 - 60 years	1	2.6	19	26.0	7	41.2	
>60 years	0	0.0	1	1.4	0	0.0	
Geographical location (n = 128)							**0.0131**
Eastern Cape	12	31.6	6	8.2	4	23.5	
Free State	9	23.7	8	11.0	5	29.4	
Gauteng	6	15.8	29	39.7	4	23.5	
KwaZulu-Natal	2	5.3	10	13.7	1	5.9	
Limpopo	1	2.6	0	0.0	0	0.0	
Mpumalanga	1	2.6	1	1.4	0	0.0	
Northern Cape	2	5.3	3	4.1	0	0.0	
North West	0	0.0	1	1.4	1	5.9	
Western Cape	5	13.2	15	20.6	2	11.8	

4.3 The use of food exchange lists

All reference to the FEL used in practice in this section will refer to FELs either designed by dietitians themselves or obtained from a university. As South Africa does

not have a standardised FEL and FELs obtained from different universities may vary, the FELs in question is not only referring to one specific FEL but rather to whichever FEL the specific dietitian is using in a particular setting. As per Table 4.5, 72.5% of participants were currently using FELs; however, 24.4% reported having used FELs in the past. A larger proportion of dietitians reported using FELs as part of the intervention phase of the NCP (29.0%), with 92.1% using FELs for meal planning and 67.7% for nutrition counselling (Table 4.5). Furthermore, only 15.3% reported using FELs for both dietary assessment as well as the intervention phase of the NCP. As described in Table 4.5, motivations for not using FELs were mainly dietitians' perceptions that FELs are impractical (25.0%) while 21.9% reported working in settings where the use of FELs was irrelevant.

As shown in Table 4.5, most dietitians used FELs two to three times per week (27.0%), whereas FELs were used by 70.6% of dietitians at least once per week. The patient profile for which dietitians used FELs most often included DM (92.1%) followed by overweight and obesity patients (89.8%). However, as described in Table 4.5, 90.6% of dietitians reported also using FELs for other additional miscellaneous conditions, which included, micronutrient malnutrition management (7.1%); eating disorders (15%); food allergies (15%); and enteral feeding (15%).

Table 4.5: The use of food exchange lists by dietitians in South Africa

Variable	n	%
Dietitians using FELs (N = 131)		
Yes, currently	95	72.5
Not at the moment, but I did in the past	32	24.4
No	4	3.1
Tasks for which FELs are used (n = 127)		
Dietary analysis	49	38.6
Meal planning and compiling menus	117	92.1
Nutrition counselling and education	86	67.7
Training of students	19	15.0

Reasons for not using FELs (n = 32)		
FELs are impractical	8	25.0
FELs are too complicated	4	12.5
FELs are not up to date	4	12.5
Other	2	6.3
N / A in area of work	7	21.9
Using general dietary guidelines	4	12.5
Frequency of use (n = 126)		
Every day	30	23.8
2 to 3 times per week	34	27.0
Once a week	25	19.8
< Once per week	37	29.4
Patient profile (n = 127)		
Diabetes (all types)	117	92.1
Cardiovascular disease / hypertension	67	52.8
Renal disease	79	62.2
Weight management (for weight loss)	114	89.8
Undernutrition / malnutrition (for weight gain)	55	43.3
Gastrointestinal tract diseases	37	29.1
Hypercatabolic conditions[#]	51	40.2
Sports nutrition	51	40.2
Healthy pregnant women	51	40.2
Healthy toddlers / children	27	21.3
Other additional conditions	115	90.6

[#]Hypercatabolic conditions: Cancer (22.1%); Human immunodeficiency virus (HIV)/ Acquired immunodeficiency syndrome (AIDS) (18.1%)

4.3.1 Associations between dietitians' socio-demographic information and the use of food exchange lists

As illustrated in Table 4.6, the current study did not find a statistically significant association between the use of FELs and dietitians' gender, age or years of practising experience. However, there was a statistically significant association between the area of work and the use of FELs p = (0.0008). A larger proportion of dietitians working in the private sector were currently using FELs compared dietitians working in the public

or research sector. Also, as shown in Table 4.6, this study found a statistically significant association between the use of FELs and dietitians' home language (p = 0.0339). A larger proportion of dietitians with Afrikaans or English as a home language were currently using FELs compared to dietitians with home languages other than Afrikaans or English. A larger percentage of dietitians who reported English as their home language were employed in the private sector (60.3%) compared to 31.60% in government and 47.1% in tertiary education institutions.

Table 4.6: Associations between the use of food exchange lists and dietitians' socio-demographic information

	Currently use		Previously used		Do not use		p-value
	n	%	n	%	n	%	
Gender (N = 131)							0.6604
Male	3	60.0	2	40.0	0	0.0	
Female	92	73.0	30	23.8	4	3.2	
Age (N = 131)							0.0574
<30 years	40	63.5	21	33.3	2	3.2	
≥30 years	55	80.9	11	16.2	2	2.9	
Years of practice (n = 125)							0.3283
≤5 years	38	67.9	17	30.4	1	1.8	
>5 years	54	78.3	13	18.8	2	2.9	
Area of work (n = 128)							**0.0008**
Government	21	55.3	13	34.2	4	10.5	
Private	63	86.3	10	13.7	0	0.0	
Tertiary / pharmaceutical /research	11	64.7	6	35.3	0	0.0	
Home language (N=131)							**0.0339**
Afrikaans / English	90	73.8	30	24.6	2	1.6	
Other	5	55.6	2	22.2	2	22.2	

Additionally, as indicated in Table 4.7, a statistically significant association between area of employment and the use of FELs for counselling or education existed. A larger

proportion of private practising dietitians used FELs for counselling compared to dietitians working in government or research / training / pharmaceutical settings (p = 0.0087). Likewise, significantly more dietitians working in tertiary educations used FELs for training purposes compared to dietitians employed in government or private settings (p< 0.0001). A statistically significant association was found between the area of employment and the use of FELs in the management of HIV / AIDS in the current study. A larger proportion of dietitians working in government settings (35.3%) used FELs in the management of HIV / AIDS compared to private practising dietitians (12.3%) (p = 0.0178). No statistically significant associations were found between area of practice and the use of FELs for other health and disease conditions (p> 0.05).

Table 4.7: Associations between area of employment and the functions and patient profile for which dietitians use food exchange lists

	Government		**Private**		**Tertiary/ pharmaceutical/ research**		**p-value**
	n	**%**	**n**	**%**	**n**	**%**	
Function of FELs (n = 124)							
Dietary analysis	12	35.3	24	32.9	11	64.7	0.0605
Meal planning and compiling menus	33	97.1	67	91.8	14	82.4	0.1674
Nutrition counselling and education	21	61.8	57	78.1	7	41.2	**0.0087**
Training of students	6	17.7	3	4.1	10	58.8	**<0.0001**
Patient profile (n = 124)							
HIV / AIDS	12	35.3	9	12.3	2	11.8	**0.0178**

4.4 The provision of food exchange lists to patients

As per Table 4.8, 78.6% of dietitians reported providing patients with FELs, although 66.7% stated that the decision to give a FEL is patient dependent. A larger proportion of the dietitians who provided FELs to patients invariably, reported using simplified, personalised FELs (53.3%) compared to dietitians who provided patients with a FEL respective of the situation (39.3%).

Regarding the patient specifics which influence the decision to give patients a FEL, as depicted in Table 4.8, the main contributing factor was patients' literacy level (78.6%), although 10.7% of dietitians reported that both literacy level and patient preference are considered. While 29.2% of dietitians reported that patients speaking different languages cannot use FELs, which was one of the challenges experienced with using FELs, a mere 10.2% reported language as one of the factors informing the decision to provide FELs to patients (Table 4.8).

Table 4.8: The use of food exchange lists by patients

Variable	n	%
Provision of FELs to patients (n = 126)		
Yes, I always give the patient a food exchange list	15	11.9
Yes, depending on the patient / situation	84	66.7
I never give patients food exchange lists	27	21.4
Type of FELs provided to patients (n = 100)		
The same food exchange list used in dietary analysis and meal planning	17	17.0
A simplified, generic food exchange list	47	47.0
A simplified, personalised food exchange list	53	53.0
Influencing factors (n = 98)		
Disease / condition	59	60.2
Literacy level of the patient	77	78.6
Patient preference	54	55.1
Age	23	23.5
Gender	3	3.1
Language	10	10.2
Other[#]	2	2.0

[#] Other: dietary diversity; patient compliance; nutritional literacy

4.4.1 Associations between dietitians' age and the provision of food exchange lists to patients

As seen in Table 4.9, there was a statistically significant association between dietitians' age and the provision of FELs to patients. A larger proportion of older dietitians provided FELs to patients respective of the situation, whereas a greater percentage of younger dietitians admitted to never providing patients with FELs (p =

0.0010). As shown in Table 4.9, no statistically significant difference was found between age and language as a deciding factor in the provision of FELs to patients (p = 1.0000). A statistically significant association was found between dietitians' age (Table 4.9) and literacy level as a deciding factor in the provision of FELs to patients. A larger proportion of older dietitians considered the patient's literacy level in the decision to provide a FEL (p = 0.0251).

Table 4.9: Association between dietitians' age and the provision of food exchange lists to patients

	<30 years		≥30 years		p-value
	n	%	N	%	
Provision of FELs to patients (n = 126)					**0.0010**
Yes, I always give the patient a food exchange list	7	11.7	8	12.1	
Yes, depending on the patient / situation	32	53.3	52	78.8	
I never give patients food exchange lists	21	35.0	6	9.1	
Factors affecting the provision of FELs to patients (n = 95)					
Literacy level of the patient	29	67.4	48	87.3	**0.0251**
Language	4	9.3	6	10.9	1.0000

4.4.2 Associations between dietitians' area of employment and the provision of food exchange lists to patients

As per Table 4.10, a statistically significant association was found between dietitians' area of employment and literacy level as a deciding factor in the provision of FELs to patients. A larger proportion of dietitians working in the public sector (p = 0.0096) considered patients' literacy level in the decision to provide FELs. Conversely, no statistically significant association was found between area of employment and the provision of FELs to patients, as illustrated in Table 4.10. However, a statistically significant association, as presented in Table 4.10, was found between area of employment and language as a contributing factor in the decision to provide a FEL. A larger proportion of dietitians working in the public sector used language in their

decision to provide patients with FELs compared to dietitians employed in the private sector (p = 0.0181).

Table 4.10: Association between dietitians' area of employment and the provision of food exchange lists to patients

	Government		Private		Tertiary/ pharmaceutical / research		p-value
	n	%	n	%	n	%	
Provision of FELs to patients (n = 126)							0.2162
Yes, I always give the patient a FEL	2	5.9	13	18.1	0	0.0	
Yes, depending on the patient / situation	24	70.6	46	63.9	13	76.5	
I never give patients FELs	8	23.5	13	18.1	4	23.5	
Factors affecting the provision of FELs to patients (n = 95)							
Literacy level of the patient	26	92.9	35	67.3	14	93.3	**0.0096**
Language	7	25.0	3	5.8	0	0.0	**0.0181**

4.4.3 Associations between dietitians' home language and the provision of food exchange lists to patients

As per Table 4.11, no significant associations were found between dietitians' home language and either literacy level or patients' language as a deciding factor to provide patients with FELs (p> 0.05).

Table 4.11: Association between dietitians' home language and the provision of food exchange lists to patients

	Afrikaans / English		Other		p-value
	n	%	n	%	
Provision of FELs to patients (n = 126)					0.5950
Yes, I always give the patient a FEL	14	11.8	1	14.3	
Yes, depending on the patient / situation	80	67.2	4	57.1	
I never give patients FELs	25	21.0	2	28.6	

Factors affecting the provision of FELs to patients (n = 98)					
Literacy level of the patient	73	78.5	4	80.0	1.0000
Language	9	9.7	1	20.0	0.4231

4.5 Dietitians' perceptions regarding adapting food exchange lists for various literacy levels in South Africa

As per Table 4.12, 58.6% of dietitians reported that FELs should be adapted for various literacy levels in South Africa, of which 30.0% stated that FELs should be adapted to a literacy level of Grade 8-9. No statistically significant associations were found between the perception to adapt FELs for various literacy levels and either dietitians' age, area of employment or home language ($p > 0.05$).

Table 4.12: Dietitians' perceptions regarding adapting food exchange lists for various literacy levels in South Africa

Variable	n	%
FELs should be adapted for various literacy levels in South Africa (n = 128)		
Yes	75	58.6
No	34	26.6
Unsure	19	14.8
Literacy levels for which FELs should be adapted to in South Africa (n = 120)		
Grade 1 - 3	7	5.8
Grade 3 - 7	25	20.8
Grade 8 - 9	36	30.0
Grade 10 - 11	30	25.0
Obtained matric	21	17.5
Tertiary education	1	0.8

4.6 Alternative tools to food exchange lists, used as part of the nutrition care process

Seeing as 24.1% of participants reported never providing patients with FELs (Table 4.8) and 3.1% not using FELs at all (Table 4.5), this study also investigated alternative tools used by South African dietitians in practice. Firstly, as represented in Table 4.13, the study investigated alternative tools used as part of the nutrition intervention phase of the NCP in the event that dietitians decided not to provide FELs to patients. Although the literacy level of patients contributes greatly towards the decision to provide FELs to patients, as indicated in Table 4.13, only 5.4% of dietitians reported using visual tools as an alternative to FELs when it was decided not to give a FEL. Although, 28.2% of dietitians reported using visual tools instead of or in combination with FELs in dietary counselling (Table 4.13). Furthermore, Table 4.13 shows that 85.7% of dietitians alternatively made use of nutritional guidelines in the form of educational materials for dietary counselling. Also, 64.3% of dietitians used sample meal plans comprising a limited number of options for the patient to choose from as an alternative to FELs. However, a larger proportion of dietitians reported using a combination of alternative tools. While 26.0% reported using both, the “OR” method for sample meal plans as well as nutritional guidelines, 16.8% purely used nutritional guidelines instead of FELs. Regarding sample meal plans, as illustrated in Table 4.13, the “OR” method (64.3%), which allows for greater flexibility within the diet, was preferred by dietitians to set menus (34.8%). Although, there was no statistically significant association found between either area of employment, age or number of years’ experience and alternatives to FELs provided to patients by dietitians in practice ($p > 0.05$).

Additionally, the study investigated alternative tools being used instead of or in combination with FELs in various parts of the NCP. Just over half (51.6%) of dietitians preferred using alternative tools to the FELs in the NCP. The tool of choice differed between the stages of the NCP, with 15.3% of dietitians reported using food analysis software or composition tables for dietary analysis instead of or in combination with FELs. A small percentage (17.6%) used other tools for dietary analysis, of which the most mentioned tools were visual tools, including plate / hand models and the food guide pyramid, or pre-calculated meal plans / menus. As for meal planning, the alternative tool / s used by 16.0% of dietitians were nutrition education materials / guidelines / models, whereas for nutritional counselling 28.2% of dietitians reported

using visual tools instead of or in combination with FELs. The main reason for using alternative tools to FELs as part of the NCP was convenience (27.5%).

Table 4.13: Alternatives to food exchange lists as part of the nutrition intervention phase of the nutrition care process

Variable	n	%
Alternatives used in the absence of FELs (n = 112)		
Sample meal plans / menus not requiring the use of FELs, e.g. cycle menus	39	34.8
Nutrition guidelines, related to the specific disease / condition	96	85.7
Sample meal plans / menus where you use the 'OR' method, e.g. 2 starch exchanges = 2 small slices of bread OR 1 cup of soft maize meal OR 1 cup of cooked brown rice, etc	72	64.3
Visual tools / guidelines e.g. plate model / hand model / pictures	6	5.4
Dietitians use alternative tools instead of FELs in the NCP (n = 128)		
Yes	66	51.6
No	52	40.6
Unsure	10	7.8
Alternative tools used for dietary analysis (N = 131)		
Subjective dietary assessment methods	12	9.2
Nutrition related health applications	8	6.1
Food analysis software / composition tables	20	15.3
Other	23	17.6
Nutrition information labels	3	2.3
Alternative tools used for meal planning (N = 131)		
Subjective dietary assessment methods	5	3.8
Nutrition related health applications	8	6.1
Food analysis software / composition tables	9	6.9
Nutrition information labels	2	1.5
Meal plans / menus / recipe books	12	9.2
Nutrition education materials / guidelines / models	21	16.0
Other	5	3.8
None	9	6.9
Alternative tools used for counselling and education (N=131)		

Nutrition related health applications	3	2.3
Nutrition education materials / guidelines	32	24.4
Visual aids / models	37	28.2
Food groups / meal plans / nutrition information labels	12	9.2
Other	3	2.3
None	3	2.3
Reason for using alternatives instead of FELs (N=131)		
Use in combination with FELs	7	5.3
Alternative tools are available / accessible	4	3.1
FELs are inadequate	11	8.4
FELs are not population specific	13	9.9
Alternative tools are more convenient	36	27.5
General guidelines are preferred	4	3.1
Other	4	3.1

4.6.1 Associations between dietitians' socio-demographic information and alternative tools / methods used instead of or in combination with food exchange lists as part of the nutrition care process

As per Table 4.14, although a statistically significant association was found between dietitians' area of employment and the use of nutritional labels for dietary analysis, the percentage of dietitians using nutritional labels for dietary analysis was small. Only 5.9% of dietitians working in tertiary education / research institutions and the private sector used nutritional labels for dietary analysis compared to dietitians employed in government settings (0.0%) ($p = 0.0256$).

Table 4.14: Association between dietitians' area of employment and tools used instead of or in combination with food exchange lists in various parts of the nutrition care process

	Government		Private		Tertiary/ pharmaceutical/ research		p-value
	n	%	n	%	n	%	
The use of alternative tools for dietary analysis (N = 131)							**0.0256**
Nutrition labels	0	0.0	1	1.4	1	5.9	

As shown in Table 4.15, a larger proportion of dietitians above 30 years of age used meal plans / menus / recipe books for meal planning (p = 0.0047) apart from the use of FELs, while a larger proportion of dietitians younger than 30 years used food analysis software / composition tables (p = 0.0142). Also, a statistically significant association was found between dietitians' age and the use of visual aids in dietary counselling. A larger proportion of dietitians above 30 years of age reported using visual aids in dietary counselling compared to younger dietitians (p = 0.0324).

Table 4.15: Association between dietitians' age and tools used instead of or in combination with food exchange lists in various parts of the nutrition care process

	<30 years		≥30 years		p-value
	n	%	n	%	
The use of alternative tools for meal planning and menus (N = 131)					
Meal plans / menus / recipe books	1	1.6	11	16.2	**0.0047**
Food analysis software / composition tables	8	12.7	1	1.5	**0.0142**
The use of alternative tools for counselling (N = 131)					
Visual aids / models	12	19.1	25	36.8	**0.0324**

As indicated in Table 4.16, a significantly larger proportion of dietitians with more than five years practice experience used meal plans / menus / recipe books apart from FELs for meal planning compared to dietitians with ≤5 years' experience (p = 0.0191).

Table 4.16: Association between dietitians' years of experience and tools used instead of or in combination with food exchange lists in various parts of the nutrition care process

	≤5 years		>5 years		p-value
	N	%	n	%	
The use of alternative tools for meal planning and menus (N = 131)					
Meal plans / menus / recipe books	1	1.8	11	15.9	**0.0191**

4.7 Sources of and resources used to modify food exchange lists

Considering the importance of evidence-based practice, this study investigated the sources from which dietitians obtained FELs, as well as the resources used to update or design FELs. As per Table 4.17, 78.7% of dietitians obtained FELs through a university, while 33.1% reported designing FELs themselves.

As seen in Table 4.17, product packaging was the most used resource (70.7%) in FEL development by dietitians; however, there was no statistically significant association between either age or area of practice and resources used to modify FELs.

Table 4.17: Sources used by dietitians in South Africa to obtain and update food exchange lists

Variable	n	%
Source of FELs in use (n = 127)		
Self-designed	42	33.1
University	100	78.7
American Diabetes / Dietetic Association	28	22.1
Unsure	6	4.7
Other[#]	6	4.7

[#] textbooks 66.7%; online (e.g. websites and social media) 33.3%

Resources used to self-design FELs (n = 41)		
Product packaging (e.g. nutritional information on labels)	29	70.7
Food analysis software (e.g. Foodfinder / Foodfundi)	15	36.6
South African Food Composition Database	21	51.2
Textbooks [#]	9	22.0
Other[##]	7	17.1

[#] Krause's Food & the Nutrition Care Process 77.8%

[##] Online (e.g. Google or health applications) 71.3%

4.7.1 Associations between dietitians' socio-demographical information and sources of and resources used to modify food exchange lists

As shown in Table 4.18, a statistically significant association was found between dietitians' age and the source from which FELs were obtained. A larger proportion of older dietitians reported self-designing FELs compared to a greater percentage of younger dietitians who obtained FELs from a university (p = 0.0001).

Table 4.18: Association between dietitians' age and the source of food exchange lists

	<30 years		≥30 years		p-value
	n	%	n	%	
Source of FELs in use (n = 127)					
Self-designed	10	16.4	32	48.5	**0.0001**
University	57	93.4	43	65.2	**<0.0001**

As per Table 4.19, there was a statistically significant association between dietitians' area of employment and the source of FELs. A larger proportion of dietitians working in the private sector or tertiary education / research setting self-designed FELs, whereas dietitians working in the public sector obtained FELs from a university (p< 0.05).

Table 4.19: Association between dietitians' area of employment and the source food exchange lists

	Government		Private		Tertiary/ pharmaceutical/ research		p-value
	n	%	n	%	n	%	
Source of FELs in use (n = 124)							
Self-designed	5	14.7	31	42.5	6	35.3	**0.0136**
University	31	81.2	50	68.5	16	94.1	**0.0065**

4.7.2 Relationship between the source of food exchange lists and the provision of FELs to patients

Table 4.20 shows that a larger percentage of dietitians who obtained FELs from a university, also reported providing patients with FELs respective of the situation, as opposed to always or never providing patient with FELs.

Table 4.20: Provision of food exchange lists to patients by dietitians who obtained FELs from a university

Variable	n	%
Provision of FELs to patients (N = 131)		
Yes, I always give the patient a food exchange list	5	3.8
Yes, depending on the patient / situation	35	26.7
I never give patients food exchange lists	20	15.3

4.8 Perceived knowledge, time, and resources available to dietitians for the modification of food exchange lists

To understand the obstacles encountered in updating FELs, this study investigated dietitians' perceptions regarding the availability of resources to modify the FEL. As seen in Table 4.21, 58.8% of dietitians perceived their knowledge on FELs to be adequate to update FELs, while 41.2% were either unsure or did not feel they have

sufficient knowledge on the topic. While 40.0% of dietitians reported not having enough resources available to update FELs, a large proportion of dietitians mentioned an accurate, comprehensive South African nutritional analysis database as the limiting resource. However, lack of time was the limitation experienced by the majority (80.0%) of dietitians, as shown in Table 4.21.

Table 4.21: Dietitians' perceptions regarding resources required for updating food exchange lists in South Africa

Variable	n	%
Dietitians' perceptions regarding adequate knowledge on FELs (N = 131)		
Yes	77	58.8
No	33	25.2
Unsure	21	16.0
Dietitians' perceptions regarding adequate resources available (n = 130)		
Yes	48	36.9
No	52	40.0
Unsure	30	23.1
Dietitians' perceptions regarding adequate time available (n = 130)		
Yes	22	16.9
No	104	80.0
Unsure	4	3.1

4.9 Associations between dietitians' socio-demographic information and dietitians' perceived knowledge, time, and resources available to modify food exchange lists

As shown in Table 4.22, a larger proportion of older dietitians perceived their knowledge on FELs to be sufficient to update FELs compared to younger dietitians ($p = 0.0055$).

Table 4.22: Association between dietitians' age and dietitians' perceptions regarding available resources to update food exchange lists

	<30 years		≥30 years		p-value
	n	%	n	%	
Dietitians' perceptions regarding knowledge of FELs (N = 131)					**0.0055**
Yes, I have enough knowledge to self-design FELs	28	44.4	49	72.1	
No, I do not have enough knowledge to self-design FELs	22	34.9	11	16.2	
Unsure	13	20.6	8	11.8	
Dietitians' perceptions regarding time available to update FELs (n = 127)					0.6531
Yes, I have enough time to self-design FELs	10	15.9	12	17.9	
No, I do not have enough time to self-design FELs	50	79.4	54	80.6	
Unsure	3	4.8	1	1.5	
Dietitians' perceptions regarding resources available to update FELs (n = 130)					0.4346
Yes, I have enough resources to self-design FELs	20	31.8	28	41.8	
No, I do not have enough resources to self-design FELs	26	41.3	26	38.8	
Unsure	17	27.0	13	19.4	

Even though a significantly larger proportion of dietitians working in the private sector were older and an association existed between age and perceived knowledge of FELs, there was no statistically significant association found between dietitians' area of employment and knowledge, as illustrated in Table 4.23.

Table 4.23: Association between dietitians' area of employment and dietitians' perceptions on available resources to update food exchange lists

	Government		Private		Tertiary/ pharmaceutical/ research		p-value
	n	%	n	%	n	%	
Dietitians' perceptions regarding knowledge of FELs (N = 131)							0.5253
Yes, I have enough knowledge to self-design FELs	20	52.6	44	60.3	12	70.6	
No, I do not have enough knowledge to self-design FELs	12	31.6	15	20.6	4	23.5	
Unsure	6	15.8	14	19.2	1	5.9	
Dietitians' perceptions regarding time available to update FELs (n = 127)							0.0814
Yes, I have enough time to self-design FELs	2	5.3	15	20.8	3	17.7	
No, I do not have enough time to self-design FELs	33	86.8	56	77.8	1	82.4	
Unsure	3	7.9	14	1.4	0	0.0	
Dietitians' perceptions regarding resources available to update FELs (n = 127)							0.0740
Yes, I have enough resources to self-design FELs	14	36.8	26	35.6	8	50.0	
No, I do not have enough resources to self-design FELs	10	26.3	35	48.0	5	31.3	
Unsure	14	36.8	12	16.4	3	18.8	

4.10 Updating food exchange lists

Table 4.24 shows that 30.7% of dietitians were unsure when the FEL used by them in practice was last reviewed. It follows that 67.9% of dietitians were of opinion that the FEL is due for an update. The main motivation for an update was to add food items that are obtainable in South Africa, seeing as 46.6% of dietitians perceived FELs as not being comprehensive enough (Table 4.24). Likewise, 46.2% of dietitians reported that one of the challenges experienced with using FELs was that it becomes outdated quickly with food products constantly being added or removed from the market. Additionally, 12.5% of dietitians reported to not use FELs due to it being outdated (Table 4.5). While 19.9% of dietitians, as shown in Table 4.24, reported FELs should be updated due to changes in portion sizes, which adds to the questionability of FELs' accuracy, 36.9% suggested that FELs contain portion sizes that are impractical for patients eating away from home, where there are no measuring utensils available. Among other comments (Table 4.24), dietitians' uncertainty regarding the specifics of the FELs used by colleagues (33.3%) was revealed, as some reported only being familiar with the FEL they themselves used in practice.

Table 4.24: Dietitians' perceptions regarding the update of food exchange lists that are currently being used in South Africa

Variable	n	%
Time since FELs in use have last been updated (n = 127)		
<1 year ago	13	10.2
1 to 2 years ago	31	24.4
3 to 5 years ago	26	20.5
>5 years ago	18	14.2
Unsure	39	30.7
FELs due for an update (N = 131)		
Yes	89	67.9
No	20	15.3
Unsure	22	16.8

Motivations for and against an update of current FELs (N = 131)		
Current South African specific products should be added / FELs are not comprehensive enough	61	46.6
Unsure when last current FELs have been updated / FELs need to be updated every few years	31	23.7
Changes that occurred e.g. portion sizes / recipes should be reflected / accuracy of FELs is questionable	26	19.9
FELs need to be updated to reflect changes in lifestyle e.g. convenience foods / supplements	17	13.0
Miscellaneous motivations in favour of an update[#]	20	15.3
Miscellaneous motivations against an update[##]	16	12.2
Other	18	13.7

[#] Vegan / vegetarian options need to be more comprehensive 6.1%; FELs should be more user friendly 6.1%; FELs currently in use are not standardised 3.1%

[##] FELs in use have recently been updated 4.6%; current FELs are accurate and relevant / nutritional content remains the same over time 3.8%; FELs in use are comprehensive enough 3.1%; FELs in use are user friendly 0.8%

4.10.1 Associations between dietitians' socio-demographic information and the updating of food exchange lists

Statistical significance was determined by means of Chi-square and Fisher's exact tests. From Table 4.25 it is evident that there was a statistically significant association between dietitians' age and the time since the FEL has last been updated as reported by dietitians ($p = 0.0008$). Although a larger proportion of older dietitians reported that the FELs used in practice, have been updated within the last two years compared to younger dietitians, further post-hoc tests would be needed to determine the time period for which the difference between age and time since the FEL has been updated were statistically significant. However, there were no statistically significant associations found between dietitians' age and the perceived need to update the FELs used in practice. Although, a slightly larger percentage of the younger dietitians (Table 4.25) compared to older dietitians reported that FELs should be updated.

Table 4.25: Association between dietitians' age and the time since the food exchange lists used in practice have been updated

	<30 years		≥30 years		p-value
	n	%	n	%	
Time since FELs in use have last been updated (n = 127)					**0.0008**
<1 year ago	3	4.9	10	15.2	
1 to 2 years ago	8	13.1	23	34.9	
3 to 5 years ago	17	27.9	9	13.6	
>5 years ago	7	11.5	11	16.7	
Unsure	26	42.6	13	19.7	
FELs due for an update (N = 131)					0.6656
Yes	45	71.4	44	64.7	
No	8	12.7	12	17.7	
Unsure	10	15.9	12	17.7	

Additionally, Table 4.26 shows that there was also a statistically significant association between dietitians' area of employment and the time since the FEL was last updated ($p = 0.0053$). A larger proportion of dietitians working in private practice reported the FEL was updated within the last two years compared to more dietitians working in the public sector being unsure when last the FEL was updated. However, there were no statistically significant associations found between dietitians' area of employment and the perceived need to update the FELs used in practice. Although, a slightly larger percentage of dietitians working in the private sector (Table 4.26) compared to those employed in the public sector reported that FELs should be updated.

Table 4.26: Association between dietitians' area of employment and the time since the food exchange lists used in practice have been updated

	Government		Private		Tertiary/ pharmaceutical/ research		p-value
	n	%	n	%	n	%	
Time since FELs in use have last been updated (n = 124)							**0.0053**
<1 year ago	1	2.9	11	15.1	1	5.9	
1 to 2 years ago	4	11.8	19	26.0	6	35.3	
3 to 5 years ago	6	17.7	19	26.0	1	5.9	
>5 years ago	10	29.4	4	5.5	4	23.5	
Unsure	13	38.2	20	27.4	5	29.4	
FELs due for an update (n = 128)							0.0974
Yes	22	57.9	55	75.3	11	64.7	
No	6	15.8	8	11.0	5	29.4	
Unsure	10	26.3	10	13.7	1	5.9	

4.11 Usefulness of food exchange lists

As per Table 4.27, 78.6% of dietitians perceived FELs as useful to them; however, only 62.3% found it useful to their patients. Furthermore, as shown in Table 4.8, a total of 78.6% of dietitians provided FELs to patients, even though Table 4.27 indicates that 23.9% of dietitians were unsure whether patients find FELs useful. Furthermore, Table 4.27 indicates that 26.0% of dietitians perceived FELs as useful given the basic framework it provides, while the flexibility offered by FELs was the main reason dietitians felt patients find FELs useful (30.5%). Conversely, 27.5% of dietitians (Table 4.27) argued that FELs are too complex and impractical for patient use, leading to confusion, which affects its usefulness. This correlates with the challenges experienced with using FELs earlier referred to in Table 4.5.

Other challenges reported by 18.5% of dietitians included mistakes found in FELs, which correlated with Table 4.27 showing that 4.6% of dietitians perceived FELs as less useful due to inaccuracies.

Furthermore, Table 4.27 reveals that 30.5% of dietitians found FELs useful in various steps of the NCP. A slightly higher percentage of dietitians perceived FELs to be useful

to patients (32.8%) in various phases of the NCP as opposed to dietitians. Also, only 6.1% of dietitians found FELs useful in dietary analysis and 12.2% in meal planning, compared to 19.9% who perceived FELs useful to patients in dietary analysis and meal planning.

Table 4.27: Dietitians' perceptions regarding the usefulness of food exchange lists

Variable	n	%
Useful to dietitians (N = 131)		
Yes	103	78.6
No	11	8.4
Unsure	17	13.0
Useful to patients (n = 130)		
Yes	81	62.3
No	18	13.9
Unsure	31	23.9
Motivations provided regarding the usefulness of FELs to dietitians (N = 131)		
FELs are not comprehensive and relevant	27	20.6
Other	17	13.0
FELs are user friendly / provide a basic framework	34	26.0
FELs are adequate	26	19.9
FELs provide flexibility	16	12.2
FELs are useful in counselling / education	16	12.2
FELs are useful in meal planning	16	12.2
Miscellaneous motivations supporting the usefulness of FELs[#]	13	9.9
Miscellaneous motivations opposing the usefulness of FELs[##]	21	16.0

[#] FELs are comprehensive and relevant 3.8%; FELs are useful in dietary analysis 6.1%

[##] Using FELs is time consuming 2.3%; FELs are not population specific 6.9%; FELs are not standardised 2.3%; FELs are not accurate 4.6%

Motivations provided regarding the usefulness of FELs to patients (N = 131)		
FELs are impractical / too complex	36	27.5
FELs are useful if population / patient specific	24	18.3
FELs provides flexibility	40	30.5
Other[#]	33	25.2
FELs are useful in meal planning / dietary analysis / portion control	26	19.9
FELs are useful in counselling / education	17	13.0

[#] FELs are irrelevant 0.8%; FELs' usefulness is limited in illiterate patients 3.8%; FELs are user friendly 3.1%; Miscellaneous 17.6%

4.11.1 Associations between dietitians' socio-demographic information and the usefulness of food exchange lists

No significant associations were found between the usefulness of FELs and dietitians' age (Table 4.28), area of employment (Table 4.29), or home language (Table 4.30).

Table 4.28: Association between dietitians' age and the usefulness of food exchange lists

	<30 years		≥30 years		p-value
	n	%	n	%	
Useful to dietitians (N = 131)					0.9514
Yes	49	77.8	54	79.4	
No	5	7.9	6	8.8	
Unsure	9	14.3	8	11.8	
Useful to patients (n = 130)					0.0813
Yes	33	53.2	48	70.6	
No	9	14.5	9	13.2	
Unsure	20	32.3	11	14.2	

Table 4.29: Association between dietitians' area of employment and usefulness of food exchange lists

	Government		Private		Tertiary/ pharmaceutical/ research		p-value
	n	%	n	%	n	%	
Useful to dietitians (n = 128)							0.1411
Yes	33	86.8	52	71.2	15	88.2	
No	2	5.3	7	9.6	2	11.8	
Unsure	3	7.9	14	19.2	0	0.0	
Useful to patients (n = 127)							0.3852
Yes	19	51.4	49	67.1	12	70.6	
No	8	21.6	7	9.6	2	11.8	
Unsure	10	27.0	17	23.3	3	17.7	

Table 4.30: Association between dietitians' language and the usefulness of food exchange lists

	Afrikaans / English		Other		p-value
	n	%	n	%	
Useful to dietitians (N = 131)					1.0000
Yes	95	77.9	8	88.9	
No	11	9.0	0	0.0	
Unsure	16	13.1	1	11.1	
Useful to patients (n = 130)					0.6985
Yes	76	62.8	5	55.6	
No	16	13.2	2	22.2	
Unsure	29	24.0	2	22.2	

4.12 Effectiveness of food exchange lists

As shown in Table 4.31 , 58.1% of dietitians reported that FELs are effective in dietary analysis, compared to a mere 6.1% (Table 4.27) who found FELs useful in dietary analysis. Consequently, as shown in Table 4.5, only 38.6% reported using FELs for this part of the NCP.

As for meal planning, Table 4.31 depicts that 93.9% of dietitians found FELs effective in dietary interventions. Even though 12.2% of dietitians found FELs useful in meal planning, as shown in Table 4.27, a greater percentage (19.9%) of dietitians perceived FELs in meal planning as useful to patients. Hence, as seen in Table 4.5, the majority of dietitians reported using FELs for meal planning (92.1%), although, **Error! Reference source not found.** shows that 16.0% of dietitians also use nutrition education materials / guidelines / models in meal planning.

With regards to nutritional counselling, as shown earlier, 67.7% (Table 4.5) of dietitians reported using FELs in dietary counselling, and although the perceived usefulness thereof to dietitians and patients ranged between 12.2% and 13% respectively (Table 4.27), Table 4.31 shows that 85.2% found FELs effective in counselling.

Table 4.31: Dietitians' perceptions regarding the effectiveness of food exchange lists used as part of the nutrition care process

Variable	n	%
Effectiveness of FELs used for dietary analysis (n = 129)		
Yes	75	58.1
No	35	27.1
Unsure	19	14.7
Effectiveness of FELs used in dietary interventions (n = 130)		
Yes	122	93.9
No	4	3.1
Unsure	4	3.1
Effectiveness of FELs used in counselling and education (n = 128)		
Yes	109	85.2
No	11	8.6
Unsure	8	6.3

4.12.1 Associations between dietitians' socio-demographic information and the effectiveness of food exchange lists

Although no significant associations were found between the effectiveness of FELs and age, as shown in Table 4.32, or language, as illustrated in Table 4.33, a statistically significant association between area of employment and the perceived effectiveness of FELs in dietary analysis was found. The languages selected by the majority of participants both as a home language and language used in practice, were grouped together as languages spoken by the majority of dietitians' vs languages spoken by smaller a smaller proportion of participants.

Table 4.32: Association between dietitians' age and dietitians' perceived effectiveness of food exchange lists

	<30 years		≥30 years		p-value
	n	%	n	%	
Effectiveness of FELs used for dietary analysis (n = 129)					0.2599
Yes	37	59.7	38	56.7	
No	19	30.7	16	23.9	
Unsure	6	9.7	13	19.4	
Effectiveness of FELs used in dietary interventions (n = 130)					0.0639
Yes	58	93.6	64	94.1	
No	3	4.8	1	1.5	
Unsure	1	1.6	3	4.4	
Effectiveness of FELs used in counselling and education (n = 128)					0.4543
Yes	54	87.1	55	83.3	
No	6	9.7	5	7.6	
Unsure	2	3.2	6	9.1	

Table 4.33: Association between dietitians' language and dietitians' perceived effectiveness of food exchange lists

	Afrikaans / English		Other		p-value
	n	%	n	%	
Effectiveness of FELs used for dietary analysis (n = 129)					0.3253
Yes	70	58.3	5	55.6	

No	31	25.8	4	44.4	
Unsure	19	15.8	0	0.0	
					0.4470
Effectiveness of FELs used in dietary interventions (n = 130)					
Yes	114	94.2	8	88.9	
No	3	2.5	1	11.1	
Unsure	4	3.3	0	0.0	
Effectiveness of FELs used in counselling and education (n = 128)					0.7725
Yes	101	84.9	8	88.9	
No	10	8.4	1	11.1	
Unsure	8	6.7	0	0.0	

To determine statistical significance between dietitians' area of employment and the perceived effectiveness of FELs, Fisher's Exact Test were performed. A statistically significant association was found between employment area and perceived effectiveness of FELs ($p = 0.0058$) (Table 4.34). As evident in Table 4.34, a larger proportion of dietitians working in government institutions perceived the use of FELs effective in dietary analysis (66.7%) compared to the private sector (46.6%). Also, a significantly greater percentage of dietitians working in tertiary education or research perceived FELs to be effective in dietary analysis (88.2%).

Table 4.34: Association between dietitians' area of employment and dietitians' perceived effectiveness of food exchange lists

	Government		Private		Tertiary/ pharmaceutical/ research		p-value
	n	%	n	%	n	%	
Effectiveness of FELs used for dietary analysis (n = 126)							**0.0058**
Yes	24	66.7	34	46.6	15	88.2	
No	10	27.8	22	30.1	2	11.8	
Unsure	2	5.6	17	23.3	0	0.0	
Effectiveness of FELs used in dietary interventions (n = 127)							0.9498
Yes	34	91.9	68	93.1	17	100.0	
No	2	5.4	32	2.7	0	0.0	
Unsure	1	2.7	3	4.1	0	0.0	
Effectiveness of FELs used in counselling and education (n = 125)							0.6408
Yes	30	81.1	62	87.3	15	88.2	
No	3	8.1	5	7.0	2	11.8	
Unsure	4	10.8	4	5.6	0	0.0	

4.13 Advantages and challenges pertaining to the use of food exchange lists

Table 4.35 shows that most dietitians reported the use of FELs as an easy method to meal planning (78.5%), followed by the advantage of FELs providing flexibility to the diet (71.5%). Other advantages to using FELs in meal planning included, FELs saves time and labour (43.1%) and the perception that the use of FELs is the only method to calculate a meal plan and menus, based on the nutrition prescription (14.6%). Advantages to using FELs for dietary analysis reported by dietitians included: FELs are faster than using nutrient analysis software (43.1%) or a food composition database (36.9%); FELs are easier than using nutrient analysis software (33.9%) or a food composition database (31.5%); FELs provide the necessary information to make a nutrition diagnosis (29.2%). Dietitians noted that students have shown an increased understanding of certain concepts when explained in conjunction with FELs, including portion estimations (33.1%), meal planning (30.8%), and certain disease-specific

dietary management (29.2%). Other advantages reported by a smaller percentage of dietitians included the average nutrient values in FELs, which are more convenient than specific nutrient values and FELs containing generic information and not all the different brands available on the market.

To some dietitians simplicity is an advantage while 53.1% of dietitians reported that FELs are not comprehensive enough, which was the third most commonly reported challenge experienced with using FELs, as illustrated in Table 4.35. However, as shown in Table 4.27, more dietitians found FELs useful for the very reason of it providing a basic framework to work from, while the comprehensiveness of FELs did not influence dietitians' perceptions of its usefulness to them in practice to the same degree.

Other challenges with using FELs included the risk that FELs are distributed and used incorrectly by the wrong population groups (25.4%). Also, FELs do not distinguish between total carbohydrate and available carbohydrate (e.g. fibre content) (36.2%) or carbohydrate from added sugar (40.8%). While only 3.8% of dietitians perceived FELs as less useful due to its limited use in illiterate patients, as presented in Table 4.27, 60.8% of dietitians reported that the use of FELs in illiterate patients is limited, which was one of the main challenges experienced with using FELs, illustrated in Table 4.35.

Table 4.35: Dietitians' perceptions regarding advantages and challenges with using food exchange lists

Variable	n	%
Advantages of using FELs (n = 130)		
All dietitians in South Africa have access to some form of FEL.	77	59.2
FELs can be used in dietary analysis based on a diet history.	78	60.0
The use of FELs is an easy method to meal planning.	102	78.5
The use of FELs is a quick method to meal planning.	83	63.9
The use of FELs make the adjustment of menus and meal plans easier when the nutrition prescription changes.	69	53.1

FELs can be used in counselling of patients.	87	66.9
Using FELs in meal plans, give patients a feeling of control.	85	65.4
Using FELs in meal plans, provides patients with a variety of food to choose from.	93	71.5
Concepts, e.g. carbohydrate counting, are easier understood by patients when a FEL list is used as a counselling tool.	86	66.2
Challenges with using FELs (n = 130)		
FELs are not sensitive to the different cultural eating habits	80	61.5
FELs are not sensitive to different disease conditions	65	50.0
FELs cannot be used for patients that are illiterate.	79	60.8
FELs that I use are not comprehensive enough; many of the foods that my patients consume are not on the lists.	69	53.1

4.14 Adapting food exchange lists for various languages

As mentioned, no significant associations were found between dietitians' home language and either the perceived usefulness (Table 4.30) or effectiveness of FELs (Table 4.33). However, as previously referred to, Table 4.6 shows that a larger proportion of dietitians with Afrikaans or English as a home language were currently using FELs compared to dietitians with home languages other than Afrikaans or English. Although Table 4.11 shows that there was no statistically significant association between dietitians' home language and the provision of FELs to patients, Table 4.10 indicate that a larger proportion of dietitians working in the public sector used language in their decision to provide patients with FELs compared to dietitians employed in the private sector.

As presented in Table 4.36, 65.4% of dietitians stated that FELs should be available in various languages in South Africa. The top three languages dietitians reported FELs should be adapted for were isiZulu (23.7%), isiXhosa (22.9%), and Afrikaans (20.6%).

Table 4.36: Dietitians' perceptions regarding adapting food exchange lists for various languages in South Africa

Variable	n	%
FELs should be available in various languages (n = 129)		
Yes	83	65.4
No	23	18.1
Unsure	21	16.5
Languages in which FELs should be available in South Africa (N = 131)		
isiZulu	31	23.7
isiXhosa	30	22.9
Afrikaans	27	20.6
Setswana	7	5.3
Sesotho	23	17.6
Sepedi	2	1.5
English	4	3.1
Other	8	6.1
All official / local languages	18	13.7

4.14.1 Associations between dietitians' socio-demographic information and dietitians' perceptions regarding adapting food exchange lists for various languages in South Africa

To determine statistical significance between dietitians' home language and languages dietitians reported FELs should be adapted for, Fisher's Exact Test were performed. While there was no statistically significant association between dietitians' home language and the perception that FELs should be available in more languages, a statistically significant association was found between dietitians' home language and isiZulu as the language for which dietitians suggested FELs should be adapted. As shown in Table 4.37, 55.6% of dietitians with home languages other than Afrikaans or English reported that FELs should be adapted for isiZulu compared to 21.3% of dietitians with Afrikaans or English as a home language ($p = 0.0338$). However, no statistically significant associations were found between the opinion to adapt FELs for various languages and either the area of employment or dietitians' age ($p > 0.05$).

Additionally, there were no statistically significant associations between dietitians' area of employment or age and specified languages for which dietitians perceived FELs should be adapted (p> 0.05).

Table 4.37: Association between dietitians' home language and perception regarding adjusting food exchange lists for various languages in South Africa

	Afrikaans / English		Other		p-value
	n	%	n	%	
Should FELs be available in more languages (n = 127)					0.3119
Yes	75	63.6	8	88.9	
No	23	19.5	0	0.0	
Unsure	20	17.0	1	11.1	
In which other languages should FELs be available in South Africa (N = 131)					
isiZulu	26	21.3	5	**55.6**	**0.0338**
isiXhosa	26	21.3	4	44.4	0.2094
Afrikaans	24	19.7	3	33.3	0.3904
Sesotho	20	16.4	3	33.3	0.1937

4.15 Adapting food exchange lists for various socio-demographic patient groups

Even though language and literacy level were indicated as the most considered factors when deciding to equip patients with FELs, there are other aspects which should be accounted for when striving for an individualised approach to nutrition therapy. As shown earlier in Table 4.27, 18.3% of dietitians reported FELs are useful to patients given that it is patient specific. Also, as per Table 4.13**Error! Reference source not found.**, 9.9% of dietitians reported using alternative tools seeing as FELs are not population specific. Thus, this study investigated the use of FELs considering dietitians' perspectives regarding ethnic and cultural groups, as well as religion, socio-economic status, and patients' lifestyle choices.

As presented in Table 4.38, 85.3% of dietitians reported that it would be beneficial for dietitians to uniformly use standardised FELs, specifically designed for various ethnic

groups in South Africa. While the majority of dietitians perceived it necessary to have FELs adapted for most patient subgroups, less than half reported that FELs should be adapted for various religions or patients with different levels of socio-economic status. As presented earlier in Table 4.35, less than half (40.8%) of the dietitians reported that FELs are not sensitive to population groups where there is limited money available for food, and 61.5% of dietitians reported FELs are not culturally sensitive. However, as illustrated in Figure 4.1, the groups for which dietitians showed most uncertainty about, regarding the modification of FELs, included cultural and religious groups.

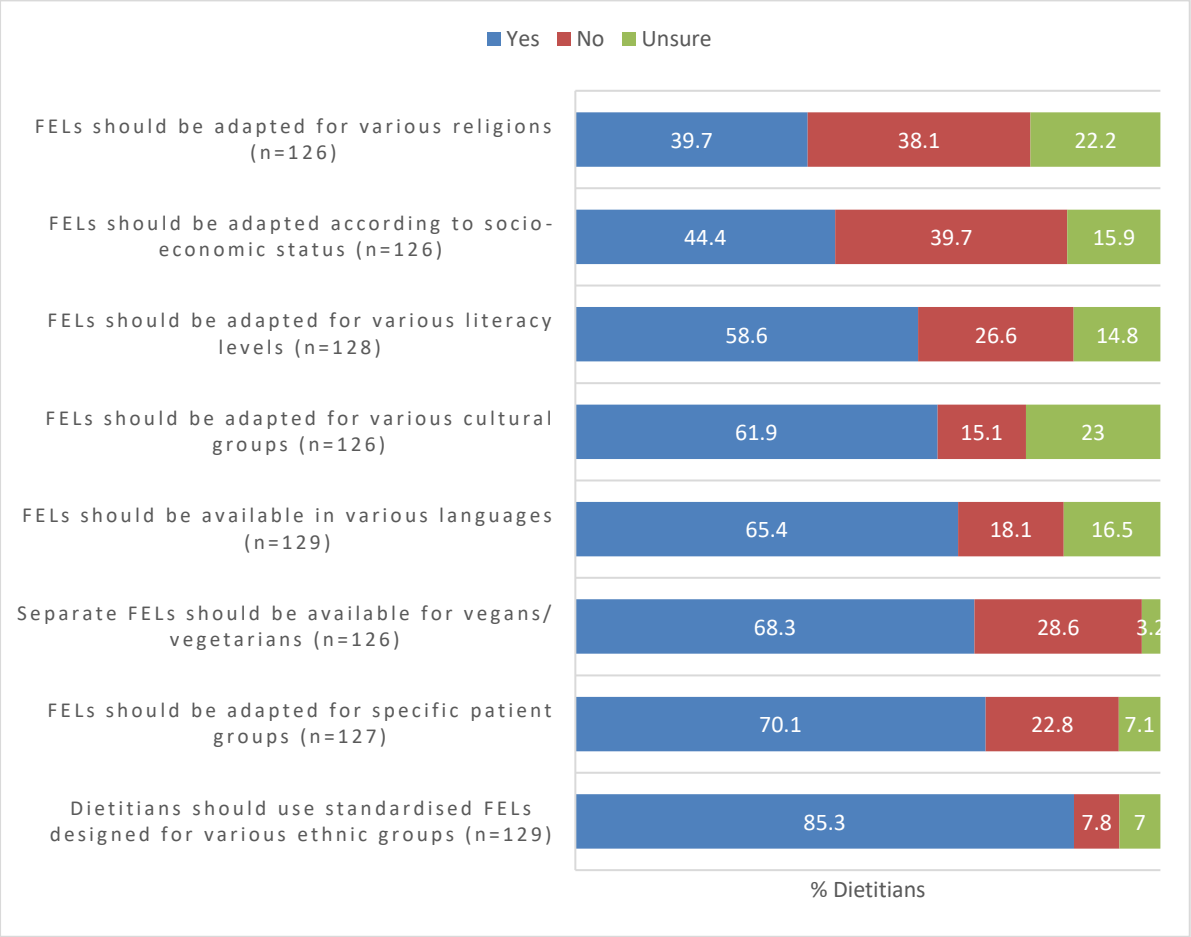

Figure 4.1: Dietitians' perceptions regarding population-specific food exchange lists in South Africa.

As per Table 4.38, 29.8% of dietitians indicated that FELs should be adapted for various African cultures, while 26.0% suggested that FELs should be adapted for the Muslim religion. Furthermore, as illustrated in Table 4.38, the majority of dietitians reported that FELs should be modified for vegans / vegetarians (68.3%) and specific

health or disease conditions (70.1%). The main patient group for which dietitians suggested FELs should be adapted was patients in different stages of the lifecycle (45.0%), followed by DM (29.0%) and renal disease (20.6%). This corresponds with the patient profile of DM (92.1%) and renal diseases (62.2%) for which dietitians reported using FELs, as presented earlier in Table 4.5. However, as shown in Table 4.38, less dietitians used FELs for patients in various stages of the life cycle, including paediatric patients (21.3%) and pregnant women (40.2%).

Table 4.38: Dietitians' perceptions regarding population-specific food exchange lists in South Africa

Variable	n	%
Standardised FELs should be designed for various ethnic groups (n = 129)		
Yes	110	85.3
No	10	7.8
Unsure	9	7.0
FELs should be adapted for various cultural groups in South Africa (n = 126)		
Yes	78	61.9
No	19	15.1
Unsure	29	23.0
Cultural groups for which FELs should be adapted in South Africa (N = 131)		
Various African cultures	39	29.8
Afrikaans culture	6	4.6
All cultures / all cultures based on demographics of the area	17	13.0
Indian / Cape Malay culture	26	19.9
Other	8	6.1
Vegan /Vegetarian	6	4.6
FELs should be adapted for various religions in South Africa (n = 126)		
Yes	50	39.7
No	48	38.1
Unsure	28	22.2

Religions for which FELs should be adapted in South Africa (N = 131)		
African traditional	3	2.3
All religions	4	3.1
Hindu	12	9.2
Jewish	17	13.0
Muslim	34	26.0
Vegan / Vegetarian	8	6.1
Other	10	7.6
FELs should be adapted according to socio-economic status in South Africa (n = 126)		
Yes	56	44.4
No	50	39.7
Unsure	20	15.9
Separate FELs should be available for vegans / vegetarians in South Africa (n = 126)		
Yes	86	68.3
No	36	28.6
Unsure	4	3.2
FELs should be adapted for specific patient groups (n = 127)		
Yes	89	70.1
No	29	22.8
Unsure	9	7.1
Specific patient groups for which FELs should be adapted in South Africa (N = 131)		
Allergies / food intolerances	6	4.6
Diabetes	38	29.0
Gastrointestinal disorders	8	6.1
Other	9	6.9
Cardiovascular diseases	10	7.6
Different life cycle stages	59	45.0
Malnutrition	8	6.1
Renal diseases	27	20.6

Sports nutrition	4	3.1
Vegans / Vegetarians	8	6.1

4.15.1 Associations between dietitians' socio-demographic information and dietitians' perceptions regarding adapting food exchange lists for various patient groups, based on patient socio-demographical characteristics

As illustrated in Table 4.39, there was a statistically significant association between dietitians' home language and religions for which dietitians reported FELs should be adapted. A larger proportion of dietitians with home languages other than Afrikaans or English recommended that FELs be adapted for the Muslim religion (66.8%) compared to dietitians with Afrikaans or English as a home language (23.0%) (p = 0.0095).

Table 4.39: Association between dietitians' home language and perception regarding adjusting food exchange lists for various religions in South Africa

	Afrikaans / English		Other		p-value
	n=122	%	n=9	%	
Religions for which FELs should be adapted in South Africa (N = 131)					
African traditional	2	1.6[#]	1	11.1	0.1937
All religions	3	11.1	1	11.1	0.2503
Hindu	12	9.8	0	0.0	1.0000
Jewish	17	13.9	0	0.0	0.6043
Muslim	28	23.0	6	66.8	**0.0095**
Vegan / Vegetarian	8	6.6	0	0.0	1.0000
Other	8	6.6	2	22.2	0.1416

#Percentages were calculated as follow:

2 of 122 participants who reported Afrikaans/English as a home language also selected African traditional religion as one of the religions for which FELs should be adapted

Also, as per Table 4.40, a statistically significant association was found between dietitians' years of experience and the religion for which they recommended that FELs be adapted. None of the dietitians with more than five years' experience recommended

that FELs should be adapted for the African traditional religion compared to 3.6% of dietitians with ≤5 years practice experience (p = 0.0313).

Table 4.40: Association between dietitians' years of experience and perception regarding adjusting food exchange lists for various religions in South Africa

	≤5 years		>5 years		p-value
	n	%	n	%	
Religions for which FELs should be adapted in South Africa (N = 131)					
African traditional	2	3.6	0	0.0	**0.0313**
All religions	1	1.8	3	4.4	0.6927
Hindu	4	7.1	8	11.6	0.7484
Jewish	3	5.4	13	18.4	0.0701
Muslim	14	25	18	26.1	0.8899
Vegan / Vegetarian	3	5.4	5	7.3	0.8199
Other	5	8.9	5	7.3	0.8682

Lastly, as depicted in Table 4.41, a statistically significant association was observed between the area of employment and the religion for which dietitians recommended FELs be adapted. While none of the dietitians working in the government setting recommended that FELs be adapted for the Hindu religion, 12.3% of dietitians working in private and 11.8% of dietitians employed in tertiary education / research areas suggested that FELs should be adapted for the Hindu religion (p = 0.0253). No statistically significant associations were found between dietitians' home language, age, years of experience or area of employment and dietitians' perceptions to adapt FELs for various cultural groups, patient conditions, socio-economic status, or vegan / vegetarianism (p> 0.05).

Table 4.41: Association between dietitians' area of employment and perception regarding adjusting food exchange lists for various religions in South Africa

	Government		Private		Tertiary/ pharmaceutical/ research		p-value
	n	%	n	%	n	%	
Religions for which FELs should be adapted in South Africa (N = 131)							
African traditional	1	2.6	2	2.7	0	0.0	1.0000
All religions	1	2.6	2	2.7	1	5.9	0.6377
Hindu	0	0.0	9	12.3	2	11.8	**0.0253**
Jewish	4	10.5	11	15.1	2	11.8	0.9151
Muslim	12	31.6	19	26	2	11.8	0.4425
Vegan / Vegetarian	2	5.3	6	8.2	0	0.0	0.7319
Other	2	5.3	7	9.6	1	5.9	0.9145

4.16 The use of nutritional health applications as part of the nutrition care process

Besides adapting FELs to make it more population specific, the main reason dietitians reported using alternative tools to the FELs, as described earlier in Table 4.13, was convenience (27.5%). Likewise, Table 4.42 illustrates that the main advantage to using applications reported by 75.6% of dietitians was convenience, while the most experienced limitations to using applications comprised accessibility and relevance (40.5%). Furthermore, as presented in Table 4.42, the stage of the NCP for which 74.5% dietitians used applications involved dietary counselling and education. While 37.0% of dietitians reported using nutrition related applications, 47.6% recommended applications to patients (Table 4.42). Like the factors influencing dietitians' choice to provide FELs to patients, Table 4.42 illustrates that 64.3% of dietitians considered patient's literacy level in the decision to recommend applications. Also, as shown in Table 4.42, 57.1% of dietitians indicated that diagnosis was a deciding factor in the recommendation of applications to patients. Although 61.7% of dietitians considered applications to be evidence-based, as presented in Table 4.42, a notable percentage (34.0%) of dietitians were unsure whether applications are evidence-based. This

relates to the factors influencing dietitians' choice to use applications, as 90.6% contemplated applications' trustworthiness. Also, Table 4.42 indicated that merely 34.9% of dietitians considered the patient's follow up plan in the decision to recommend applications. Finally, the platform used by 25.2% of dietitians, as shown in Table 4.42, were smartphone-based; while other applications used, included infographics and applications/ websites that were not necessarily directly related to nutrition.

Table 4.42: The use of nutrition related health applications by dietitians in South Africa

Variable	n	%
Dietitians using nutrition related health applications (n = 127)		
Yes	47	37.0
No	80	63.0
Factors influencing the decision to use nutrition related health applications (n = 127)		
Cost	94	74.0
Ease of use	106	83.5
Accuracy	110	86.6
Trustworthiness	115	90.6
Platform	59	46.5
Other	6	4.7
Part of the NCP for which nutrition related health applications are used (n = 47)		
Dietary analysis	26	55.3
Dietary interventions for meal planning and menus	29	61.7
Counselling and education	35	74.5
Other	2	4.3
Are nutrition related health applications based on scientific evidence (n = 47)		
Yes	29	61.7
No	2	4.3

Unsure	16	34.0
Advantages of using nutrition related health applications (N = 131)		
Convenience	99	75.6
Adequacy	22	16.8
Efficiency	13	9.9
Efficacy	11	8.4
Usefulness	12	9.2
Other	4	3.1
Limitations of using nutrition related health applications (N = 131)		
Accessibility and relevance	53	40.5
Inappropriate use	17	13.0
Reliability and trustworthiness	30	22.9
Rigid, generic and complicated	21	16.0
Ineffective and inefficient	16	12.2
Other	7	5.3
Recommend nutrition related health applications to patients (n = 124)		
Yes	59	47.6
No	65	52.4
Factors influencing the choice to recommend nutrition related health applications (n = 127)		
Diagnosis	72	57.1
Follow up plan	44	34.9
Patient's age	55	43.7
Patient's literacy level	81	64.3
Patient's occupational status	32	25.4
Patient's compliance	53	42.1
Patient's preference	63	50.0
Unsure	5	4.0
Other	16	12.7

Platform of applications used (N = 131)		
Web-based application	1	0.8
Smartphone application	33	25.2
Software	3	2.3
Other	15	11.5

4.16.1 Associations between dietitians' area of employment and the use of nutritional health applications as part of the nutrition care process

As illustrated in Table 4.43, there was a statistically significant association between dietitians' area of employment and the use of mobile health applications. A larger proportion of dietitians working in the private sector (37.0%) used mobile health applications compared to government (7.9%) and research / tertiary education (17.7%) sectors (p = 0.0026). Furthermore, accuracy as an informing factor to the use of applications was significantly associated with dietitians' area of employment. A significantly larger proportion of dietitians working in private (93.2%) and tertiary education / research (93.3%) reported that accuracy informed the decision to use applications compared to 69.4% of dietitians working in government settings (p = 0.0036). Also, a statistically significant association was found between dietitians' area of employment and the use of applications as part of counselling / education. A larger proportion (82.9%) of dietitians working in the private sector used applications in dietary counselling compared to government (66.7%) and tertiary institutions (33.3%) (p = 0.0365). Additionally, a statistically significant association existed between accessibility of applications and dietitians' area of employment. A larger proportion of dietitians working in the government sector reported accessibility of applications as a limitation (60.5%) compared to dietitians working in the private sector (31.5%) and in tertiary education / research (29.4%) (p = 0.0097). Furthermore, a statistically significant association existed between dietitians' area of employment and the recommendation of applications to patients. While 61.4% of dietitians working in the private sector recommended applications to patients, only 25.0% of dietitians working in government and 40.0% in tertiary education / research recommended health applications to patients (p = 0.0008). Also, 59.7% of dietitians working in private

settings accounted for patient preference in the decision to recommend applications compared to 33.7% of dietitians working in the public sector (p = 0.0346), while 51.4% of dietitians employed in the private sector considered patient age in the decision to recommend applications compared to 25.0% of dietitians working in the government setting (p = 0.0241).

Table 4.43: Association between dietitians' area of employment and the use of nutritional health applications as part of the nutrition care process

	Government		Private		Tertiary/ pharmaceutical/ research		p-value
	n	%	n	%	n	%	
Dietitians using nutrition related health applications (n = 124)							**0.0052**
Yes	6	16.7	35	48.0	6	40.0	
No	30	83.3	38	52.1	9	60.0	
Factors influencing the decision to use nutrition related health applications (n = 127)							**0.0346**
Accuracy	12	33.3	43	59.7	7	46.7	
Part of the NCP for which nutrition related health applications are used (n = 47)							**0.0365**
Counselling and education	4	66.7	29	82.9	2	33.3	
Limitations to using nutrition related health applications (N = 131)							**0.0097**
Accessibility of applications	23	60.5	23	31.5	5	29.4	
Recommend nutrition related health applications to patients (n = 121)							**0.0008**
Yes	9	25.0	43	61.4	6	40.0	
No	27	75.0	27	38.6	9	60.0	
Factors influencing the decision to recommend nutrition related health applications (n = 123)							
Patients' age	9	25.0	37	51.4	8	53.3	**0.0241**
Patients' preference	12	33.3	43	59.7	7	46.7	**0.0346**

4.16.2 Associations between dietitians' home language and the use of nutritional health applications as part of the nutrition care process

Similar to the association between dietitians' home language and the use of FELs presented earlier in Table 4.6, Table 4.44 shows that 89.8% of dietitians with Afrikaans or English as a home language considered accuracy in the decision to use applications compared to 44.4% of dietitians with home languages other than Afrikaans or English (p = 0.0022). Also, as with the provision of FELs to patients (Table 4.6), no statistically significant association was found between dietitians' home language and the recommendation of applications to patients (p> 0.05).

Table 4.44: Association between dietitians' home language and the use of nutritional health applications as part of the nutrition care process

	Afrikaans / English		Other		p-value
	n	%	n	%	
Factors influencing the decision to use nutrition related health applications (n = 127)					
Accuracy	106	89.8	4	44.4	**0.0022**
Recommend nutrition related health applications to patients (n = 121)					0.7351
Yes	54	47.0	5	55.6	
No	61	53.0	4	44.4	

4.16.3 Associations between dietitians' age and the use of nutritional health applications as part of the nutrition care process

As per Table 4.45, a larger proportion of dietitians above 30 years of age (90.8%) considered ease of use in the decision to use applications compared to younger dietitians (75.8%) (p = 0.0311). Also, 45.2% of dietitians under 30 years of age compared to 25.0% older dietitians considered patients' follow up plan in the decision to recommend health applications to patients (p = 0.0246). Additionally, dietitians' age was significantly associated with patient compliance as a factor to consider in the decision to recommend applications. A larger percentage (51.6%) of younger dietitians compared to older dietitians (32.8%) used patient compliance to inform the decision to recommend applications (p = 0.0467). Finally, as presented in Table 4.55, 66.1% of

younger dietitians compared to 48.4% older dietitians used patients' diagnosis to inform the decision to recommend applications to patients (p = 0.0499).

Table 4.45: Association between dietitians' age and the use of nutritional health applications as part of the nutrition care process

	<30 years		≥30 years		p-value
	n	%	n	%	
Factors influencing the decision to use nutrition related health applications (n = 127)					
Ease of use	47	75.8	59	90.8	**0.0311**
Factors influencing the choice to recommend nutrition related health applications (n = 126)					
Follow up plan	28	45.2	16	25.0	**0.0246**
Patients' compliance	32	51.6	21	32.8	**0.0467**
Patients' diagnosis	41	66.1	31	48.4	**0.0499**

4.16.4 Associations between dietitians' years of practice experience and the use of nutritional health applications as part of the nutrition care process

Advantages like convenience may correlate with factors considered in the decision to use applications, such as ease of use, which in this study was significantly associated with years of experience. As shown in Table 4.58, a larger proportion of dietitians with more than five years practice experience (89.6%) compared to less than five years' experience (74.6%) considered ease of use in the decision to use applications (p = 0.0329). Unlike the role of literacy in the decision to provide patients with FELs, age and area of employment was not significantly associated with literacy as a deciding factor to recommend applications to patients. However, as shown in Table 4.58, a significantly larger proportion of dietitians with more than five years practice experience (72.7%) considered patient literacy levels in the decision to recommend applications to patients, compared to dietitians with less experience (52.7%) (p = 0.0363). Also, 69.1% of dietitians with ≤5 years practice experience considered patients' diagnosis in the decision to recommend applications compared to 48.5% of dietitians with more years' experience (p = 0.0271).

Table 4.46: Association between dietitians' years of experience and the use of nutritional health applications as part of the nutrition care process

	≤5 years		>5 years		p-value
	n	%	n	%	
Factors influencing the decision to use nutrition related health applications (n = 122)					
Ease of use	41	74.6	60	89.6	**0.0329**
Factors influencing the choice to recommend nutrition related health applications (n = 121)					
Patients' literacy level	29	52.7	48	72.7	**0.0363**
Patients' diagnosis	38	69.1	32	48.5	**0.0271**

4.17 Dietitians' perceptions regarding electronic food exchange lists

As the majority of dietitians used FELs and given that convenience was not only the main motivation for using alternative tools, but also the topmost advantage of using applications as part of the NCP, this study further investigated dietitians' perceptions regarding electronic FELs. Table 4.47 shows, that nearly all dietitians (98.4%) supported the concept of an electronic FEL. Likewise, 96.0% of dietitians were of opinion that the use of an electronic FEL would be beneficial. In agreement with the platform of applications currently being used, as per Table 4.47, 76.0% indicated that a smartphone application would be the preferred format for an electronic FEL. While 89.6% of dietitians reported it would be useful if the electronic FEL could include a cost analysis of the meal plan, 53.4% of dietitians postulated that there would be limitations pertaining to the use electronic FELs. Concerns raised, which would limit the use of an electronic FEL, included the FEL's relevance, trustworthiness, accessibility, adjustability, ease of use, and costs involved with its use.

As seen in Table 4.47, 62.4% of dietitians would be willing to pay for an electronic FEL that is kept up to date, although a 26.4% were unsure, especially given that dietitians reported having many other financial obligations and 53.3% argued that there may not truly be a need for an electronic FEL. However, 61.8% estimated that ≤ R100 per month would be a reasonable amount to pay for a well-maintained electronic FEL.

Table 4.47: Dietitians' perceptions regarding electronic food exchange lists, used as part of the food exchange system, in the nutrition care process in South Africa

Variable	n	%
Electronic FELs would be useful to dietitians (n = 126)		
Yes	124	98.4
No	1	0.8
Unsure	1	0.8
Preferred format of an electronic FEL (n = 125)		
Web-based application	71	56.8
Smartphone application	95	76.0
Software	28	22.4
PDF document format	2	1.6
Beneficial if an electronic FEL could include cost analysis of a meal plan (n = 125)		
Yes	112	89.6
No	4	3.2
Unsure	9	7.2
Benefits to using an electronic FEL (n = 124)		
Yes	119	96.0
Unsure	5	4.0
Limitations of using an electronic FEL (N = 131)		
Limitations pertaining to the application itself	70	53.4
Limitations pertaining to data within the application	6	4.6
Uncontrolled target groups	4	3.1
Incomprehensive	8	6.1
Other	9	6.9
None	14	10.7
Dietitians who would be willing to pay for access to a well-maintained FEL (n = 125)		
Yes	78	62.4
No	14	11.2
Unsure	33	26.4
Monthly fee dietitians would be willing to pay for a well-kept FEL (n = 76)		
≤R50	22	28.9
R51-R100	25	32.9
>R100	20	26.3
Other	9	11.8

Reasons dietitians would not be willing to pay for a well-kept FEL (n = 15)		
Financial objections / obligations	5	33.3
No demand for it	8	53.3
Other	2	13.3

4.17.1 Associations between dietitians' area of employment and dietitians' perceptions regarding electronic food exchange lists

As per Table 4.48, a statistically significant association was found between dietitians' area of employment and a web-based platform as the preferred format for an electronic FEL. While 67.6% of dietitians working in private settings and 66.7% of dietitians employed in tertiary education / research sectors suggested a web-based platform, only 33.3% of dietitians working in government settings recommended that an electronic FEL should be web-based, with a higher proportion advocating for smartphone based applications (p = 0.0023). Also, a significant association was found between area of employment and perceived limitations pertaining to electronic FELs. A larger proportion of dietitians working in the public sector were concerned about limiting factors involving electronic FELs itself (60.5%) compared to 31.5% of dietitians working in private and 29.4% of dietitians employed in tertiary education / research settings (p = 0.0172).

Table 4.48: Association between dietitians' area of employment and dietitians' perceptions regarding electronic food exchange lists

	Government		**Private**		**Tertiary/ pharmaceutical/ research**		**p-value**
	n	**%**	**n**	**%**	**n**	**%**	
Preferred format of an electronic FEL (n = 122)							
Web-based application	12	33.3	48	67.6	10	66.7	**0.0023**
Limitations of using an electronic FEL (N = 131)							
Limitations pertaining to the application itself	23	60.5	23	31.5	5	29.4	**0.0097**

4.17.2 Associations between dietitians' years of practice experience and dietitians' perceptions regarding electronic food exchange lists

As shown in Table 4.49, a statistically significant association was found between years of experience and willingness to pay for FELs (p = 0.0233). More experienced dietitians were less sure regarding their willingness to incur costs to gain access to an up to date FEL (35.4%) compared to only 16.4% of less experienced dietitians Furthermore, a statistically significant association was found between dietitians' years of experience and the amount they would be willing to pay for access to an up to date FEL (p = 0.0425). As per Table 4.49, 26.8% of dietitians with less than five years' experience would be willing to pay a monthly amount of R51-R100 for access to a well-maintained electronic FEL, compared to 11.6% of dietitians with more than five years' experience.

Table 4.49: Association between dietitians' years of experience and dietitians' perceptions regarding electronic food exchange lists

	≤5 years		>5 years		p-value
	n	%	n	%	
Dietitians who would be willing to pay for access to a well-maintained FEL (n = 120)					**0.0233**
Yes	41	74.6	33	50.8	
No	5	9.1	9	13.9	
Unsure	9	16.4	23	35.4	
Monthly fee dietitians would be willing to pay for a well-kept FEL (N = 131)					
≤R50	14	25.0	8	11.6	0.0965
R51-R100	15	26.8	8	11.6	**0.0425**
>R100	8	14.3	10	14.5	0.3577
Other	3	5.4	6	8.7	0.8274

4.18 Dietitians' perceptions regarding additions and modifications to the current food exchange list

4.18.1 Dietitians' perceptions regarding characteristics of a good food exchange list

In defining approaches to increase the use of FELs among dietitians, and as preliminary work for the updating of the FELs used by dietitians in South Africa, the current study investigated dietitians' expectations of FELs by determining characteristics or specifications dietitians perceive as essential in FELs.

As shown in Table 4.50, 48.9% of dietitians perceived convenience as one of the top priorities when it comes to FELs. Also, as illustrated earlier, 27.5% of dietitians indicated convenience as the reason for using alternative tools to FELs and 75.6% (Table 4.42) reported convenience as an advantage to using applications. However, as presented in Table 4.50, 56.5% of dietitians defined a good FEL as one that is comprehensive. This corresponds with the 53.1% of dietitians, referred to earlier in Table 4.35, who reported that FELs are not comprehensive enough.

Table 4.50: Dietitians' perceptions regarding the characteristics of a good food exchange list (N = 131)

Variable	n	%
Accessible and obtainable	9	6.9
Reliable	50	38.2
Convenient	64	48.9
Comprehensive	74	56.5
Relevant	22	16.8
Practical	39	29.8
Other	7	5.3
Simplicity	6	4.6

4.18.1.1 Association between dietitians' socio-demographic information and perceived characteristics of a good food exchange list

Although a mere 6.9%, as illustrated in Table 4.50, suggested that a good FEL should be accessible / obtainable, a statistically significant association was found between dietitians' choice regarding accessibility as a characteristic of a good FEL and dietitians' home language. As shown in Table 4.51, 33.3% of dietitians with a home language other than Afrikaans or English suggested a good FEL should be accessible compared to 4.9% of dietitians with Afrikaans or English as a home language (p = 0.0155).

Table 4.51: Association between dietitians' home language and perceived characteristics of a good food exchange list (N = 131)

	Afrikaans / English		Other		p-value
	n	%	n	%	
Accessible and obtainable	6	4.9	3	33.3	**0.0155**

As shown in Table 4.52, 8.9% of dietitians with ≤5 years practice experience compared to 2.9% of dietitians with more years of experience proposed accessibility as a characteristic of a good FEL (p = 0.0321). Furthermore, a statistically significant association was observed between dietitians' years of experience and comprehensiveness as a quality of a good FEL. Compared to 67.9% of dietitians with ≤5 years' experience, 50.7% of dietitians with more years' experience proposed comprehensiveness as a quality of a good FEL (p = 0.0213). As presented in Table 4.50, 29.8% of dietitians perceived a good FEL as one that is practical. This result correlates with the 25.0% of dietitians, as referred to earlier in Table 4.5, who argued that FELs are impractical, hence it is not being used, and 27.5% of dietitians, as presented in Table 4.26, who reported FELs are impractical which impacts its usefulness to patients. Additionally, as shown in Table 4.52, a statistically significant association was found between dietitians who indicated a good FEL is practical and dietitians' years of experience. While 44.6% of dietitians with ≤5 years' experience described a good FEL as practical, only 18.8% of dietitians with more years' experience indicated practicality as a quality of a good FEL (p = 0.0054).

Table 4.52: Association between dietitians' years of experience and dietitians' perceptions regarding characteristics of a good food exchange list (N = 131)

	≤5 years		>5 years		p-value
	n	%	n	%	
Accessible and obtainable	5	8.9	2	2.9	**0.0321**
Comprehensive	38	67.9	35	50.7	**0.0213**
Practical	25	44.6	13	18.8	**0.0054**

As indicated in Table 4.53, a statistically significant association was observed between dietitians' age and practicality as a quality of a good FEL. Compared to 42.9% of younger dietitians, only 17.7% older dietitians described a good FEL as practical (p = 0.0021).

Table 4.53: Association between dietitians' age and dietitians' perceptions regarding characteristics of a good food exchange list (N = 131)

	<30 years		≥30 years		p-value
	n	%	n	%	
Practical	27	42.9	12	17.7	**0.0021**

As per Table 4.54, 23.5% of dietitians working in tertiary education / research settings proposed other characteristics which would improve the quality of a FEL compared to 4.1% of dietitians working in private settings and none of the dietitians employed in government settings (p = 0.0152). Other characteristics mentioned, comprised adding sample menus and recipes to the FEL, and increasing the flexibility of use by enabling dietitians to easily adapt the FEL to patient level.

Table 4.54: Association between dietitians' area of employment and dietitians' perceptions regarding characteristics of a good food exchange list (N = 131)

	Government		Private		Tertiary/ pharmaceutical/ research		p-value
	n	%	n	%	n	%	
Other	0	0.0	3	4.1	4	23.5	**0.0152**

4.18.2 Preferences pertaining to portion sizes

In addition to FELs not distinguishing between raw and cooked portion sizes, other challenges mentioned by dietitians in this study included impractical descriptions of and changes in portion sizes. This study further investigated dietitians' perceptions on the preferred format of portion sizes. As per Table 4.55, 78.6% of dietitians preferred portion sizes in FELs to appear in cooked format, mainly for the purpose of convenience (38.9%). Although 51.6% of the dietitians recommended that portion sizes should be described in weight on FELs, 91.3% of dietitians suggested that household measurements be used to define portion sizes. As for analysis of food products, the majority (79.4%) of dietitians indicated that analysis should preferably be done per exchange instead of per 100 grams of the product.

Table 4.55: Preferred specifications regarding the format of portion sizes in food exchange lists used as part of the nutrition care process

Variable	n	%
Preferred format of portion sizes on FELs (n = 126)		
Raw	83	65.9
Cooked	99	78.6
Other	2	1.6
Factors influencing the preferred format of portions in a FEL (N = 131)		
Accuracy of measurement	15	11.5
Food wastage	20	15.3
Patient preference	18	13.7

Characteristics of the food item	21	16.0
Convenience	51	38.9
Other	9	6.9
Both raw and cooked are preferred	15	11.5
Preferred unit of measure for portion sizes in FELs (n = 126)		
Weight	65	51.6
Volume	43	34.1
Household measures such as cups teaspoons etc.	115	91.3
Other	5	4.0
Preferred format of analysis in FELs (n = 126)		
Per exchange	100	79.4
Per 100 g	45	35.7
Other	3	2.4

4.18.2.1 Association between dietitians' socio-demographic information and dietitians' preferences pertaining to portion sizes

As per Table 4.56, a statistically significant association was found between dietitians' age and the preference of portion sizes in raw format. A larger proportion of dietitians younger than 30 years of age preferred portion sizes in FELs to be represented in raw format (75.8%) compared to older dietitians (56.3%) (p = 0.0247).

Table 4.56: Association between dietitians' years of experience and dietitians' preferences pertaining to portion sizes

	<30 years		**≥30 years**		**p-value**
	n	**%**	**n**	**%**	
Preferred format of portion sizes on FELs (N=126)					
Raw	47	75.8	36	56.3	**0.0247**

As illustrated in Table 4.57, 49.3% of dietitians working in the private sector reported that convenience informed the preferred format of portion sizes compared to 23.7% of dietitians working in the public sector and 35.3% of dietitians employed in tertiary education / research settings (p = 0.0256).

Table 4.57: Association between dietitians' area of employment and dietitians' preferences pertaining to portion sizes

	Government		Private		Tertiary/ pharmaceutical/ research		p-value
	n	%	n	%	n	%	
Factors influencing the preferred format of portions in a FEL (N = 131)							
Convenience	9	23.7	36	49.3	6	35.3	**0.0256**

4.18.3 Additional elements to consider adding to food exchange lists

Besides information on portion sizes, this study investigated dietitians' perceptions regarding other components that may need to be incorporated into the FEL, which will be presented in this section.

4.18.3.1 Micronutrients

Although current FELs focus on macronutrient distribution and energy composition, as referred to earlier in Table 4.5, 7.1% of dietitians reported using FELs in the management of micronutrient malnutrition. However, as depicted in Table 4.58, less than half (47.6%) of the dietitians supported the addition of micronutrient values in the FEL. Nevertheless, should micronutrient values be added to FELs, as indicated in Table 4.58, 26.7% of dietitians recommended that iron be incorporated into the FELs.

4.18.3.2 Fibre

While 29.1% of dietitians used FELs in the management of gastrointestinal diseases as shown earlier in Table 4.5, Table 4.58 shows a significant percentage (87.1%) of dietitians suggested that fibre analysis form part of the FEL. Motivations supporting this notion, besides the usefulness in managing lower gastrointestinal tract conditions

as indicated by 21.4% of dietitians, was the value it may add in the promotion of healthier dietary choices (26.0%). Majority of these motivations reiterated dietitians' support in adding fibre to the FEL, but also included dietitians' concern that by adding this element, FELs might become too complex, specifically as lists are already too complicated for patients to understand. Some suggested that separate lists for dietitians and patients should exist, while others highlighted the need for information on both the type of fibre as well as the amount, which could be indicated by flagging sources low or high in fibre.

4.18.3.3 Fluid

Given that 52.8% - 62.2% of dietitians used FELs in the management of either cardiovascular- or renal diseases, the investigation of dietitians' perception on fluid content in FELs was justified, as often these population groups are fluid restricted. However, as illustrated in Table 4.58, only a third of dietitians recommended that information on fluid content of food be added to FELs, as 38.9% of dietitians inferred that information on fluid content is population specific and not necessary to include in general FELs.

4.18.3.4 Sodium

Even though 42.8% of dietitians indicated that information on sodium content is population specific, as depicted in Table 4.58, 83.2% of dietitians supported the intention to add sodium values of food products to FELs.

4.18.3.5 Sugar

Table 4.58 shows that 77.6% of dietitians motivated to add information on the sugar content of food products to the FEL. Although, 24.4% argued that information on sugar content is population specific, therefore not essential to include in general FELs, nearly a third of dietitians (30.5%) stated that information on sugar content may be useful in dietary counselling, monitoring and evaluation (Table 4.58).

4.18.3.6 Glycaemic index

The addition of glycaemic index, as presented in Table 4.58, was supported by 76.0% of dietitians, although 35.9% reported that glycaemic index is population specific and not necessarily useful to the general population.

4.18.3.7 Fatty acids

As shown in Table 4.58, information on fatty acid content of food was perceived essential enough to be included in the FEL by more than half of the dietitians (51.6%). Even though 19.9% believed the addition of fatty acid information would be useful in dietary analysis and intervention, the majority of the 18.3% dietitians who provided other additional comments, perceived the addition of fatty acid content as impractical and unnecessary.

Table 4.58: Dietitians' perceptions regarding the inclusion of additional elements in food exchange lists used as part of the nutrition care process

Variable	n	%
Micronutrient analysis should be part of FELs (n = 124)		
Yes	59	47.6
No	41	33.1
Unsure	24	19.4
Most important micronutrients to include in FELs (N = 131)		
Vitamin B	22	16.8
Calcium	28	21.4
Iron	35	26.7
Main electrolytes (Magnesium / Phosphate / Potassium)	23	17.6
Sodium	19	14.5
Fat soluble vitamins (Vitamin A / D)	19	14.5
Vitamin C	18	13.7
Zinc	14	10.7
Other	23	17.6
Fibre analysis should form part of FELs (n = 124)		
Yes	108	87.1
No	10	8.1
Unsure	6	4.8
Motivations in support of or against including fibre analysis in FELs (N = 131)		
Useful for patient education	13	9.9
Useful in treating lower gastrointestinal tract complications	28	21.4
Assist patients in making healthier food choices	34	26.0

General dietary guidelines are preferred	10	7.6
Assist in dietary analysis and meal planning	11	8.4
Other	19	14.5
Fluid content of food should be included in FELs (n = 124)		
Yes	41	33.1
No	60	48.4
Unsure	23	18.6
Motivations in support of or against including fluid content in FELs (N = 131)		
Useful in various phases of the NCP	7	5.3
Population specific	51	38.9
Impractical	24	18.3
Other	14	10.7
Sodium content should be included in FELs (n = 125)		
Yes	104	83.2
No	12	9.6
Unsure	9	7.2
Motivations in support of or against including sodium content in FELs (N = 131)		
Relevant for patient education on food choices	36	27.5
Population specific	56	42.8
Useful in meal planning / dietary analysis	7	5.3
Added sugar content should be included in FELs (n = 125)		
Yes	97	77.6
No	16	12.8
Unsure	12	9.6
Motivations in support of or against including added sugar content in FELs (N = 131)		
Population specific	32	24.4
Other	7	5.3
Useful in counselling / education and dietary monitoring	40	30.5
Useful in meal planning / dietary analysis	4	3.1
General guidelines are sufficient	13	9.9
Dependent on the target population	7	5.3
Sugar intake is a public health concern	7	5.3
Glycaemic index should be included in FELs (n = 125)		
Yes	95	76.0
No	22	17.6
Unsure	8	6.4

Motivations in support of or against including glycaemic index in FELs (N = 131)		
Assist in dietary intervention	24	18.3
Other	18	13.7
Population specific	47	35.9
FELs will get too complicated	12	9.2
Glycaemic index is not significant or useful	6	4.6
Fatty acid content should be included in FELs (n = 122)		
Yes	63	51.6
No	37	30.3
Unsure	22	18.0
Motivations in support of or against including fatty acid content in FELs (N = 131)		
Assist in dietary analysis and intervention	26	19.9
Population specific	13	9.9
FELs would become too complicated	23	17.6
Other	24	18.3

4.18.3.8 Associations between dietitians' socio-demographic information and additional elements to consider adding to food exchange lists

As per Table 4.59, a statistically significant association was found between dietitians' area of work and the opinion to incorporate information on certain elements in the FELs, including iron, sodium, sugar, and glycaemic index. Compared to 17.7% of dietitians employed in tertiary education / research, 27.4% of dietitians working in private settings and 23.7% of those employed in the government sector proposed iron as the micronutrient to include in FELs ($p = 0.0458$). Also, a statistically significant association was found between dietitians who motivated that the addition of sodium to the FEL would assist with meal planning / dietary analysis and dietitians' area of employment. While 94.4% of dietitians employed in government settings were of opinion that sodium values in the FEL would assist in meal planning and dietary analysis, compared to 77.5% of dietitians working in private settings ($p = 0.0253$). Additionally, a larger proportion of dietitians working in government settings (47.4%) compared to private (26.0%) motivated that information on sugar content in FELs would assist in dietary counselling / monitoring and evaluation ($p = 0.0037$). Lastly, a statistically significant association was found between area of employment and the

perception that glycaemic index is population specific. Compared to 55.3% of dietitians working in the public sector who perceived glycaemic index as population specific, only about a quarter of dietitians working in private and tertiary education / research settings suggested that glycaemic index is population specific (p = 0.0098).

Table 4.59: Association between dietitians' area of employment and dietitians' preferences pertaining to additional elements to consider adding to food exchange lists

	Government		Private		Tertiary/ pharmaceutical/ research		p-value
	n	%	n	%	n	%	
Most important micronutrients to include in FELs (N = 131)							
Iron	9	23.7	20	27.4	3	17.7	**0.0458**
Motivations in support of or against including sodium content in FELs (n = 122)							
Useful in meal planning / dietary analysis	34	94.4	55	77.5	12	80.0	**0. 0253**
Motivations for or against including added sugar content in FELs (N = 131)							
Useful in counselling / education and dietary monitoring	18	47.4	19	26.0	1	5.9	**0. 0037**
Motivations for or against including glycaemic index in FELs (N = 131)							
Population-specific	21	55.3	20	27.4	4	23.5	**0. 0098**

As presented in Table 4.60, a statistically significant association was found between dietitians' home language and the preference to include information on micronutrient values in FELs (p = 0.0275). While 49.6% of dietitians with Afrikaans or English as a home language motivated for the addition of micronutrient values to the FEL, only 22.2% of dietitians with home languages other than Afrikaans or English perceived the

addition of micronutrients to FELs essential. Also, a statistically significant association was found between dietitians' home language and the opinion to add information on fluid content to the FEL (p = 0.0259). A larger proportion of dietitians with Afrikaans or English as a home language argued against the addition of fluid to the FEL (51.3%) compared to dietitians with other home languages (11.1%). A statistically significant association was found between dietitians' home language and the opinion to add information on fatty acid content to the FEL (p = 0.0456). About one third of dietitians with home languages other than Afrikaans or English reported that fatty acid content is population specific, thus not necessary to add to general FELs, compared to only 8.2% of dietitians with Afrikaans or English as a home language.

Table 4.60: Association between dietitians' home language and preferences pertaining to additional elements to consider adding to food exchange lists

	Afrikaans / English		Other		p-value
	n	%	n	%	
Micronutrient analysis should be part of FELs (n = 124)					**0.0275**
Yes	57	49.6	2	22.2	
No	39	33.9	2	22.2	
Unsure	19	16.5	5	55.6	
Fluid content of food should be included in FELs (n = 124)					**0.0259**
Yes	37	32.2	4	44.4	
No	59	51.3	1	11.1	
Unsure	19	16.5	4	44.4	
Motivations for or against including fatty acid content in FELs (N = 131)					
Population-specific	10	8.2	3	33.3	**0.0456**

As shown in Table 4.61, a statistically significant association was observed between dietitians' perception on the addition of sugar information in FELs and dietitians' years of experience (p = 0.0268). A larger proportion of dietitians with fewer years' experience (85.5%) compared to dietitians with more years' experience (70.8%)

motivated for the inclusion of information on the sugar content of food products in the FELs Additionally, 5.4% of dietitians with less years' experience motivated that information on sugar content in FELs would assist in meal planning and dietary analysis compared to none of the dietitians with more than five years' experience (p = 0.0244). Also, 8.9% of dietitians who had ≤5 years' experience compared to none of the dietitians with more than five years' experience reported that the addition of sodium to the FEL would assist with dietary analysis and meal planning (p = 0.0014). Lastly, 23.2% of dietitians with more years' experience compared to 5.4% of dietitians with ≤5 years practice experience provided further motivations or comments regarding the addition of fibre to FELs, as discussed above (p = 0.0114).

Table 4.61: Association between dietitians' years of experience and dietitians' preferences pertaining to additional elements to consider adding to food exchange lists

	≤5 years		**>5 years**		**p-value**
	n	**%**	**n**	**%**	
Added sugar content should be included in FELs (n = 120)					**0.0268**
Yes	47	85.5	46	70.8	
No	2	3.6	13	20.0	
Unsure	6	10.9	6	9.2	
Motivations for or against including added sugar content in FELs (N = 131)					
Useful in meal planning / dietary analysis	3	5.4	0	0.0	**0.0244**
Motivations in support of or against including sodium content in FELs (N = 131)					
Useful in meal planning / dietary analysis	5	8.9	0	0.0	**0.0014**
Motivations in support of or against including fibre analysis in FELs (N = 131)					
Other	3	5.4	16	23.2	**0.0114**

As per Table 4.62, a statistically significant association was observed between dietitians' perceptions that information on sugar content should be added to the FEL and dietitians' age (p = 0.0050). While 85.5% of dietitians <30 years of age motivated for the addition of sugar content of food products in the FELs, only 69.8% of older dietitians perceived information on sugar content in FELs, as necessary. A statistically significant association was observed between dietitians' perceptions that information on fatty acid content could make FELs too complicated and age (p = 0.0227). One quarter of older dietitians felt that the addition of elements, like fatty acids to the FEL would make FELs too complicated, compared to only 9.5% of younger dietitians having raised that concern

Table 4.62: Association between dietitians' age and dietitians' preferences pertaining to additional elements to consider adding to food exchange lists

	<30 years		≥30 years		p-value
	n	%	n	%	
Added sugar content should be included in FELs (n = 125)					**0.0050**
Yes	53	85.5	44	69.8	
No	2	3.2	14	22.2	
Unsure	7	11.3	5	7.9	
Motivations for or against including fatty acid content in FELs (N = 131)					
FELs would become too complicated	6	9.5	17	25.0	**0.0227**

4.18.4 Preferences pertaining to the incorporation of additional elements into the food exchange list

Given the importance of convenience, this study also determined dietitians' preferences regarding the inclusion of additional information to FELs. As illustrated in Table 4.63, half of the dietitians suggested that additional elements should be incorporated into existing FELs, while a notable percentage preferred separate FELs for the additional elements (41.1%). Although 58.4% of dietitians preferred that food

sources be arranged according to high or low values by means of flagging, almost half of the dietitians indicated that exact amounts per exchange should be provided.

Table 4.63: Dietitians' perceptions regarding the incorporation and format of additional elements in the food exchange lists

Variable	n	%
Additional elements as part of the FEL (n = 124)		
As part of the existing exchange list	62	50.0
As part of a separate exchange list	51	41.1
Unsure	11	8.9
Format of additional elements in FELs (n = 125)		
The exact amount per exchange next to each food item	60	48.0
The highest / lowest sources / by means of flagging	73	58.4
Unsure	12	9.6
Other	1	0.8

4.18.5 Associations between dietitians' socio-demographic information and dietitians preferences pertaining to the incorporation of additional elements into the food exchange list

As presented in Table 4.64, a statistically significant association between dietitians' age and additional elements that should eb added to FELs (p = 0.0019). A larger proportion of younger dietitians suggested that additional elements should be added to existing FELs (64.5%) compared to older dietitians (35.5%), who reported that separate lists should be made for the added elements

Table 4.64: Association between dietitians' age and dietitians' preferences pertaining to the incorporation of additional elements into the food exchange list

	<30 years		≥30 years		p-value
	n	%	n	%	
Additional elements as part of the FEL (n =124)					**0.0019**

As part of the existing exchange list	40	64.5	22	35.5	
As part of a separate exchange list	16	25.8	35	56.5	
Unsure	6	9.7	5	8.1	

4.18.6 Addition of mixed meals to the food exchange list

Given that dietitians focussed a lot of attention on convenience and the practical use of FELs, also mentioning the increased use of ready-made meals by patients, it was warranted to investigate dietitians' perceptions on mixed meals as part of the FEL. While 62.9% of dietitians supported the addition of mixed meals to the FELs, as shown in Table 4.65, a large proportion of dietitians recognised that there would be limitations to this concept. Especially as significant variations may even exist between the same type of meal given the differences in recipes used (92.0%). However, more than half of the dietitians reported that having mixed meals as part of the FEL would be useful in various stages of the NCP, as it would assist with dietary counselling (69.6%), save time in meal planning (54.4%) and dietary analysis (53.6%). Therefore, as presented in Table 4.65, 64.0% of dietitians also supported the addition of fast-food meals to the FEL.

Table 4.65: Dietitians' perceptions regarding mixed meals in the food exchange lists

Variable	n	%
Mixed meals should be included in FELs (n = 125)		
Yes	78	62.9
No	31	25
Unsure	15	12.1
Limitations of including mixed meals in FELs (n = 125)		
Differences in recipes	115	92.0
FEL would become too complex	71	56.8
Unsure	2	1.6

Other	5	4.0
Advantages of including mixed meals in FELs (n = 125)		
It would save time analysing a diet history	67	53.6
It would save time during meal planning	68	54.4
It would assist in counselling	87	69.6
The nutrient value would be more accurate	59	47.2
Unsure	9	7.2
Other	4	3.2
Fast food items should be included in FELs (n = 125)		
Yes	80	64.0
No	38	30.4
Unsure	7	5.6

4.18.6.1 Associations between dietitians' socio-demographic information and dietitians' perceptions pertaining to the addition of mixed meals to the food exchange list

As shown in Table 4.66, variations between recipes as a limitation to the inclusion mixed meals in FELs was significantly associated with the area of employment. Dietitians working in the government setting unanimously reported one of the limitations to including mixed meals in FELs would be that differences in recipes used to prepare dishes affect the nutritional value thereof, whereas 90.1% of dietitians working in the private sector and 80.0% in tertiary education / research were of opinion that this would be a limitation ($p = 0.0316$). As presented earlier in Table 4.32, a significantly greater proportion of dietitians working in the public sector compared to private or tertiary education / research reported the use of FELs as effective in dietary analysis. Hence, it is not without reason that 63.9% of dietitians working in government settings reported the inclusion of mixed meals in the FEL would save time in dietary analysis compared to only 40.9% of dietitians working in private ($p = 0.0062$).

Table 4.66: Association between dietitians' area of employment and dietitians' perceptions pertaining to the addition of mixed meals to the food exchange list

	Government		Private		Tertiary/ pharmaceutical/ research		p-value
	n	%	n	%	n	%	
Limitations of including mixed meals in FELs (n = 125)							
Differences in recipes	36	100	64	90.1	12	80.0	**0.0316**
Advantages of including mixed meals in FELs (n = 125)							
It would save time analysing a diet history	23	63.9	29	40.9	12	80.0	**0.0062**

CHAPTER 5: DISCUSSION OF RESULTS

5.1 Introduction

The purpose of the current study was to investigate South African dietitians' practices and perceptions regarding FELs, used as part of the food exchange system, in the NCP. To achieve this aim the objectives that had to be investigated included dietitians' socio-demographic information, practices and perceptions regarding FELs, used as part of the food exchange system, in the NCP.

5.2 Response rate to the survey

Even though the response rate of 3.8% achieved by the current study was much lower than the anticipated 18% achieved by other studies using online surveys, the response rate was similar to a survey targeting dietitians in Canada (3.0%; n=118) (Lieffers et al., 2014). Likewise, the response rate to a survey investigating mobile health technology use among dietitians from Australia, New Zealand and the UK achieved a response rate of 5.0% (n=757) (Chen et al., 2017:439). However, a much higher response rate of 10.8% (n=180) was attained in the study targeting sports dietitians across five different countries (Jospe et al., 2015:1). While the survey in the current study was available for completion for a duration of two months, similar to Lieffers et al. (2014) and Chen et al. (2017b:440), Jospe et al. (2015:2) allowed more than four months, which may have contributed to a higher response rate.

5.3 Dietitians' Health Profession Council of South Africa registration category

After a four year Bachelor of Science (Dietetics) degree has been obtained and upon completion of one year community service, a dietitian is registered at the HPCSA in the independent practice category (HPCSA & Public Relations and Service Delivery Department, 2019; Steyn & Mbhenyane, 2008:798; Republic of South Africa, 2005:4). In spite of statistics indicating that 7.0% of South African dietitians are registered under the community service category at the HPCSA and ADSA, the participants to the current study only comprised 3.8% community service dietitians (HPCSA head office, 2020; ADSA head office, 2018). It is possible that community service dietitians have not yet joined ADSA or the various Facebook platforms on which the link to the survey was shared. Seeing as the link to the survey was shared with dietitians mainly through

these channels, not being a member might have affected the response rate of community service dietitians to this survey. Additionally, dietitians were advised to share the link to the survey with colleagues, which may have influenced the response rate among community service dietitians located in remote, rural areas (Parker et al., 2012:1412; Steyn & Mbhenyane, 2008:799).

5.4 Dietitians' gender and the use of food exchange lists

The gender distribution of the current study corresponds with the 95.0 – 98.0% female dominance reported by other studies involving dietitians, both in South Africa and other countries (Ebrahim et al., 2020:E722; Chen et al., 2017:441; McArdle et al., 2017:388; Visser et al., 2012:114 ; Martin et al., 2008:29; Steyn et al., 2005:55). However, this study found no significant difference between gender and the use of FELs, as part of the NCP, by dietitians in practice ($p = 0.6604$).

5.5 Dietitians' geographical location and the use of food exchange lists

The current study showed that the greatest proportion of dietitians resided in Gauteng, which was a similar geographical distribution profile to the study investigating South African dietitians' perceptions of the continuing professional development system, reported by Martin et al. (2008:29). Even as most studies conducted on South African dietitians either do not specify the province of residence or are province specific, the province distribution found in the current study was comparable to data received by ADSA, the HPCSA, as well as statistics from the 2011 national Census (HPCSA head office, 2019; ADSA head office, 2018; Statistics South Africa, 2012:18). A higher percentage of dietitians from the Free State (95.5%) and Gauteng (85.1%) currently used FELs compared to dietitians from the Eastern Cape (50.0%) and Western Cape (56.2%). The reason for this may be due to the significant difference found between the area of practice and dietitians' geographical location, with the highest proportion of private practising dietitians residing in Gauteng, whereas the Eastern Cape comprised the greatest proportion of dietitians practising in the government setting.

5.6 Dietitians' languages in context of South Africa's population profile

The current study revealed that the majority (53.4%) of dietitians were Afrikaans speaking, which corresponds with the 50.3% found by Visser et al. (2012:114) among dietitians in South Africa. While Afrikaans was the dominant home language reported

by dietitians in the present study, English was predominantly used in practice as this is the lingua franca in South Africa. However, less than one third of dietitians reported practising in any African language, including, amongst others, isiZulu, isiXhosa, and Sesotho. According to Statistics South Africa (2012:24) isiZulu was the language spoken by the largest proportion of South African households (22.7%), followed by isiXhosa (16.0%), while a lower percentage of the South African population reported Afrikaans (13.5%) and English (9.6%) as their home language.

Steyn and Mbhenyane (2008:797) stated that the majority of dietitians in South Africa are not proficient in African languages, which according to Paterson (2006:183) was one of the challenges experienced by community service dietitians in Kwazulu-Natal, where the majority of the population was isiZulu speaking. More recent statistics showed that the percentage of people who reported isiZulu (25.3%) and isiXhosa (14.8%) as their home languages were approximately the same as the percentage who reported speaking these languages outside of their home environment (25.1% isiZulu; 12.8% isiXhosa). Conversely, a smaller proportion (12.2%) of people speaking Afrikaans and a larger percentage of those with English (8.1%) as a home language reported verbalising in these languages in external environments (9.7% Afrikaans; 16.6% English) (Statistics South Africa, 2018:9). This is noteworthy, as although some population groups might find nutrition therapy in English acceptable, dietary counselling in English might affect African speaking population groups to a greater extent, due to being more comfortable expressing in the same language both publicly and within the home environment (Statistics South Africa, 2018:9). In support of this statement, the current study found a strong association between dietitians employed in government settings and the consideration of language in the decision to provide patients with FELs ($p = 0.0181$). According to the general household survey published by Statistics South Africa (2018:9, 25), 71.5% of South Africans reported public healthcare facilities as their initial point of contact, and as 73.7% of the population reported speaking languages other than Afrikaans or English in public, the languages spoken by patients attending public healthcare facilities may affect consultations significantly. Furthermore, 42.7% of non-institutionalised and non-military South Africans reported living within 15 minutes from a healthcare facility; hence, the likelihood of patients speaking the language indigenous to that specific area when

attending a public healthcare facility is higher (Statistics South Africa, 2018:117; Housing Development Agency, 2012:49).

5.6.1 The effect of language on efficacy and quality of nutritional therapy

Apart from patients having the right to receive nutrition therapy in their home language, the quality and efficacy of dietetic services may be influenced by the language in which dietitians practice, as misunderstandings are more prevalent when the languages spoken by patient and practitioner are not the same (Pascoe et al., 2020: 1a1378; Ahmed et al., 2017:124; Paternotte et al., 2016:222; Paterson, 2006:57). Furthermore, South Asian and White British patients who have visited English general practitioners between 2011 and 2013 in the UK, were more content with language-concordant consultations, as they felt more comfortable communicating with a healthcare practitioner whom they perceived comprehended cultural influences and who were able to demonstrate greater empathy through the use of emotive language (Brodie et al., 2016:3).

Given the significance of language in ensuring the provision of quality healthcare, Pascoe et al. (2020: 4a1378) reviewed health resources available to various disciplines in South Africa, and found that the languages for which the majority of resources have been adapted, included isiZulu, isiXhosa and Afrikaans. This correlates with the statistics regarding home languages in South Africa (Statistics South Africa, 2018:9), the main languages in which dietitians reported practising in the current study, and consequently also the languages for which dietitians reported FELs should be adapted.

Despite limited studies reporting on the language of practice by dietitians in South Africa, Spies et al. (2020:online) found that 24.0% of patients receiving haemodialysis in Bloemfontein (South Africa) did not receive nutritional therapy in either their first or second languages. This is appreciable, seeing as the level to which patients, who received maintenance haemodialysis in Bloemfontein, understood nutritional counselling, was significantly different between patients who have received nutritional management in one of their native languages compared to the patients who did not (Spies et al., 2020:online).

Also, internationally, Paternotte et al. (2017:173) reported that non-native patients receiving medical care by a Dutch healthcare practitioner in the Netherlands, perceived the language barrier as the main obstacle in intercultural communication. Even though immigrants from various countries receiving nutritional counselling in the Netherlands on DM, did not report language as one of the challenges experienced, Jager et al. (2019:211) recommended that dietitians be considerate of patients' languages when providing nutritional therapy.

Considering the languages indigenous to South Africa, specifically in light of the important influence language may have on the quality and efficacy of nutrition therapy, language may thus influence the value of FELs, especially seeing as FELs are mainly available in English. While 29.2% of dietitians reported that FELs cannot be used in patients speaking different languages, 65.4% of dietitians in the current study perceived it necessary to adapt FELs for specific languages. Particularly, given that a number of resources used in various other healthcare disciplines have been adapted for specific languages in South Africa (Pascoe et al., 2020:3 a1378).

5.6.2 Dietitians' home language and the use of food exchange lists

Besides the home language of patients affecting healthcare delivery, the current study found a statistically significant association between dietitians' home language and the use of FELs ($p = 0.0339$), with more dietitians reporting Afrikaans or English as a home language currently using FELs compared to dietitians with other home languages. Although dietitians' home language affected the use of FELs, the association between dietitians' home language and the consideration of patients' language in the decision to provide FELs was not significant ($p = 0.4231$). This result was not anticipated, as it was assumed, given dietitians' own perceptions regarding language and the use of FELs, patients' language would be considered with an increased level of apprehension. As the associations between dietitians' home language and both the perceived effectiveness and usefulness of FELs were not significant ($p > 0.05$) it could be assumed that dietitians still provide patients with FELs given the value it adds to the nutrition therapy irrespective of patient language, however no similar literature were available to compare these findings to.

5.6.3 Dietitians' home language and the modification of food exchange lists

The association between dietitians' home language and the perception to adjust FELs for various languages was not significant (p = 0.3119). It was expected, seeing as dietitians' home language significantly affected the use of FELs, that the perception to adjust FELs for various languages would also be significantly associated with dietitians' home languages. However, this may indicate that dietitians' perceptions to have FELs available in more languages are not based on their personal biases, but instead on the needs of patients.

Also, a significant association was found between dietitians who reported home languages other than Afrikaans or English and those selecting isiZulu as the language for which FELs should be adapted (p = 0.0338). The same proportion of Afrikaans or English-speaking dietitians suggested isiZulu and isiXhosa as the languages for which FELs should be adapted. Conversely, the larger part of dietitians with home languages other than Afrikaans or English reported FELs should be available in isiZulu and isiXhosa, which is more representative of the languages spoken by population groups as indicated by Statistics South Africa (2018:9). This might suggest that dietitians who have been more familiar with African languages showed greater insight and may have been able to better distinguish between the various African languages.

5.7 Dietitians' age and the use of food exchange lists

Studies from other countries reported a distribution of younger dietitians (≤35 years of age) between 24.7% and 44.0% of the dietetics population, whereas the current study found a higher proportion (52.0%) of dietitians aged below 30 years (Chen et al., 2017a:441; Chen et al., 2017b:3; McArdle et al., 2017:388; Jospe et al., 2015:3). Likewise, Joyner (2015:58) reported 56.6% of dietitians in South Africa were below 30 years of age. The median age of 30 years found in the current study is slightly lower, but comparable to other South African studies comprising dietitians, which ranged between 31.3 - 33.3 years. Although the study by Molenaar (2018:47), which investigated dietitians' knowledge and practices on eating disorders in South Africa, reported a lower median age of 26.5 years (Ebrahim et al., 2020:E722; Joyner, 2015:59; Visser et al., 2012:114; Martin et al., 2008:28).

The majority of younger aged dietitians in South Africa may be ascribed to the recent expansion of the dietetics profession, as evidenced by the 128.0% (1628 to 3717 registered dietitians) growth in the number of registered dietitians in South Africa since 2005 (Martin et al., 2008:28; Nortjé & Hoffmann, 2015:78; HPCSA, 2018:online; HPCSA head office, 2019). According to Steyn and Mbhenyane (2008:798), the number of newly qualified dietitians had to increase to above 250 per annum by the year 2010, given the increase in health care demands as a result of the morbidity prevalence of NCDs associated with the ageing population (Zhao et al., 2018:342).

5.8 Dietitians' years of experience

Visser et al. (2012:114) reported 45.3% of dietitians in South Africa had up to five years practice experience, which correlates with the distribution trend found in the current study. Also, Bonilla et al. (2015:5) investigated the use electronic assessment tools by healthcare workers, including dietitians, in Canada and found that 57.0% of dietitians had less than 10 years' experience, compared to 68.0% of dietitians having ≤10 years' experience in the current study. The median of six years practice experience in the current study correlated with 5.25 years' experience reported by Molenaar (2018:49) comprising dietitians in South Africa. However, a significantly higher median years of experience were reported by both Hand and Burrowes (2015:407) (24 years) involving dietitians working in outpatient haemodialysis facilities in the US and Desroches et al. (2015:106) (15 years) targeting dietitians treating patients with chronic diseases in Canada. However, results from the current study indicated that a larger proportion of South African dietitians seem to have less than five years practice experience compared to other countries. However, since a relatively low response rate was observed, the generalisability of the results should be done with caution.

5.8.1 The overall impact of years practising

The median years of practice experience may impact the transfer of knowledge between dietitians, which has been found to affect the quality and efficacy of health care services (Soguel et al., 2019:1 ; Scott et al., 2012:7). Especially, given that apart from evidence-based practice and patient-specific circumstances, dietitians' expertise informs decision making (Soguel et al., 2019:1). Thomas et al. (2003:318) investigated the knowledge and use of evidence-based practice among dietitians working in

paediatrics in Australia and found that 29.0% of dietitians consult with colleagues when a knowledge gap is experienced, which further highlights the significance of dietitians' years of experience in nutritional therapy. Investigating strategies of knowledge transfer, Scott et al. (2012:5) found that dietitians ultimately transferred knowledge by means of educational meetings. However, to allow the dietetics profession to build on existing work instead of wasting resources on reinvention, the value of dietitians' experience was accounted for in the current study by evaluating aspects of FEL practices and perceptions which are significantly associated with years of experience (Pascoe et al., 2020:2a1378).

5.9 Associations between the use of food exchange lists and age, years of practice and area of employment

A significantly larger proportion of older dietitians were employed in the private sector ($p = 0.0179$), however the current study did not find a significant association between age and the use of FELs ($p = 0.0574$).

Results from the current study indicated that 53.4% of dietitians were in private practice, which is higher than the percentages reported by other studies conducted on dietitians in South Africa. While Martin et al. (2008:29) found that 25.3% of dietitians worked in private practice, a higher percentage of between 37.1% and 40.9% were reported by other South African authors (Joyner, 2015:58; Visser et al., 2012:114; Steyn et al., 2005:388). However, it should be noted that it appeared that more recent studies found higher percentages of private practising dietitians compared to earlier studies, which indicate that dietitians may becoming more inclined to progress towards private practice. In support of this theory, the current study found strong evidence of an association between years of experience and area of employment ($p = 0.0230$), with a greater proportion of dietitians practising in the private sector having more years' experience.

Dietitians working in government institutions had the least median years of experience compared to private and tertiary education / research settings. Although the association between years of practice and the use of FELs was not statistically significant ($p = 0.3283$), the proportion (86.3%) of private practising dietitians who currently used FELs was significantly larger compared to dietitians working in

government (55.3%) and training / research / pharmaceutical settings (64.7%) (p = 0.008). Thus, considering the possible increased trend of dietitians practising in the private sector and that a significantly greater proportion of dietitians employed in private settings used FELs (p = 0.0008), it could be assumed that more dietitians may utilise FELs going forward, which highlights the need to ensure its suitability.

5.10 The use of food exchange lists in dietary analysis, as part of the nutrition care process

While FELs can be used in the dietary assessment phase of the NCP, only 38.6% of dietitians in the current study reported using FELs for this purpose, with the majority reported using FELs for meal planning and counselling. Correspondingly, 58.1% of dietitians perceived FELs effective in dietary analysis, compared to 93.9% and 85.2% of dietitians who perceived FELs effective in dietary intervention and nutritional counselling. Although the association between area of employment and tasks for which dietitians used FELs was not significant, a significantly greater proportion of dietitians working in government institutions perceived the use of FELs effective in dietary analysis (66.7%) compared to the private sector (46.6%) (p = 0.0058). Also, a larger proportion of dietitians employed in the public sector reported information on sodium content of food in FEL would be useful to them in dietary analysis and meal planning compared to private and tertiary education institutions / research (p = 0.0253). One of the possible reasons for this may include the increased reliance on shorter methods to dietary analysis among dietitians working in government settings. As only 16.4% of the South African population reported having a medical aid in 2018, the majority of the population are dependent on public healthcare facilities (Statistics South Africa, 2018:26), supporting the theory that dietitians working in government settings may have higher patient numbers which consequently increases the need for shorter methods to dietary analysis. As suggested by Wheeler et al. (2008), besides the FEL functioning as a short method to meal planning it can also be utilised for dietary analysis. Also, dietitians in the private sector may have increased access to alternative methods for dietary analysis, as a significantly larger proportion of dietitians employed in the government sector reported limitations accessing health applications compared to private practising dietitians (p = 0.0097). Furthermore, the use of FELs in dietary analysis may have been under reported. Firstly, seeing as most dietitians who reported using FELs were working in the private sector; however, a slightly higher

percentage of dietitians in the public sector used FELs for dietary analysis compared to private. Also, dietitians may not have been as cognisant of the role the FEL has in dietary assessment due to the indirect application thereof in dietary analysis, which might explain why only 60.0% of dietitians perceived the use of FELs in dietary analysis as an advantage.

5.10.1 Alternative tools used for dietary analysis, as part of the nutrition care process

Although a larger percentage of dietitians reported using food analysis software for dietary analysis instead of FELs, the only significant association found between alternatives used in dietary analysis and dietitians' area of practice was the use of nutritional labels. Even though the percentage of dietitians working in tertiary education / research and private settings who used nutritional labels in dietary analysis were higher compared to public settings ($p = 0.0256$), only one dietitian of each area of employment reported using nutritional labels for dietary analysis. Although the association between area of employment and resources used to update FELs were insignificant, the majority (70.7%) of dietitians used nutritional labels in updating FELs. The association between the use of nutrition labels in dietary analysis and area of employment may be partly attributed to the larger proportion of dietitians employed in government settings using FELs obtained from universities ($p = 0.0065$) and a greater percentage of dietitians working in private or tertiary education self-designing FELs ($p = 0.0136$). While Herselman and Esau (2005:52) stated that dietitians are often unaware of the source from which the FEL in use was obtained, dietitians in the current study reported mainly using FELs obtained from the University, ADA or self-designed FELs, while only 4.7% were unsure of the source.

5.11 The use of food exchange lists for meal planning, as part of the nutrition care process

The FEL was initially developed with the intention to provide a short method to meal planning and to provide flexibility in the diet of patients who are required to follow a restrictive diet or who have increased nutritional requirements, either as a result of lifestyle choices or due to a health concern or disease condition (Menal-Puey et al., 2019; Menal-Puey & Marques-Lopes, 2017; Fadupin, 2009; Herselman & Esau, 2005; Holzmeister, 1992; Caso & Stare, 1947). Dietitians in the current study motivated that

the increased flexibility provided through the application of FELs translates to a manageable nutritional plan with less taste fatigue, which consequently increases adherence. Also, the use of FELs allow for variety in the diet to ensure an adequate intake of nutrients (Fadupin, 2009; Wheeler et al., 1996; Caso, 1950). Consequently, dietitians in the present study also reported that FELs is an easy and quick method to meal planning, especially as menus / meal plans can be conveniently adjusted in the event of prescription changes. It has become of increasing importance to have time-efficient methods to nutrition therapy in place, especially given the increase in prevalence of both obesity and NCDs in South Africa (Gray & Vawda, 2018:199). The latest statistics released in 2020 indicated that South Africa has a population of 59.6 million, with an overweight and obesity prevalence in South Africa of 50% (68% females; 31% males) as reported by the National Department of Health et al. (2019:289) and Statistics South Africa (2020:8). Additionally, statistics from August 2020 confirmed that there are 3717 qualified dietitians registered with the HPCSA in South Africa (HPCSA head office, 2020). Consequently, there are 8000 potential patients per dietitian in need of weight loss counselling alone. For this reason, it is imperative to search for methods that are time-efficient and that will allow for extended dietetic intervention, especially considering the more effective personalised approach to nutrition therapy. Furthermore, by using methods and tools that are time-efficient more focus can be placed on the nutrition intervention phase of the NCP, specifically dietary counselling (Chen et al., 2018:751).

While 92.1% of dietitians reported using FELs for meal planning, 51.6% of dietitians reported making use of alternative or complementary tools and methods. The alternative or complementary tools used by the majority dietitians in meal planning were nutrition education materials, nutritional guidelines, or plate / cup models. The use of plate / cup models correlates with the greater part of dietitians who recommended that portion sizes in the FELs should be in household-measure format, as the use of plate /cup models in conjunction with FELs may improve patients' understanding of portion sizes and consequently their comprehension of the FEL. Although, dietitians not only made use of nutritional guidelines to complement FELs, as 85.7% also reported using guidelines in the absence of FELs for various parts of the NCP. The use of guidelines or models that are simpler and more practical were supported, given that dietitians indicated that FELs are impractical and too

complicated for patient use. Likewise, Maryniuk (2017:67) mentioned that often food pyramids, guidelines or plate models are used in practice to simplify nutrition therapy, especially since dietary education have become less nutrient-focussed and more directed towards dietary patterns. Besides alternative options being perceived as simpler, 27.5% of dietitians reported using alternative tools for the purpose of convenience.

Although meal plans are not used for all patients, incorporating nutritional guidelines into meal planning is essential, as patients' health status impacts their nutritional requirements. Consequently, the AND recommended that besides accounting for patient preference, individualised nutrition therapy should consider evidence-based guidelines (Franz et al., 2017:18). Likewise, Toledo et al. (2019:96695) suggested that nutrition therapy should be tailored to a patient's needs; therefore, integrating both patient preference and nutritional information, including the patients' health status, when developing a meal plan. This was also evident in the current study, as 55.1% of dietitians considered patient preference and 60.2% accounted for patients' health status in the decision to provide FELs.

5.12 The use of food exchange lists for counselling, as part of the nutrition care process

While the FEL is a well-known tool used in meal planning and counselling of patients, Wheeler et al. (2008:888) and Franz (1987:66) suggested that the FEL can be used for dietary assessment, meal planning, counselling and education. Additionally, Cho et al. (2011:175) reported that 89.1% of fifty five dietitians employed in Korean hospitals made use of FELs in nutritional counselling. Although the current study found that 92.1% of dietitians used FELs for meal planning as part of the NCP, a significantly larger proportion of dietitians working in private settings used FELs for dietary counselling ($p = 0.0087$). Often in the dietetics profession FELs are provided to patients during counselling, seeing as handouts should always be complemented by a verbal explanation, hence the possible relationship between the use and provision of FELs in counselling (Sustersic et al., 2017:539). Even though the area of employment did not significantly impact the decision on whether or not to provide patients with FELs or even the type of FELs provided ($p > 0.05$), statistically significant associations were found between the area of employment and factors, such as literacy

level and language, influencing the choice to provide FELs to patients. Also, the proportion of dietitians who provided patients with FELs depending on the situation were significantly greater among dietitians older than 30 years compared to younger dietitians (p = 0.0010).

5.12.1 Literacy level and the use of food exchange lists

The use of FELs generally requires patients to be literate, which was reported by 60.8% of dietitians as one of the challenges experienced with using FELs. Therefore, one of the possible reasons for the significantly smaller proportion of dietitians employed in government settings using FELs for counselling, could be related to patients' literacy level, for which a larger proportion of dietitians employed in government settings accounted for in the decision to provide FELs (p = 0.0096). Given that 29.9% of the population aged ≥15 years in the Eastern Cape, where the majority of the dietitians who worked in the government setting resided, had a level of education below grade 7 and were unable to read (Statistics South Africa, 2018:98).

Dietitians above 30 years of age were more considerate of the literacy level of patients in the decision to provide FELs (p = 0.0251), consequently a larger proportion of older dietitians reported using visual aids in nutritional counselling compared to younger dietitians (p = 0.0324). Although 78.6% of dietitians reported considering the literacy level of patients in the decision to provide FELs, only 26.6% suggested that FELs should be adapted for a literacy level below grade 7. This is noteworthy, as in 2018, 13.0% of the South African population >20 years of age were considered functionally illiterate (no schooling / not completed grade 7) (Statistics South Africa, 2018:22). Given the high prevalence of illiteracy in South Africa and the percentage of dietitians who reported that FELs cannot be used in illiterate patients, it was surprising to find that only 28.2% of dietitians in the current study reported using visual aids instead of or in combination with FELs in dietary counselling. Given the literacy level of patients in South Africa, the use of visual aids in dietetics practice should further be investigated and possible ways identified to incorporate visual tools into FELs. The difference of the effect patients' literacy level has in South Africa compared to the US is evident from the larger percentage of dietitians in the current study who considered literacy level in their decision to recommend health applications (64.3%) compared to 38.0%

(n=274) clinicians, of which 57.0% were registered dietitians, from the US (Karduck & Chapman-Novakofski, 2018:65).

5.13 The use of food exchange lists in student training

Besides the use of FELs as part of the NCP, FELs can also be used for training of dietetic students (Wheeler et al., 2008:888). Although merely 15.0% of dietitians used FELs for training of students, only 12.2% of participants reported working in tertiary educational institutions. Given that 58.8% ($p < 0.0001$) of dietitians working in tertiary educational / research reported using FELs in student training, a better indication of its use as part of student training might have been achieved if the study sample comprised a larger proportion of dietitians employed in tertiary education / research. The current study found that dietitians mainly perceived the use of FELs in student training effective in improving students' understanding of portion sizes, meal planning and the nutritional management of certain diseases.

5.14 The use of food exchange lists for specific health conditions

While the FEL is known for its use in the management of DM and weight management (Wheeler et al., 2008:887), the current study found that dietitians use FELs for a variety of patient groups. The patient profile for which dietitians in the current study mainly reported using FELs were for the management of DM, overweight / obesity, renal disease and cardiovascular disease, which was consistent with the majority of studies investigating the use of FELs in patients with metabolic syndrome and associated NCDs (Shaw et al., 2018; Cho et al., 2011; Ahn et al., 2010; Moore et al., 2009; Herselman & Esau, 2005; Ziemer et al., 2003).

5.14.1 The use of food exchange lists in diabetes mellitus and overweight / obesity

Although most dietitians reported using FELs in the management of DM and overweight / obesity, 29.0% suggested that FELs should be adapted for patients with DM. Consequently, the majority of dietitians suggested that information on added sugar content of products should be included in the FEL. However, significantly more older dietitians ($p = 0.0050$) with more years' experience ($p = 0.0268$) were opposed

to the inclusion of sugar content in the FELs. Seeing as a greater proportion of dietitians with less years practice experience defined a good FEL as one that is comprehensive (p = 0.0213), this might justify why a larger proportion of dietitians with less years' experience advised that information on sugar content be added. Although the sugar content of food products has a notable effect on patients with DM, the World Health Organization (WHO) has recommended that sugar intake for the entire population, excluding severe and moderate acute malnutrition, should be limited to <10.0% of the total energy intake (WHO, 2015:4). The guideline on sugar reduction was developed as a strategy to lower the prevalence of NCDs, of which dental caries and obesity were the main concerns (WHO, 2015:3). Seeing as meal planning is based on nutritional guidelines, incorporating information on the sugar content of food into the FELs could be valuable. Especially in light of the taxation on sugar sweetened beverages in South Africa, which was proposed in 2016 and implemented in 2018 (South African Revenue Service, 2020; South African National Treasury, 2016:2). Additionally, the study evaluating South African dietitians' perspectives on sugar taxation by Ebrahim et al. (2020:E722) found that 83% (n=72) of dietitians counselled patients regarding the sugar content on nutrition labels of food products, further supporting the need to incorporate sugar content of food items in FELs. Although, a larger proportion of dietitians employed in the public sector suggested that information on sugar content of food in FELs would be useful in dietary counselling, monitoring and evaluation compared to dietitians working in the private setting (p = 0.0037); whereas a larger proportion of dietitians in working in the private sector used FELs in counselling. As Okop et al. (2019b:9) reported that populations that were food insecure consumed higher volumes of sugar sweetened beverages compared to communities that were food secure, it could justify why a larger proportion of dietitians working public settings would perceive sugar information in FELs as useful in counselling compared to dietitians from private settings.

Apart from sugar content, extensive research has been done on the effect of glycaemic index on the management of blood glucose levels. A recent systematic review and meta-analysis of 54 randomised control trials involving patients with impaired glucose tolerance, type 1 and type 2 DM, showed a significant reduction in HbA1c and fasting blood glucose levels in patients consuming foods in the low glycaemic index category (Zafar et al., 2019:893). Given the value glycaemic index adds to the management of

patients with DM, the majority of dietitians in the current study suggested that glycaemic index should be incorporated into the FELs. Although, a greater proportion of dietitians reported that glycaemic index is population specific with significantly more dietitians employed in government setting perceiving information on glycaemic index as population specific ($p = 0.0098$). However, it should be noted that significantly more dietitians employed in government settings also considered patients' literacy level in the decision to provide FELs ($p = 0.0251$); thus, the addition of glycaemic index in FELs may be perceived as impractical considering the population profile of patients attending government institutions. Even so, 13.7% of dietitians suggested that it would be beneficial to have the information as some reported that it could also be used in the nutritional management of healthy individuals. Likewise, Zafar et al. (2019:891) reported that adherence to a low glycaemic index diet assisted with weight loss in patients with normoglycaemia.

5.14.2 The use of food exchange lists in renal disease

One of the patient groups for which dietitians reported using FELs was patients with renal disease. Similar to the survey by Herselman and Esau (2005:53) which indicated that dietitians preferred renal and diabetic FELs separate, the current study found that less than half (47.6%) of dietitians preferred micronutrient analysis to be part of the FEL. The main micronutrients reported by dietitians for which information should be included in the FELs were iron, calcium and the main electrolytes, including magnesium, phosphate, and potassium. Seeing as FELs are based on average composition per exchange, large variations may exist between different food items within the same list (Wyse, 1979:242). Given that variations in micronutrient values could have a detrimental effect on the management of certain conditions, such as renal disease, it was decided to develop a FEL specifically for the management of renal disease in South Africa (Herselman & Esau, 2005). The renal FEL therefore contains information on the phosphate, potassium, and sodium content of food items in addition to the macronutrient values.

5.14.3 The use of food exchange lists in hypertension and cardiovascular disease

Information on sodium content of food is not only essential in renal disease, but also one of the main factors to consider in managing patients with hypertension. While the

renal FEL can be used in patients with renal disease as well as cardiovascular disease due to the inclusion of fat and sodium content in the renal FEL, protein, phosphate and potassium are not routinely limited in patients whose only diagnosis is hypertension or cardiovascular disease. In the current study 52.8% of dietitians reported using FELs in the management of patients with cardiovascular disease or hypertension. However, 83.2% suggested that information on sodium content be added to FELs. While 42.8% reported the need to incorporate sodium into the FEL is population specific, some dietitians perceived sodium as a component essential for all patients. In support of this statement, the South African Department of Health (2013a) has implemented regulations on the reduction of sodium content in food products in support of the fight against hypertension (South African Department of Health, 2013a:37). Given that the South African Demographic and Health Survey of 2016 found that 45.0% of the South African population above 15 years of age had hypertension and the percentage of people with hypertension in South Africa has increased by up to 91.0% from 1998 to 2016, the inclusion of information on sodium content of food products in the FELs is warranted (National Department of Health et al., 2019:268).

Besides sodium, various studies have shown that dietary fat composition plays an intrinsic role in the management of cardiovascular disease (Casula et al., 2020; Jang & Park, 2020; Innes & Calder, 2020; Heshmati et al., 2019). Even so, dietitians' perceptions on the inclusion of fatty acid content in the FEL were diverse and almost equally distributed between those indicating that the addition of fatty acid content to FELs would make FELs too complicated, having information on the fatty acid content of food would be useful and others being unsure whether it is necessary to add this information to FELs. However, just over half of the dietitians in the present study supported the inclusion of fatty acid content in FELs. Although, motivations against the incorporation of fatty acids included that patients are seldomly counselled on this topic and that it is unnecessary as dietitians are knowledgeable on which food products are superior based on the fatty acid composition. Seeing as a large proportion of dietitians preferred using dietary guidelines when the use of FELs are not feasible, and 24.4% used dietary guidelines in counselling in conjunction with FELs, it may indicate that dietitians prefer more general and practical guidelines when it comes to counselling on the benefits relating to fatty acid composition. The South African Food Based Dietary Guidelines, which are commonly used in practice, may therefore alternatively

be used to counsel patients on fatty acids. As part of the guideline “Fish, chicken, lean meat and eggs can be eaten daily”, it is recommended that fish, especially fatty fish, is consumed at least twice per week given the benefits of its omega-3 fatty acid content (Schonfeldt et al., 2013:68). In conclusion, it may be unnecessary to include specific values for fatty acids in FELs; however, other methods such as flagging of sources that are high in certain fatty acids may be welcomed by dietitians. Especially, as the majority of dietitians preferred additional elements to be part of the same FEL; however, instead of providing the exact values, high or low sources could rather be indicated by means of flagging.

Furthermore, patients with cardiovascular disease are often counselled on fluid restrictions to combat oedema and consequently lessen the strain on the heart muscle (Krówczyńska & Jankowska-Polańska, 2020:1358). As a result, it may be necessary to incorporate the fluid content of food products in the FELs; however, the present study found that the majority of dietitians were opposed to the inclusion of fluid analysis in the FEL. The main concerns were that fluid restrictions are population specific and inclusion of fluid content in FELs would be impractical. Although fluid restrictions are mainly population specific, it is not only applicable to cardiac patients, but also other patient groups, such as patients with ascites, high output fistulas, and renal failure (Beerendrakumar et al., 2018; Adaba et al., 2017; Lalama & Saloum, 2016).

5.14.4 The use of food exchange lists in enteral feeding

Besides using information on the fluid content of food to manage patients with fluid restrictions, one of the challenges with calculating a home-made tube feed for patients requiring enteral feeding is achieving the patient’s fluid requirements while still considering the volume of boluses provided (Walia et al., 2017). Thus, information on fluid content of various foods in the FEL could assist dietitians in developing a practical meal plan for enteral feeding. Home-made tube feeds is especially important in the South African setting, as patients cannot afford ready-to-feed supplements, given that up to 27.6% of South African households in 2016 did not have enough money for food to last the month and in 2018 up to 36.6% of households had inadequate access to food (Statistics South Africa, 2018:67; Statistics South Africa, 2016). Although 15.0% of the dietitians in the current study reported using FELs in the management of patients requiring enteral feeding, the percentage of those using FELs in enteral feeding may

have been influenced by the larger proportion of the study sample having been employed in the private setting. As patients who attend private health care facilities are usually a member of a medical aid fund and therefore may be less dependent on cost effective enteral feeds, this could explain the low reported use of FELs for this population group in the present study.

5.14.5 The use of food exchange lists to ensure micronutrient adequacy

Food items grouped together in the FEL have approximately the same macronutrient composition, however large variations may exist between micronutrients of food items within the same food group. As a result, Russolillo-Femenías et al. (2018) set out to unify food items within the same food group for which macronutrient and micronutrient composition are similar, including calcium and iron values. Although only 7.1% of dietitians in the current study reported using FELs in the management of micronutrient deficiencies, 26.7% suggested that information on iron content of food be added to FELs. While the prevalence of iron deficiency for the entire South African population is not clearly defined, iron deficiency prevalence in various subgroups from Africa as well as other countries have been investigated, including children, pregnant women and women of child bearing age, patients with tuberculosis and patients awaiting elective surgeries (Barzegari et al., 2019; Conradie et al., 2019; Jordaan et al., 2020; Simo et al., 2020; Jonker et al., 2017). Given that one of the factors leading to iron deficiency anaemia is the inadequate dietary intake of iron, South Africa has implemented the legislation on the fortification of South African staple foods, including maize meal and wheat flour (South African Department of Health, 2016; South African Department of Health, 2003). Also, a recent systematic review and meta-analysis found the fortification of flour to be an effective strategy in addressing low iron levels in a population (Sadighi et al., 2019). Considering the research and strategies being implemented targeting iron specifically, it may be worthwhile to include nutritional information on iron in the FELs. Likewise, the study by Russolillo-Femenías et al. (2018) identified the need to incorporate iron and calcium into the Spanish FEL, to ensure adequate intake of these micronutrients while planning a diet that provides sufficient amounts of energy and macronutrients especially in population groups with increased requirements, like pregnant and lactating women.

Besides iron, dietitians in the current study also perceived calcium as one of the top micronutrients to consider adding to FELs, which corresponds with the study by Russolillo-Femenías et al. (2018). A recent review on the importance of calcium in health support dietitians' perceptions to add calcium to FELs, particularly as calcium is not only essential in bone health and growth, but also in the prevention of pre-eclampsia through the effects of calcium on blood pressure and cardiovascular health (Cormick & Belizán, 2019).

5.14.6 The use of food exchange lists in different stage of the life cycle

While 40.2% and 21.3% of dietitians in the current study reported using FELs for pregnant women and paediatrics respectively, 45.0% recommended that FELs be adapted for different stages of the life cycle. The use of FELs in the nutritional management of patients with increased nutritional requirements, including pregnant and lactating women, was also supported by Russolillo-Femenías et al. (2018:2030).

Although dietitians in the current study reported using FELs for healthy paediatric patients, selected studies have explored the use of FELs in paediatrics, mainly targeting conditions such as epilepsy, DM, and metabolic diseases such as phenylketonuria (Evans et al., 2020; Park et al., 2018; Holzmeister, 1992). Marín-Lizarazo et al. (2020) reported on the development of a FEL for use in healthy paediatrics in Colombia. Using FELs in children is especially challenging due to variations in portion sizes between adults and children, which may explain why only 21.3% of the dietitians in the current study reported using FELs in children. Currently, limited resources are available informing on the portion sizes to use in meal planning for children, thus potentially making meal planning in paediatrics a time-consuming task. Although the South African food based dietary guidelines on complementary feeding can assist with the recommended food volume per day for children up to 24 months, guidelines on portion sizes per food group and for children above two years of age are insufficient (Du Plessis et al., 2013:S136). As reported by Ong et al. (2014:186) FELs adapted for paediatric patients will not only assist dietitians in meal planning, but can also be used in counselling of parents, especially in children who are classified as picky eaters purely as a result of lack of knowledge on appropriate portions sizes in children. While the study by Ong et al. (2014:188) on the development of paediatric FELs in Singapore, made reference to the Health Promotion Board (HPB)

website for information on portion sizes, Menal-Puey et al. (2019:3) used portion sizes adapted from the food frequency questionnaire previously validated in the Spanish adult population, which was used in the study by Menal-Puey et al. (2016:387). The studies evaluating FELs in epilepsy and phenylketonuria in children either did not indicate portion sizes or determined portion sizes based on the amount of food that would provide one gram of protein / 50 mg phenylalanine. Thus, leaving only the study by Holzmeister (1992:377) in which milk exchanges were based on the volume of milk providing the same macronutrient composition as an adult dairy exchange (12 g carbohydrates; 8 g protein; 8 g fat); for the age group 10 - 12 months portions included 30 g meat, ¼ - ⅓ cup of fruit, and ¼ - ⅓ of the size of an adult starch portion (Holzmeister, 1992:377). It is therefore evident that there is a lack of research on portion sizes in children and consequently, insufficient resources available to dietitians to use in meal planning and counselling in this population group, necessitating the urgency for the modification of FELs targeting paediatrics.

5.14.7 The use of food exchange lists in gastrointestinal tract disease

While fibre forms an integral part of the nutritional management of lower gastrointestinal diseases, fibre also has various other health benefits. Therefore, the inclusion of fibre analysis of food products in FELs is applicable, not only to patients with lower gastrointestinal problems, but to the general population.

5.14.7.1 Functions of fibre

Dietary fibre, non-digestible carbohydrates, is available in two forms in the diet, soluble or insoluble fibre (Barber et al., 2020:3). While fruits and vegetables mainly provide soluble fibre, which are more readily fermented by gut microbiota, wholegrain products and legumes are primarily sources of insoluble fibre (Barber et al., 2020:3; Venter et al., 2013:S37). When polysaccharides, referred to as prebiotics, are fermented in the large intestine, short-chain fatty acids are formed, contributing to a healthy gut microbiota while adding to a patient's energy intake (Vorster, 2013:S30). Although the benefits of fibre in gut health, prevention and treatment of constipation is well known, the important role fibre has in various conditions are often overlooked (Barber et al., 2020:3). Vorster (2013:S28) and other authors have mentioned that dietary fibre may provide many health benefits, including, contributing to calcium absorption through exerting prebiotic qualities; soluble fibre has shown beneficial effects in prevention

and/ or management of hypercholesterolaemia; due to fibre lowering the glycaemic index of food it is a valuable element to consider in the management of DM; dietary fibre may increase satiety, thereby assisting in the management of obesity; through various pathways fibre lowers the risk of colorectal cancer; short chain fatty acids possibly mediates anti-inflammatory pathways both locally and systemic; and, fibre intake may be associated with improved mental health conditions Nirmala Prasadi & Joye, 2020; Barber et al., 2020; Gianfredi et al., 2019:21).

5.14.7.2 Adequacy of dietary fibre intake

The recommended amount of fruit and vegetables per day is 400 g (five 80 g servings); however, the South African population has an average intake of 230 g per day (Naude, 2013:S49). Besides fruit and vegetables, wholegrains are also essential sources of fibre in the diet, contributing to up to 50.0% of the total fibre intake (Nirmala Prasadi & Joye, 2020:3). However, due to the refinement of grains, population groups often do not consume adequate amounts of fibre. The average amount of wholegrains recommended by various countries is 80 grams, which equates to 2.5 servings per day; however, the global mean intake of wholegrains is 50 g (Nirmala Prasadi & Joye, 2020:1). Consequently, Shisana et al. (2014:176) reported that South Africans, similar to other countries, are consuming roughly 50.0% of the recommended fibre intake, given the more Westernised dietary pattern which is higher in refined carbohydrates and does not include an adequate amount of fruits and vegetables (Nirmala Prasadi & Joye, 2020; Barber et al., 2020:3; Sekgala et al., 2018:2).

Furthermore, between 1999 and 2012 the vegetable intake by South Africans has decreased by 8.0% (Okop et al., 2019a:13). The low fruit and vegetable intake in South Africa can partly be ascribed to a low socio-economic status (Sekgala et al., 2018:1), as Okop et al. (2019b:13) found that having more than R1000 per month available for groceries and access to personal transport were significantly associated with fruit and vegetable consumption. Additionally, Sekgala et al. (2018) reported that the intake of fibre in a rural population from Limpopo were suboptimal with an intake of less than 2 g soluble fibre per day. Seeing as the beneficial effects of fibre may be dose dependent, Sekgala et al. (2018) did not find a significant reduction in the risk factors for metabolic syndrome among patients who consumed sources of fibre. Thus, information on fibre is not only essential in specific disease conditions, but also in the

nutritional management of healthy patients. Given the extent of health benefits fibre has, especially in the prevention of NCDs, the addition of fibre analysis in FELs is warranted; particularly, considering the low fibre intake of the South African population. Seeing as dietitians often use FELs in dietary counselling, the inclusion of fibre analysis in FELs could therefore be beneficial.

5.14.7.3 Dietitians' practices and perceptions regarding fibre in the food exchange lists

In corroboration with the identified need based on results from other studies, the current study found that 87.7% of dietitians supported the need to add fibre analysis in the FEL. While most of the dietitians stated that fibre analysis will assist patients in making healthier lifestyle choices, 21.4% of dietitians reported that information on fibre of food products in FELs will be useful in the nutritional management of lower gastrointestinal tract complications. Although only 6.1% suggested FELs should be adapted specifically for this population group, 29.1% of dietitians in the current study reported using FELs for gastrointestinal diseases. Thus, while not many dietitians perceived it necessary to adjust FELs for gastrointestinal diseases, a much higher percentage would find the addition of fibre analysis to FELs advantageous in the nutritional management of this population group; however, the majority would use the information on fibre in FELs to promote healthy dietary choices.

5.14.8 The use of food exchange lists in patients with increased nutritional requirements

Meal plans are often required by patients with increased nutritional requirements, of which one such an example is the dietary management of athletes. Sports dietitians calculate meal plans for athletes to ensure dietary sufficiency as it is essential to follow a diet providing adequate nutrients for optimal performance (Jospe et al., 2015). The current study showed that 40.2% of dietitians used FELs in sports nutrition, although only 3.1% suggested that FELs need to be adapted specifically for the use in athletes. Likewise, a mere 6.1% of dietitians perceived it necessary to adapt FELs for patients with malnutrition, particularly underweight patients which is another condition requiring additional nutrients, for which 43.3% of dietitians reported using FELs. Therefore, it could be assumed that dietitians found the current FEL sufficient for use in patients

who are not metabolically stressed, but who have increased energy and protein requirements.

Besides increased activity and underweight, nutritional requirements are elevated in various hypercatabolic disease conditions characterised by cachexia, like cancer or AIDS (Oliveira et al., 2020; Prado et al., 2020). The current study found that 40.2% of dietitians used FELs in the management of cancer and HIV / AIDS. The high reported use of FELs in HIV may be due to the high prevalence of HIV in South Africa, as well as the various phenotypes HIV patients may present with, which may either be related to underweight or NCDs (Koethe et al., 2020). According to Statistics South Africa (2020:iii) the prevalence of HIV among those aged 15 - 49 years was 18.7%. Furthermore, Mabuto et al. (2019:1) suggested that undiagnosed HIV infections may be as high as 20.0% - 30.0%. In the current study there was a significant association between dietitians' area of employment and the use of FELs in the management of HIV / AIDS. A significantly larger proportion of dietitians employed in the government setting reported using FELs in the management of patients with HIV compared to the private setting. A possible reason for this could be that more patients with HIV attended public health care facilities compared to private settings, seeing as only 16.0% - 17.0% of the population were members of a medical aid in 2016 and 71.0% reported receiving prescribed medication from a public healthcare facility (National Department of Health et al., 2019:251). However, by having a clearer picture of the patient profile for which dietitians use FELs and the settings in which it is more often used, food items that are economically, culturally and disease sensitive could be added.

5.15 The use of food exchange lists in the dietary management of patients who follow a vegan / vegetarian lifestyle

There are various motives behind the decision to follow a vegetarian dietary lifestyle, although recent literature has mainly focussed on the health benefits of vegetarianism. While it is well known that vegetarianism is influenced by certain cultural and religious aspects, other influences, including ethical and preferential factors could also inform the decision to follow a vegetarian dietary lifestyle (Bryant, 2019:6844; McGir et al., 2017; Petti et al., 2017:231; Cramer et al., 2017:561).

5.15.1 Different forms of vegetarianism

A vegetarian diet generally excludes products that originate from animals; however various degrees of vegetarianism exist. A vegan diet excludes any product derived directly or indirectly from animals, including honey, gelatine and products using animal rennet in the processing (Petti et al., 2017:230; Agrawal et al., 2014:3; Orlich et al., 2014:1645). Less prevalent, raw veganism not only excludes any animal related products, but also excludes cooked foods; whereas fruitarianism includes only plant-based foods that can be collected without causing harm to the source in the process (Petti et al., 2017:230). Forms of vegetarianism that are more commonly followed include lacto-ovo-vegetarianism, which is mainly plant based, but also includes dairy products and eggs, while lacto-vegetarianism includes dairy products but not eggs (Agrawal et al., 2014:3). Lastly, pesco-vegetarianism is a plant-based dietary lifestyle that includes dairy, eggs and fish (Orlich et al., 2014:1645).

5.15.2 Advantages and limitations of vegetarianism and how it relates to the use of food exchange lists

A vegetarian dietary lifestyle has been associated with various health benefits, mainly comprising reduced risk factors for metabolic syndrome, resulting in lower incidence of NCDs (Haghighatdoost et al., 2017:2713; Petti et al., 2017:236; Cramer et al., 2017:562; Lee & Park, 2017). Although, many of the advantageous effects may be related to the benefits of a vegetarian lifestyle on the intestinal microbiota, as discussed under 5.14.7.1 the functions of fibre section of this chapter (Tomova et al., 2019). Even so, these diets are generally insufficient in certain micronutrients (Menal-Puey et al., 2019:1509; Petti et al., 2017:237; Cramer et al., 2017:562). Additionally, Bryant (2019:6844) reported that patients perceived meal planning as one of the top challenges experienced when transitioning to vegetarianism. Micronutrients that are often suboptimal include calcium and vitamin D, especially when dairy products are excluded; vitamin B_{12}, zinc, and iron of which animal products are good sources; and, omega-3 fatty acids and iodine of which fish is a rich food source (Petti et al., 2017:232).

When a vegetarian diet is planned properly it can provide sufficient amounts of the recommended micronutrients (Iguacel et al., 2019:7; Menal-Puey & Marques-Lopes, 2017:1509; Menal-Puey et al., 2016; Melina et al., 2016:1970). As a result,

vegetarianism in meal planning has been a particular focus point, especially seeing as the prevalence of vegetarianism is increasing (Menal-Puey et al., 2019:1509; Cramer et al., 2017:564). By paying attention to the composition of meals, specifically considering the amino acid profile, phytate and oxalate content, the bioavailability of the respective nutrients can be improved (Melina et al., 2016:1971). At risk population groups that may require special attention to ensure adequate nutirional intake when following a vegetarian lifestyle, include children and pregnant / lactating women, seeing as the nutritional requirements in these groups are slightly increased (Menal-Puey et al., 2019; Ferrara et al., 2020; Russolillo-Femenías et al., 2017:2029; Petti et al., 2017:232; Melina et al., 2016:1975).

5.15.3 Dietitians' perception regarding food exchange lists considering vegetarianism and religion

There is a correlation between certain religions, including Hinduism, Judaism and Islamic religion, and vegetarianism. This might explain why dietitians in the present study did not report using FELs specifically for the nutritional management of patients following a vegetarian lifestyle; even though, the majority reported that separate FELs should exist for vegans / vegetarians. Also, only 39.7% advised that FELs should be adapted for different religions of which the three main religions were Islam, Judaism and Hinduism. Majority of dietitians in the current study agreed that FELs should be adapted for specific ethnic groups, especially seeing as ethnicity impact dietary food patterns and indigenous foods used by a specific population group (Creswell, 2007:71; Dekker et al., 2015:1; Beyers, 2017:1; Rashid et al., 2018:9; Brown, 2019:11). While ethnicity comprises culture, language and religion, a larger percentage of dietitians stated that language (65.4%) and cultural groups (61.9%) should be accounted for when adapting FELs; however a smaller percentage advised that religion (39.7%) should be considered. Therefore, although dietitians seem to have accounted for the impact of certain religions on dietary choices, there may be a higher degree of uncertainty regarding the different religions and the associations between religion and food preferences compared to cultural and language influences.

Majority of people belonging to the Hindu religion are vegetarians, even though Hinduism does not prohibit the consumption of meat, apart from cows being deemed sacred animals (Leng & Keane-Rao, 2019:93). According to the Jewish law of religion

(Judaism) food should be Kosher, which not only refers to the physical characteristics of the product but also the preparation thereof. Similarly, food classified as Halal mainly refers to the preparation thereof, although people of Muslim religion (Islam), like Judaism, are prohibited from consuming certain foods including pork (Dubey & Mishra, 2020; Kagan et al., 2020; Ameh et al., 2016:2; Bibon & Ariffin, 2010). There are some similarities between Kosher and Halal food; while both religions permit meat from ruminants with cloven hooves and fish with scales and fins, shellfish is not Kosher, but may be Halal. The regulations comprising fish in the Islamic religion are more controversial, although one of the more constant features pertaining to fish in the Islamic religion is the presence of scales. Additionally, meat from birds of prey is not considered Kosher and dairy may not be consumed in combination with meat in a Kosher diet (Dubey & Mishra, 2020; Kagan et al., 2020; Sibal, 2018; Bibon & Ariffin, 2010). Due to Kosher and Halal food not being ubiquitous, vegetarian options are often chosen by people of Jewish or Muslim religion. Thus, the development of a separate vegetarian FEL is warranted considering the increase in vegetarianism as a result of ethical and health reasons, but also given its usefulness in the dietary management of various religious population groups.

5.16 The use of food exchange lists in the dietary management of different cultural groups

Culture refers to the inherited knowledge, standards and attitudes of a specific population group that are formed, perpetuated and learned through various practices (Sibal, 2018: 10909; Beyers, 2017:2; Puoane et al., 2006:92). Culture of a population is often expressed through dietary patterns, which is why it is essential to consider cultural influences in the dietary management of patients (Puoane et al., 2006:92).

5.16.1 Cultural influences on dietary intake in light of socio-economic status

Given the relationship between food security, culture and socio-economic status these concepts may be of equal importance in nutritional therapy. Even though food is economically accessable, if it is not culturally acceptable, population groups may still face food insecurity, seeing as food security is based on four concepts, which include accessibility, usability, availability, and stability (El Bilali et al., 2019: e00154; Olum et al., 2017:427). Similarly, Kasimba et al. (2018:1207) mentioned that the significance of traditional foods lies partly in affordability, but that cultural acceptability is as

essential. Likewise, the association between family dietary customs, economical factors and food preferences have also been discussed by Qiu and Hou (2020) and Scaglioni et al. (2018). As the socio-economic status of individuals affect dietary intake, the development of cultural habits pertaining to nutrition may therefore partly be attributed to the socio-economic status of that particular population (Kapelari et al., 2020; Borelli et al., 2020). One such an example is the association between the consumption of indigenous wild plants in food insecure communities (Mbhenyane, 2017; Misselhorn & Hendriks, 2017:17). Njume, et al. (2014) described a variety of indigenous leafy vegetables found in various parts of South Africa, signifying the need for population-specific FELs, seeing as the use of different leafy vegetables are used by populations depending on the geographical location.

5.16.2 The importance of considering culture in nutrtional management

One example that signifies the importance of accounting for culture in nutrition therapy involve the consumption of maize meal. Maize meal is one of the staple foods consumed by the South African population and was the highest contributor to total energy intake in 2010 among 1154 African men and women from the Western Cape, with consumed volumes in grams ranging between 507 - 679 per day (Wentzel-Viljoen et al., 2018:2953). Although many South Africans consume maize meal, the consistency thereof and complimentary foods consumed in combination with maize meal often differ between various cultural groups. From practical experience it was evident that some population groups traditionally eat meat and tomato stew with maize meal, while others prefer to combine maize porridge with leafy vegetables, legumes or dairy (milk or sour milk). These are important differences to consider in meal planning as firstly, the nutritional composition of thin porridge and stiff porridge vary; secondly, to develop a meal plan that is culturally sound, appropriate combinations of food has to be incorporated into a menu based on die dietary prescription; and, lastly it is essential to be familiar with common traditional names for meals to eliminate miscommunication. This can be illustrated by the following example: while it is generally assumed that salad refers to a meal containing fruit or vegetables, in the African culture, when sour milk, known as “Amasi”, is combined with maize meal crumbs, called “Umphokoqo”, it is traditionally referred to as “African salad” (Van Wyk et al., 2002:45).

Due to the important impact of culture in nutrition therapy and significant differences in food preferences between various cultures, FELs for specific cultures in South Africa may be warranted. However, in light of South Africa's history, various cultural influences contributed to the South African traditional cuisine, which may become challenging when designing separate FELs for different cultural groups (Oktay & Sadıkoğlu, 2018; Erasmus & Hoffman, 2017). Hence, a greater variety of traditional food should perhaps be added to the existing FELs, especially given that individuals do not necessarily consume traditional dishes from only one cultural group.

5.16.3 Dietitians' practices and perceptions regarding culture in food exchange lists

In the current study, the majority of dietitians argued that one of the limitations of FELs is the insensitivity towards various cultural groups. As a result, most dietitians motivated for the adaptation of FELs for different cultural groups. The main cultural groups dietitians suggested FELs should be adapted for were African and Indian / Cape Malay cultures. As religion impacts culture and some connections have been found between the Indian population and Islamic religion, the dietary preferences of the Indian culture may be explained by Islamic beliefs, as discussed earlier under 5.15.3 (Royyani & Shobaruddin, 2020). Despite literature indicating that socio-economic status influences dietary intake (Okop et al., 2019a; Dekker et al., 2015), less than half of the dietitians in the current study suggested that FELs should be adapted based on socio-economic status. This is especially significant as in 2012 nearly half (44.6%) of the South African population had either no income or reported receiving less than R800 per month (Shisana et al., 2014:70). It is therefore essential to account for socio-economic status in counselling and meal planning, as guidelines may be impractical otherwise.

5.17 Updating food exchange lists

Although the association between area of practice and the perception that FELs should be updated was insignificant, there was a statistically significant association between dietitians' area of employment and the time since the FEL was last updated ($p = 0.0053$). A substantially greater proportion of dietitians working in the private sector reported that FELs have been updated within the last two years. However, it was unclear whether a larger proportion of dietitians employed in the private sector

used FELs seeing as these FELs have been kept up to date or if dietitians working in private settings kept FELs up to date given that a greater percentage of this subgroup used FELs. Although, the latter could be assumed as there were no significant associations found between area of practice and dietitians' perception regarding the availability of adequate resources, time, or knowledge ($p > 0.05$) to update FELs. However, due to the significant association between area of practice and dietitians' age ($p = 0.0179$), and the greater percentage of dietitians above 30 years of age who reported having adequate knowledge of FELs compared to younger dietitians, it could be reasoned that dietitians working in private settings, who are older, are more likely to update FELs themselves as a result of their perceived knowledge of FELs. Especially given the greater proportion of dietitians above 30 years of age who reported self-designing FELs and having updated the FEL within the past two years.

Additionally, a greater percentage of dietitians working in tertiary educational institutions reported that FELs have been updated in the last two years. Therefore, while a larger proportion of dietitians employed in private and research settings developed and updated FELs, a larger percentage of dietitians employed in government settings reported obtaining FELs from universities, possibly explaining why the latter did not report a recent update of FELs.

Concerningly though, was that 50.8% of dietitians used FELs at least three times per week, while 30.7% reported being unsure when last the FEL has been updated. What is more, 32.2% of dietitians reported either being unsure if FELs should be updated or that FELs are not due for an update. Therefore, this could mean that nearly one third of dietitians might be using outdated FELs due to the lack of guidelines pertaining to the update of FELs. Especially given that only 23.7% of dietitians who suggested that FELs should be updated, reported the reason for an update being uncertainty regarding when last the FEL has been updated or that FELs should be updated every few years.

5.18 Portion sizes in the food exchange lists

One of the top three motivations provided by dietitians supporting the need to update FELs included challenges experienced with portion sizes. Seeing as portions of food items have increased in size over the years, as discussed in the study by Steenhuis

and Poelman (2017:11), dietitians perceived the portion sizes reflected in the current FELs as outdated. Furthermore, Gupta et al. (2016) reported on the importance of using portion sizes that are commonly used or referred to by a specific community.

5.18.1 The format of nutritional analysis in the food exchange lists

While the food composition in nutrition databases is presented per 100 g edible portion, which makes comparison between products possible, the FEL shows nutritional composition per exchange (Wolmarans & Danster, 2008:312; Wheeler et al., 2008:885). Although a small proportion of dietitians indicated that analysis would be preferred per 100 g, the majority reported that analysis should remain per exchange. A possible reason for this could be that 67.7% of dietitians used FELs for counselling compared to 38.6% for dietary analysis, and therefore analysis per portion size or exchange could have been perceived more valuable than analysis per 100 g. Also, this format eliminates the need for additional calculations to determine the appropriate portion size, making FELs more convenient to use.

5.18.2 The format of portion sizes in food exchange lists

One of the challenges experienced with portion sizes in FELs reported by 36.9% of dietitians in the current study was the impracticality thereof for patients eating away from home. Likewise, Chen et al. (2019:213) reported that patients find the estimation of portion sizes challenging, especially when eating away from home or dishing from a communal container. While Almiron-Roig et al. (2019:1095) discussed the increased efficacy of three-dimensional aids to assist in portion estimation compared to written portion size guidelines, Chen et al. (2019:213) suggested that pictures and informal measurement techniques, such as the hand model, may be more effective.

5.18.3 Hand model as a method to estimate portion sizes

Apart from FELs containing written information on portion sizes, thus making FELs unsuitable to use by illiterate patients, the format thereof is also impractical for patients to use in the absence of measuring utensils. Therefore, Almiron-Roig et al. (2019:1095) suggested that tools should instead aim to teach patients about portion sizes and promote patients' ability to estimate portion size independent of measuring equipment. As a result, patients are often advised on using the size of the hand to estimate portion sizes, specifically given that individualised recommendations

regarding portion sizes would differ based on the patients' size and gender, which are taken into account when using the hand model as an aid for portion size estimation. However, König et al. (2019:2425) found that although the hand model may assist in estimating portion sizes based on the patient's own requirements, due to differences in hand sizes the estimation of portions in weight based on the hand model was inconsistent. This method may therefore not be viable in patients for whom requirements are calculated with a higher level of precision.

5.18.4 Cup / plate model as a method to estimate portion sizes

Another simplified method of portion size estimation often used, includes portion sizes in household measures, which were preferred by 91.3% of dietitians in the current study. Although nutrient databases usually describes food in weight, by using density factors the volume of the specified weight can be calculated to determine household measures. Partridge et al. (2018:973) investigated the difference between weights of various food items as indicated in the nutrition database (USDA-SR) compared to the weight of food items that were measured out in volume. Significant discrepancies were found between the weight of food that was measured in volume, obtained by converting weight to volume using density factors, and the weight in the nutrition database. It was thus recommended that food volumes rather be estimated from images instead of extrapolated from weight.

5.18.5 Food images / photographs as a method to estimate portion sizes

Amoutzopoulos et al. (2020:8) reported that the food atlas was the portion size estimation element that showed the greatest accuracy in portion size estimation. Using a list of food photographs resulted in 68.0% and 77.0% accurately estimated portion sizes with an estimation error of -36.8 g to 17.1 g (Amoutzopoulos et al., 2020:8). While the average estimation error for food atlases were 2.3%, household measurements resulted in a 56.9% estimation error (Amoutzopoulos et al., 2020:9). It may thus be worth considering presenting portion sizes in FELs in visual format instead of household measures, especially given the literacy level of the South African population.

5.18.6 Raw versus cooked portion sizes

Partridge et al. (2018:973) suggested that variations found between weights of food volume and the nutrition database may partly be ascribed to differences in cooking processes, which was also one of the concerns raised by dietitians in the current study. In the present study 47.7% dietitians argued that FELs do not distinguish between raw and cooked portion sizes, which could result in the inaccurate interpretation and application of information presented in FELs. Likewise, various authors found that cooking methods influence the nutritional value and yield of food products (Blikra et al., 2020: 110004; Ježek et al., 2019:490; Roncero-Ramos et al., 2016; Sun et al., 2014; Wolmarans & Danster, 2008).

The current study found that the majority of the dietitians preferred portion sizes in FELs to refer to cooked portions mainly for the sake of convenience, especially seeing as patients often cook for the whole family or dish meals that have been cooked by someone else. However, raw portion sizes could eliminate the need to weigh food using a food scale, given that the known weight of the raw product can be used to establish the size of one portion. Consequently, raw portions could limit food wastage due to the value it may add to pre-cooking preparation. The effect of pre-meal planning not only reduces food wastage, but may also influence the portion sizes consumed by patients (Almiron-Roig et al., 2020; Brunstrom, 2014). Furthermore, raw portioning may result in a more accurate measurement, particularly in mixed meals. However, some dietitians reported that the decision between raw or cooked portion format would be product specific, as certain products could be eaten either raw or cooked; thus, portion sizes should be in the format most practical for patients to use. Thus, as demonstrated by Wolmarans et al. (2009:63), to prevent confusion, a detailed description of food items presented in a nutrition database, or in this case FEL, should clearly describe the food product for which the portion size was defined.

5.19 Mixed meals as part of the food exchange list: ready-made meals / fast food

Another significant aspect is the considerate and continuous growth in the consumption of convenience / ready-made meals, given the improvements in technology and the fast-paced lifestyle (Viljoen et al. 2018:19). From 2011 to 2016 the global convenience food market was expected to grow by 17.0% (Rivera & Azapagic,

2016:214). However, the consumption of convenience food is not only increasing globally, but also in South Africa. Although, only up to 9.6% of the South African population considered convenience when doing grocery shopping, 19.3% reported eating out more than once per week (Shisana et al., 2014:348). However, Viljoen et al. (2018:54) reported that 37.7% of students from Pretoria University had convenience meals at least once per week, while less than half of the students had home-cooked meals five to seven days a week. Likewise, based on the US National Health and Nutrition Examination Survey 2011-2018 Kwon et al. (2020:10) found that children aged 2 - 17 years in the US consumed 1.7 - 4.1 meals away from home per week, however meals consumed at school may have skewed these results in children. As a result of the global, and specifically South African increase in ready-made food consumption, it may be necessary to include these food items in FELs. Especially, seeing as dietitians use FELs in meal planning and counselling, information about ready-made food in FELs will allow dietitians to counsel patients on more suitable options to choose from while taking patient preferences into account by incorporating these options into meal plans which can ultimately increase patient compliance to the meal plan (Detopoulou et al., 2017:208). Consequently, 64.0% of the dietitians in the current study agreed that fast food items should be included in the FELs.

5.20 Mixed meals as part of the food exchange list: traditional home-cooked meals

Apart from fast food, mixed home-cooked meals are also lacking in FELs, which could make dietary analysis, meal planning and counselling more time-consuming. Particularly, seeing as when the specific meal is not readily available in the food composition database software the dietitian would have to add the ingredients of a recipe into the software, after adjustments have been made by using retention and yield factors where needed (Wolmarans et al., 2009:62; Schakel et al., 1997:109). Likewise, Chen and Allman-Farinelli (2019:e12349) recommended that attention be given to the reporting of meals comprising multiple components, as reporting and assessing these types of meals can become laborious. Additionally, given that FELs comprise average values of food items, analysing a mixed-meal item by adding average values from the FEL of multiple ingredients of a recipe together would result in an inaccurate estimation, thus the combined product should be analysed instead. Consequently, more than half of the dietitians in the current study suggested that

having mixed meals included in the FEL would be advantageous in various phases of the NCP, especially in counselling. Even so, a quarter of dietitians argued against the inclusion of mixed meals. The main limitation to adding mixed meals to the FEL reported by dietitians in the current study pertained to the variations that exist between different recipes. Likewise, Stock and Wheeler (1972:446) stated that variations between energy composition of different recipes could be as high as 77.0%, mainly due to fat content variances and differences in preparation procedures. To account for this objection, Bawadi and Al-Sahawneh (2008:840) based the analysis on a recipe created by calculating the average of each ingredient of five variants of local recipes for the same dish. Furthermore, Chiplonkar and Agte (2007:231) suggested that standardised recipes be used to limit differences in nutrient analysis ascribed to external factors. Seeing as some dietitians suggested the addition of recipes to the FEL, recipes used for the analysis of mixed meals could be added to FELs.

5.21 Dietitians' perception regarding electronic food exchange lists and health applications

The use of health applications is increasing (Bert et al., 2014), especially considering the ageing population, growth in obesity prevalence, and the subsequent increase in morbidity of NCDs (WHO, 2018). Additionally, literature shows a significant increase in the use of mobile health applications, especially given that 43.0% of the global population owned a smartphone in 2015; although, only 37.0% of South Africans owned a smartphone (Pew Research Center., 2016:4). As individualised nutrition therapy was found to be more effective compared to a generalised management approach, the increase in NCDs poses a concern to the dietetics profession, given the number of registered dietitians in South Africa in relation to NCDs prevalence. This necessitates the use of methods that will allow targeted nutrition therapy that is time-efficient, which includes utilising health applications (Olfert et al., 2019:50; Zhao et al., 2018:342).

However, applications first need to be evaluated for appropriateness by dietitians, as the use of unsuitable applications could result in ineffective outcomes. Although different sets of criteria may apply depending on the intended use of the application in question, Nouri et al. (2018) conducted a systematic review to define the criteria to use when assessing the quality of a health application. The following points were

described as the main criteria to consider, namely application design, content (credibility, accuracy, quality and quantity), usability (ease of use, flexibility / adaptability), functionality, ethical considerations (autonomy), security and privacy, and value. These criteria correspond with the factors considered in the decision to recommend applications to patients, as well as advantages and limitations of health applications in the current study. Furthermore, to remain relevant the ADA recommended the use of technology, not only in the management of NCDs, but across various areas of dietetic practice (Rusnak & Pamela, 2019:1375; Karduck & Chapman-Novakofski, 2018:63).

5.21.1 The use of health applications by dietitians

While only 37.0% of dietitians in the current study reported using health applications in practice, 47.6% recommended applications to patients. However, Sauceda et al. (2016:1336) suggested that dietitians are often unaware that they are using nutrition informatics, “the intersection of nutrition, information and technology”, which could mean that the use of applications may be underreported. Although the current study did not investigate the patient profile for which dietitians specifically use health applications, literature indicates that the majority of the health applications are aimed at healthy individuals; however, Martinez-Millana et al. (2019:e13362) stated that health applications are often used in the management of health and disease (Lambert et al., 2017:432).

Compared to dietitians from various countries, South African dietitians may be using applications to a much lesser extent, seeing as the use of applications by dietitians from Australia, UK, New Zealand, and Canada ranged between 32.4% - 78.0%, with higher reported use by dietitians from the US (Elvin-Walsh et al., 2018:144; Karduck & Chapman-Novakofski, 2018; Chen et al., 2017; Jospe et al., 2015). However, similar to the results reported by Chen et al. (2017b:439), a higher percentage of dietitians in the current study recommended applications to patients compared to the percentage of dietitians using health applications in practice. Additionally, Chen et al. (2017:441) reported that dietitians were 7.2 times more likely to use applications when it was recommended to patients. While the greater percentage of those recommending applications compared to the ones using applications may be due to insufficient knowledge of applications, the small percentage of applications targeting health care

professionals may also contribute to this phenomenon (Chen & Allman-Farinelli, 2018:468; Lambert et al., 2017:431). Although limited applications target health care professionals, 64.7% of dietitians in the current study reported using applications in meal planning, given that health applications provide information on nutrition and recipes (Lambert et al., 2017:431). Consequently, similar to the results reported by Chen et al. (2017a:e40), dietitians in the current study suggested the addition of sample meal plans and recipes to FELs, which could potentially be used by patients to create a shopping list directly from the nutrition prescription.

5.21.2 The target population for electronic food exchange lists and health applications

Given that the efficiency of a tool is measured through the effectiveness of its use by a specific population, it is essential to establish the target audiences for applications and FELs. The significance of the appropriate use of tools may thus partly be explained by the small percentage of dietitians in the current study who perceived the use of applications as effective (8.4%) and efficient (9.9%), while only 62.3% of dietitians found FELs useful to patients. While some dietitians may find FELs useful, in other words, perceiving the use thereof as beneficial, it may not translate into effectiveness, which refers to the ability of FELs to produce the required effects. Therefore, both dietitians' perception on FEL's usefulness and effectiveness were investigated. More dietitians perceived FELs as useful to them compared to the usefulness of FELs to patients, which may be related to the target population for which FELs are currently designed for. Especially, seeing as a slightly higher percentage (67.1%) of dietitians in private settings, where FELs were more likely adjusted for specific patient groups, reported that FELs are useful to patients compared to dietitians working in the government setting (51.4%). Furthermore, the majority of applications available are intended for patient use; consequently, Jospe et al. (2015) reported that sports dietitians perceived health applications to very effective in assisting patients with dietary assessment, whereas applications were only perceived moderately effective in dietary assessment performed by dietitians. Additionally, Chen and Allman-Farinelli (2019: e12349) suggested that the use of applications by the populations for which is was intended for may be more valuable to both patients and dietitians, thus also highlighting the need for population-specific FELs or health applications. In conclusion,

when validated FELs and applications are used, the efficacy, efficiency and usefulness thereof may be increased, resulting in improved treatment outcomes.

5.21.3 Electronic food exchange lists

Given the advantages of health applications considering the need for shorter methods to nutrition therapy and the important role of FELs in various steps of the NCP, dietitians' perceptions regarding electronic FELs were investigated. Nearly all dietitians (98.4%) in the current study reported that having an electronic FEL would be useful, especially in the form of a smartphone application. Although, more than half reported that a web-based application would also be useful. Likewise, 96.0% affirmed that an electronic FEL would hold various benefits, but even so, more than half of the dietitians were concerned about limitations pertaining to the application itself. Limitations included, application relevance, reliability, accessibility, adjustability, ease of use / health literacy demand, and costs involved with its use. Adjustability of the electronic FEL could assist in keeping FELs updated, as dietitians would be able to upload new or missing food items to the list. After evaluating for accuracy, to ensure FELs are kept evidence-based, the additions could be made available for all future users, thereby keeping the FEL relevant and accurate. Also, by being able to adjust the electronic FEL, dietitians would be able to easily modify FELs to make it more applicable to a specific patient, which could improve the efficacy of its use.

5.21.4 The use of health applications compared to traditional methods in dietary assessment

Very few studies could be found on FELs, specifically electronic FELs; however, Rangan et al. (2016) evaluated the dietary intake of 80 students in Australia using an electronic dietary intake assessment (e-DIA), based on food groups similar to the FEL, compared to three 24-hour dietary recalls. Although Rangan et al. (2016) suggested that e-DIA could be useful for dietary analysis at population level, discrepancies made it less suitable at individual level. Likewise, Ambrosini et al. (2018) evaluated the usefulness of the *Easy Diet Diary* application among university students in Australia, and found that although there was an average of 268 kJ / day difference between the application and 24-hour dietary recall analysis for energy, differences in nutritional analysis for other nutrients was insignificant and the application was preferred by 83.0% of students; thus, making the application useful in epidemiology research.

Variations between e-DIA and 24-hour recall analysis could be attributed to biases associated with self-reporting, including the selection of incorrect portion sizes or food items and not necessarily as a result of using food groups or an electronic format of reporting (Rangan et al., 2016:2224). Especially, seeing as Jospe et al. (2015:e7) found that 22.0% of sports dietitians from five different countries reported that patients selected incorrect portion sizes when using applications and 19.0% reported inadequate knowledge of various food items.

5.21.5 The role of the dietitian in the use of health applications as part of the new era of nutrition and technology

Although not an objection mentioned by many dietitians in the current study, the possible exclusion of health care professionals is one of the challenges to using health applications. However, acceptance of applications by patients and health care practitioners have been higher when applications were used in addition to physical visits instead of an alternative to consultations, partly because the involvement of dietitians are still preferred by patients even though health applications are being used (Chen et al., 2019:213; Martinez-Millana et al., 2019: e13362; Bert et al., 2014: 9995). Also, health applications are not intended to replace the consultation with a health care practitioner, but instead be used complementary to a nutrition consultation (Pires et al., 2020:11).

The involvement of dietitians is required to ensure the efficacy of health applications in the nutritional management of patients. In accordance with the current study, Braz & De Moraes Lopes (2018:1212) described the inappropriate use of applications in the absence of a health care practitioner's involvement, which was supported by the incorrect selection of portion sizes and food items by patients logging diet histories without guidance from a dietitian (Jospe et al., 2015:e7). Additionally, as the duration of application use has been found to affect the significance of the treatment outcome, dietitians still play an essential role in the nutritional management of patients using health applications as part of the NCP (Wang et al., 2019:4; Chen et al., 2018:750). While the application retention rate was higher when health care professionals recommended applications, dietitians specifically could have a significant impact on patients' use of nutrition applications, seeing as dietary interventions by dietitians was found to be more effective compared to other health care professionals (Sun et al.,

2017:e36). Besides the potential of applications to increase patient compliance, dietitians' supportive role in the use of health applications could further improve patient adherence (Chen & Allman-Farinelli, 2019: e12349; Chen et al., 2018:752).

5.21.6 The use of health applications in nutritional management as part of the nutrition care process

Chen et al. (2018:750) suggested that the use of relevant applications as part of the NCP could promote the quality of dietetics practice, as tasks could be completed more efficiently, leaving ample time for dietary counselling (Elvin-Walsh et al., 2018:146; Chen et al., 2017a:e40). Besides efficiency, appropriate applications may improve the accuracy of dietary assessment, as traditional dietary assessment methods are more susceptible to errors with it being reliant on memory. Also traditional methods may be more complicated, seeing as the conversion of food to nutrients needs to be done manually (Jospe et al., 2015:e7). What is more, the use of health applications could potentially improve patients' experience of nutritional therapy, especially given the increase in patient autonomy with using applications, but also possibly through increased communication between patient and dietitian (Lu et al., 2018:e126).

Patients often search for dietary advice on the internet, pointing towards the need for evidence-based information that can be accessed remotely and instantaneously; therefore, an application allowing a patient to connect with a dietitian remotely could improve patient satisfaction (Elvin-Walsh et al., 2018:147). Although, Chen and Allman-Farinelli (2019:e12349) did not find a significant improvement in patient satisfaction when applications were used in dietetic practice.

5.21.7 Application-related factors influencing the use of health applications: effectiveness and efficiency

Ineffectiveness and inefficiency were among the limitations to using health applications reported by dietitians in the current study. Of the dietitians in the current study using health applications, 38.3% used FatSecret and 36.2% reported using MyFitnessPal, compared to 56.0% of sports dietitians from five different countries who used MyFitnessPal (Jospe et al., 2015:e7). Correspondingly, Chen et al. (2019:213) found that MyFitnessPal, the most widely used application in various countries, underreported energy content by up to 445 kcal (1862 kJ) when used by the general

population, which is significant, seeing as this is the amount of energy prescribed to bring about change in body weight (Sauceda et al., 2016:1337). Although, other studies have shown smaller discrepancies in energy analysis between a 24-hour recall and MyFitnessPal; however, diet histories in these studies were recorded by people with a nutrition / dietetics background (Chen et al., 2019:213). Factors affecting the accuracy of dietary analysis when using health applications, include portion size estimations, appropriate food selections and the incorporation of additional information relating to meal preparation affecting nutritional composition of food, which may explain the differences observed between accuracy depending on the health literacy of the application user (Grif et al., 2018:1498; Jospe et al., 2015:e7). Likewise, Fallaize et al. (2019: e9838) reported comparable energy analysis between applications, including FatSecret and MyFitnessPal, and "*McCance and Widdowson's The Composition of Foods, 6th edition"* analysis; however, protein and sodium were underestimated and variations were observed with micronutrient analysis.

Regarding the efficacy of applications, Fakih El Khoury et al. (2020) evaluated the efficacy of a population sensitive Arabic application in 23 patients undergoing haemodialysis and found that it can possibly improve nutritional intake in this population group. Likewise, a systematic review and meta-analysis of 22 articles, of which the majority were randomised control trials, investigating the efficacy of mobile health applications on nutritional status in patients with chronic diseases concluded that the utilisation of health applications resulted in positive nutrition-related outcomes (Fakih El Khoury et al., 2019:626). Also, the systematic review and meta-analysis by Mateo et al. (2015), including 12 articles of which 10 were randomised control trials, found that the use of applications in weight loss management was useful. Therefore, it could be concluded that outcomes are more effective when health applications are specific to the population in question. Consequently, diagnosis was one of the main factors that influenced the decision to recommend health applications to patients in the current study.

5.21.8 Application-related factors influencing the use of health applications: trustworthiness and accuracy

Trustworthiness and accuracy were reported as the main considerations in the recommendation of health application to patients, especially given that reliability and

trustworthiness were among the top three limitations to using health applications reported by dietitians. The lack of accessible, evidence-based applications may not only discourage the use and recommendation of health applications by dietitians in practice but may also lead to the use of sources that are not scientifically sound. Specifically, as Lambert et al. (2017:432) evaluated 21 available nutritional applications targeting patients with chronic kidney disease and found that nearly half of the applications were not scientifically-based. Similarly, various sources stated that the majority of health applications were inaccurate and not evidence-based (Chen et al., 2015:e104; Bindhim and Trevena, 2015:e218; Bert et al., 2014; Gan & Allman-Farinelli, 2011:293).

Although the majority of dietitians in the current study reported trustworthiness as one of the main considerations in the decision to recommend applications to patients, 61.7% of dietitians in the current study suggested that the nutrition applications in use were evidence-based; which is alarming, as this does not correlate with the majority of studies evaluating some of the same applications the dietitians in the current study reported using. Thus, dietitians in South Africa may be using tools which are believed to be evidence-based, even though it may not be. This is especially significant, as one of the purposes for which health applications are used, and the part of the NCP for which the majority of dietitians in the current study reported using health applications, is education and counselling (Lambert et al., 2017:431). Therefore, information used in counselling of patients may not be reliable when health applications in use are not scientifically based.

5.21.9 Application-related factors influencing the use of health applications: accessibility considering the socio-economic status of the South African population

Various studies refer to health applications as ubiquitous and easily accessible, which could indicate why the majority of dietitians in the current study perceived the use of health applications as convenient (Chen et al., 2019:209; Bert et al., 2014:9995; Hebden et al., 2012:e9). Although a much higher percentage of dietitians in the current study reported health applications as convenient to use compared to Jospe et al. (2015:e7); ubiquity was not an advantage reported by dietitians in the present study, while this was the main advantage of health applications reported by Jospe et al.

(2015:e7). In fact, 40.5% of the dietitians in the present study perceived health applications as irrelevant and difficult for patients to access, especially given the socio-economic status of the majority of South Africans, as discussed earlier. Correspondingly, Seyyedi et al. (2019:8) suggested that a poor socio-economic status could result in infrastructural and technical limitations, consequently impeding the use of applications either through inaccessibility to mobile phones or even internet connection. Correspondingly, Karduck and Chapman-Novakofski (2018:65) reported that the decision to recommend health applications to patients were influenced mainly by patients' access to applications (57.0%, n=413).

Given the relevance of a patients' socio-economic status in meal planning, the majority dietitians agreed that it would be beneficial to have an application that could calculate the cost of the meal plan developed. This result was unexpected, given that less than half of the dietitians motivated for the adaptation of FELs based on the socio-economic status of patients. This may suggest that dietitians consider patients' socio-economic status more often in meal planning compared to counselling. Especially given that, as with FELs, the majority of dietitians reported using health applications in counselling, while only one quarter of dietitians acknowledged a patient's occupational status in their decision to recommend the use of health applications.

5.21.10 Application-related factors influencing the use of health applications: ease of use

Ease of use is as an important aspect of convenience as accessibility, seeing as this was a common limitation of health applications reported in the current study. Ease of use as a deciding factor to the use of applications was significantly associated with dietitians' age in the current study. Correspondingly, Zhao et al. (2018:349) reported that older subjects tend to attach more value to applications' ease of use compared to the younger population. Even so, the actual use of health applications was not significantly associated with dietitians' age in the current study. Likewise, Jospe et al. (2015:e7) and Difilippo & Chapman-Novakofski (2020:S80) found no significant association between dietitians' age and the use of health applications.

5.21.11 Individual factors influencing the use of health applications: area of employment

Besides health application-related factors, the leading factors influencing application use among dietitians included place of employment and individual influences (Lieffers et al., 2014). Similarly, in the current study a significantly greater proportion of dietitians working in the private setting used mobile health applications compared to government institutions ($p = 0.0052$). Possible reasons for the variation in application use between different areas of employment could be explained by the greater proportion of dietitians working in the public sector who were concerned about limitations pertaining to the use of applications ($p = 0.0172$), and the larger proportion of dietitians working government institutions who reported accessibility to applications as a limitation ($p = 0.0097$).

5.21.12 Individual factors influencing the use of health applications: dietitians' knowledge about health applications

Lieffers et al. (2014) suggested individual elements that influence the use of applications included dietitians' knowledge about applications. Consistent with findings about application use among dietitians, Byambasuren et al. (2019:13199) reported that the main objections to using health applications among general practitioners in Australia was lack of knowledge about applications and establishing trustworthy sources to access applications. Likewise, Sharman and Ashby (2015:80) investigated US dietitians and nutrition professionals' perceptions on health applications and reported that accessibility and knowledge about applications could increase the use of health applications. Accordingly, Chen et al. (2017a:e40) reported that by improving dietitians' knowledge on applications, by means of workshops or continuous professional development activities, the confidence with which it is recommended and used in practice could be enhanced (Chen & Allman-Farinelli, 2018:471; Chen & Allman-Farinelli, 2019: e12349). Although the current study did not investigate dietitians knowledge about applications, the percentage of older dietitians, employed in private settings, who perceived their knowledge on FELs as adequate was significantly higher compared to younger dietitians, working in government institutions. Also, significantly more dietitians employed in private settings made use of health applications compared to government settings. Therefore, corroborating the

findings by Chen et al. (2017a:e40), it could be assumed that dietitians who perceived their knowledge to be adequate not only were more confident in updating FELs themselves, but may also be more inclined to use applications.

5.21.13 Individual factors influencing the use of health applications: health literacy of patients

Although literacy level was the main influencing factor to recommending applications in the study, only one dietitian referred to health literacy demand. Even so, patients' knowledge of applications affects the use thereof, as sports dietitians from various countries reported that patients need to be "tech savvy" to be able to use health applications (Jospe et al., 2015:e7). Patient compliance was reported by 42.1% of dietitians in the current study as one of the factors determining whether health applications are recommended. Although poor compliance may cause reluctance among dietitians to recommend applications, health applications encourages patient autonomy and promote self-management, increasing behavioural awareness, which improves patient compliance to a treatment plan (Goldschmidt et al., 2018; Cho et al., 2011; Bawadi & Al-Sahawneh, 2008). Thus, Jospe et al. (2015:e7) suggested that health applications should rather be used to establish adherence to dietary guidelines than to accurately analyse intake, given that applications promote behavioural change, the result of comparing nutritional intake to dietary recommendations may influence dietary intake.

However, to influence behaviour, information first needs to be presented in a easily understandable way, using methods that will not detract from the information provided (Fakih El Khoury et al., 2019:627; Arora et al., 2017:JE09; Jospe et al., 2015:e7). The ease with which patients understand and use health information provided to them, therefore makes health literacy an integral part of the decision to use nutrition applications (Lambert et al., 2017:432; Mackert et al., 2016:e264). Likewise, Karduck and Chapman-Novakofski (2018:65) reported that patients' knowledge about applications (50.0%, n=361) and patients' health literacy levels (28.0%, n=202) were some of the main considering factors in the decision to recommend health applications to patients. Accordingly, Chen et al. (2019:213) suggested that patients preferred writing food diaries to the use of applications, given the increased ease of use of paper-based methods, even though there may be various advantages to application use.

5.21.14 Individual factors influencing the use of health applications: cost implications

While dietitians in the current study were concerned about the costs involved with the use of an electronic FEL, 62.4% were willing to pay for access to a well-maintained FEL. Although, a significant association was found between dietitians' years of experience and the amount they would be willing to pay per month for access to a relevant FEL. This correlated with the greater proportion of dietitians with more years' experience working in private settings and as more dietitians in private settings developed and updated their own FELs, 53.3% argued that there is not a demand for an updated FEL. While the amount per month they would be willing to pay varied, the majority were willing to pay up to R100 per month. Besides dietitians reporting that there is not a high enough demand for an updated FEL to make them willing to incur financial costs, some suggested FELs should be available to dietitians free of charge or paid for by the employer, seeing as it is a work-related expense.

5.22 Summary

Dietitians in South Africa are using FELs in practice, although a significantly larger proportion of dietitians employed in private settings are currently using FELs compared to dietitians employed in other areas. A possible reason for this may be ascribed to the increased perceived knowledge of FELs among dietitians employed in private practice, which may have been influenced by dietitians' age and years of experience. While the majority used FELs for meal planning, followed by dietary counselling, for which FELs were perceived effective, dietitians' area of employment was significantly associated with some of the differences found in the use of FELs as part of the NCP. Main contributing factors to these variations included patients' language and literacy levels. Although less than half of dietitians used health applications in practice, given their concerns about the accuracy, trustworthiness, ease of use and accessibility, the majority welcomed the idea of an electronic FEL in the form of a mobile application. However, there were some concerns regarding the complexity of the electronic FEL as well as the possible costs involved.

In evaluating dietitians' perceptions regarding adjustments to the FEL, the majority agreed that FELs should be adapted for various ethnic groups; however, a higher percentage of dietitians recommended the adjustment for cultural groups and different

languages compared to religious groups. Although vegetarianism and different health / disease conditions were deemed important aspects to consider in FELs adaptations, socio-economic status was perceived as less important. The components which most dietitians preferred to be incorporated into FELs were fibre, sugar, sodium, and glycaemic index, as these elements are more commonly associated with NCDs, for which the majority of dietitians used FELs. While more than half of the dietitians suggested that mixed meals and fast-food items should be included in FELs, especially given its value in dietary counselling, the majority of dietitians showed concerns about variations in recipes.

Throughout the survey, the two main themes that came up were portion sizes and convenience. Given that most dietitians used FELs for meal planning and counselling in the FELs, appropriate portion sizes in FELs is of utmost importance. Furthermore, to ensure that FELs are convenient to use, it needs to be comprehensive enough without compromising the ease of use.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

As there is limited literature available on the use of FELs in practice, this dissertation has provided a deeper insight into dietitians' practices and perceptions regarding the use of FELs as part of the NCP. Furthermore, this study provides proof that dietitians are still using FELs in practice 70 years after the development of the first FEL (Caso & Stare, 1947; Caso, 1950). However, the use of FELs has expanded to now cover a wide variety of conditions, in both healthy individuals and those with disease conditions. While FELs were initially developed to assist with the meal planning of patients with DM, FELs are now being used throughout all the phases of the NCP, even though it is still predominantly used for meal planning. The findings from this study make several contributions to the current literature, as this study not only determined dietitians' practices and perspectives on the use of FELs in South Africa determined, but various aspects for which there are not yet answers have been identified. Also, this study contributes to our understanding of the dietetics practice in the South African context, as the South African population is unique. Not only do South African cultures, languages and religions affect both dietary intake and dietetics practice, factors such as literacy level, health literacy demand, socio-economic status, and disease conditions can also play an important role. These aspects are what separates South African dietitians' practices and perceptions from the rest of the world. Consequently, it is not practical for South Africa to use a FEL that has been validated in another country, like the US, from which the ADA FEL originated and on which current FELs in South Africa are based. Therefore, the insights gained from this study may serve as preliminary work for the development of a South African specific FEL.

6.2 Limitations and strengths of the study

Although the response rate to the current study corresponds with that of similar studies, it was lower than anticipated. If it were not for the PoPi act of South Africa, the link to survey could have been distributed to dietitians directly through email, resulting in a better response rate (Martin et al., 2008:28). Furthermore, by keeping the survey open for a longer duration and sending out more reminders may have also increased the response rate (Jospe et al., 2015:2). However, dietitians were encouraged to share

the link to the survey with colleagues to increase the response rate. Additionally, as recommended by Jospe et al. (2015a:e7) the link to the survey was distributed on social media, specifically DIP and Dietetic services Facebook pages. To further encourage participation, lucky draw prizes in the form of five Woolworths gift vouchers were made available.

Another limitation was the length of the survey. Due to the lack of studies on the use of FELs by dietitians in practice, a variety of open and closed questions was necessary to obtain a good sense of dietitians' practices and perspectives regarding FELs. However, in an attempt to motivate participants to complete the survey, the Evasys® programme indicated the participant's progress. Also, conditional branching, alternatively known as skip logic, was used to prevent survey fatigue, as this allowed participants to only answer questions based on the previous answers.

Due to the diversity of the dietetics profession, it is challenging to ensure an adequate sample size for each area and location when conducting national studies. Thus, a limitation of the current study was the small sample obtained for certain areas and locations, which limited the ability to draw conclusions. However, this study did include a variety of areas and dietitians from all provinces, which can be used to direct future studies.

Strengths included a limited number of incomplete surveys being submitted, seeing as certain questions were made compulsory; hence, the participant could not continue or submit prior to completing specified questions. However, not all questions were compulsory, allowing dietitians the freedom to choose the questions they felt more comfortable completing. Additionally, dietitians from all the South African provinces and areas of practice were eligible to complete the survey; therefore, providing a better overall description of South African dietitians' practices and perceptions regarding FELs used as part of the NCP.

The validity of data was ensured through verifying DT numbers on the HPCSA website prior to analysis, thus ensuring that all participants were dietitians registered with the HPCSA. Also, each participant was allowed to complete the survey only once. In the event of duplications, only data from the first entry was used for analysis.

6.3 Summary and conclusions

The conclusions drawn from this study will be discussed in two sections, according to the operational definitions that were defined under the methodology section of this thesis. The first section comprises conclusions regarding dietitians' socio-demographic information and the second section describes conclusions involving dietitians' practices and perceptions regarding FELs as part of the exchange system in the NCP.

6.3.1 Socio-demographic information

6.3.1.1 Dietitians' age

- A higher proportion of South African dietitians were below 30 years of age compared to dietitians from other countries, although the median age of 30 years found in the current study is slightly lower but similar to other South African studies comprising dietitians;

- No significant association between age and the use of FELs or use of health applications were found;

- A significantly larger proportion of older dietitians were employed in the private sector, and given the strong association between the area of employment and the use of FELs, it may be concluded that the dietitians working in the private settings using FELs are older in age;

- A larger proportion of older dietitians reported self-designing FELs; additionally, a smaller proportion of older dietitians were willing to pay for an updated FEL compared to younger dietitians;

- A larger proportion of older dietitians reported having adequate knowledge of FELs, which enabled them to update and modify their own FELs.

Seeing as older dietitians seemed to have more knowledge of FELs which enabled them to update and adapt their own FELs, age may have influenced the use of FELs indirectly, even though no significant association was found between age and the use of FELs. This is especially noteworthy given the high proportion of younger dietitians in South Africa.

6.3.1.2 Dietitians' gender

- The dietetics profession is mainly practiced by females, both globally and in South Africa;
- No significant association was found between the use of FELs and gender.

6.3.1.3 Dietitians' language

- Majority of dietitians are Afrikaans speaking, although English was predominantly used in practice;
- Less than one third of dietitians reported practising in any African languages, even though isiZulu was the language spoken by the largest proportion of South African households;
- Significantly more dietitians reporting Afrikaans or English as a home language currently used FELs compared to dietitians speaking other home languages;
- The association between dietitians' home language and the consideration of patients' language in the decision to provide FELs was insignificant;
- Associations between dietitians' home language and perceived effectiveness and usefulness of FELs were insignificant;
- The association between dietitians' home language and the perception to adjust FELs for various languages was insignificant;
- A significant association was found between dietitians' home language and isiZulu as the language for which dietitians suggested FELs should be adapted.

While dietitians' home language was associated with the use of FELs in practice, neither the perceived usefulness / effectiveness or the decision to provide FELs to patients was associated with dietitians' home language. Therefore, the lower use of FELs among dietitians with home languages other than Afrikaans or English may have been due to lower use in dietary analysis or meal planning as part of the NCP, and not counselling, seeing as home language did not influence dietitians' choice to provide FELs to patients, which is usually done as part of nutritional counselling. Furthermore,

the lower use of FELs by dietitians with home languages other than Afrikaans or English may have been influenced more by personal preferences or the confidence with using tools that are in a language other than one's home language. Although, dietitians' perceptions to have FELs available in more languages did not seem to be based on their personal biases but instead on the needs of patients. However, dietitians who have been more familiar with African languages showed greater insight regarding the languages for which FELs should be adapted in South Africa. In conclusion, it could be assumed that dietitians still provided patients with FELs irrespective of their own home languages given the value that FELs add to nutrition therapy.

6.3.1.4 Dietitians' geographic location

- The greatest proportion of dietitians resided in Gauteng;
- A higher percentage of dietitians from the Free State and Gauteng currently used FELs compared to dietitians from the Eastern Cape and Western Cape;
- A significant difference was found between the area of practice and dietitians' geographical location, with the highest proportion of private practising dietitians residing in Gauteng, whereas the Eastern Cape showed the greatest proportion of dietitians practising in the government setting.

Dietitians' geographical location influenced the use of FELs based on the proportion of dietitians practising within a specific area of employment within a particular province. As a higher proportion of dietitians employed in private settings resided in Gauteng, and a significant association existed between dietitians working in the private sector and the use of FELs, it may have resulted in a higher percentage of dietitians in Gauteng using FELs.

6.3.1.5 Dietitians' area of employment

- The majority of dietitians worked in private practice;
- A significant association existed between dietitians' age and area of practice, with a higher proportion of older dietitians working in private settings;

- A significant association was found between years of experience and area of employment, with dietitians working in government institutions having had the least median years of experience compared to private and tertiary education /research settings;

- The proportion of private practising dietitians who currently used FELs was significantly larger compared to dietitians working in government and training / research / pharmaceutical settings.

There was no significant association found between either age or years of practice and use of FELs, even though there was a significant association between age and years of experience and area of employment; also, a significant association existed between area of employment and the use of FELs. Therefore, it could be concluded that area of employment affected the use of FELs to a greater extent than age or years of practice, even though the reasons for this effect may partly be explained by factors associated with age and years of experience.

6.3.1.6 Dietitians' years of practice

- The majority of dietitians had ≤10 years' experience with a median of six years practice, which correlated with other South African studies comprising dietitians; although dietitians from Canada and the US had significantly more years of practice experience compared to South African dietitians;

- No significant association was found between dietitians' years of experience and the use of FELs.

South African dietitians had less practice experience compared to other countries, which is noteworthy, given that years of experience may influence the transfer of knowledge between dietitians, thereby influence the use and modification of FELs. Especially, as dietitians working in the private setting had significantly more years' experience compared to the public sector, and given that there was a significant association between area of practice and the use of FELs, it may be concluded that the dietitians working in private settings using FELs have equal to or more than five years practice experience. Even so, no significant association was found between years of experience and the use of FELs.

6.3.2 Dietitians' practices and perceptions regarding the use of food exchange lists, used as part of the food exchange system, within the nutrition care process.

6.3.2.1 Domain 1: Dietitians' use of food exchange lists in different stages of the nutrition care process

- Majority of dietitians reported currently using FELs;
- FELs were used mainly for meal planning and counselling as part of the NCP, which were also the two stages of the NCP for which most dietitians perceived FELs to be effective;
- While the area of employment significantly impacted the use of FELs, a greater proportion of dietitians employed in the government setting perceived FELs effective in dietary analysis;
- A significantly greater proportion of dietitians in the private setting used FELs in counselling;
- More than half of the dietitians used FELs at least three times per week;
- The patient profile comprised mainly NCDs, which was in agreement with the modifications to the FEL dietitians suggested would be useful, which included the addition of nutritional information on sodium, salt, glycaemic index and fibre;
- Apart from disease specific factors, literacy level and languages spoken by patients were reported to significantly impact the decision to provide patients with FELs. The effect of language and literacy level is especially significant in the South African setting, given the native languages spoken by the majority of the population and the low literacy level of a large portion of the population;
- Even though a large proportion of dietitians acknowledged the effect of literacy level, visual tools were used by less than one third of the dietitians either alternatively to or in combination with FELs;

- The main reasons for not using FELs pertained to the impracticality and complexity of FELs, while alternative tools were selected mainly for convenience;

- Alternative or complementary tools used as part of the NCP reported by the majority of dietitians included food composition tables / software, nutritional guidelines, hand /plate models and meal plans /menus;

- A larger percentage of dietitians perceived FELs useful to them compared to its usefulness to patients;

- The main advantages to using FELs reported by dietitians included its usefulness given that FELs provide a basic framework to work from, while increasing flexibility in patients' diets;

- Limitations to FEL mainly involved the insensitivity towards different cultural eating habits and literacy levels.

In conclusion, FELs are still being used frequently by the majority of dietitians in practice. The main conditions for which dietitians reported using FELs included NCDs. Although FELs are used by the majority for counselling and meal planning, the part of the NCP for which dietitians used FELs were dependent on the area of practice and patient-specific factors, including language and literacy. The function of FELs varied depending on the population utilising it, seeing as dietitians used FELs mainly for the basic framework it provided them to work from, while according to dietitians, patients valued FELs more for the flexibility it offered to the diet. Furthermore, the usefulness of FELs was negatively influenced by the inappropriate use thereof, particularly when it was used by a population other than the one it was intended for. This not only highlighted the need for population-specific FELs in South Africa, but also the necessity to differentiate between FELs designed to be used by patients and those indicated for dietitians. Especially, as dietitians perceived FELs impractical and complex for patients to use, while at the same time not being comprehensive enough to use in practice as part of the NCP. Given that an inappropriate target population can significantly affect the value and outcome of using FELs, it is essential for South Africa to have population-specific FELs, especially in light of the unique population

characteristics relating to ethnicity, literacy, socio-economic status, and disease profile of the South African population.

6.3.2.2 Domain 2: influencing factors and type of food exchange lists provided to patients

- Majority of dietitians obtained FELs from the University, particularly dietitians employed in government settings, whereas a larger proportion of dietitians working in private settings and tertiary education / research settings self-designed FELs;

- Majority of dietitians provided FELs to patients depending on the situation, with the main considering factors being a patient's literacy level, disease / condition and patient preference;

- A significantly larger proportion of older dietitians compared to younger dietitians based the decision to provide a patient with a FEL on the patient's literacy level, therefore providing FELs dependent of the situation;

- A significantly larger proportion of dietitians working in government institutions reported that the decision to provide FELs to patients was influenced by literacy level and language;

- The FEL provided to patients by the majority of dietitians comprised of a simplified, personalised FEL;

- A significantly larger proportion of older dietitians with more years of practice experience self-designed FELs, which correlated with the percentage of older, more experienced dietitians using FELs;

- While there were no significant differences between available time or resources and dietitians' age, area of employment or years of practice experience, knowledge regarding FELs was significantly associated with dietitians' age and years of experience;

- It could be assumed that given older dietitians' perceived knowledge of FELs, the FELs used by older dietitians working in private settings were kept relevant, which contributed to the increased reported use thereof;

- The resources used for the development of FELs comprised mainly food labels and the South African food composition database;

- Given that older dietitians who worked in private or tertiary education settings self-designed FELs, the time since the last update of the FEL was significantly less compared to younger dietitians working in government settings; however, seeing as dietitians working in the public sector mainly obtained FELs from universities, it can be assumed that the FELs used by the majority of dietitians irrespective of the area of employment have been updated within the last five years;

- It was concerning that the majority of dietitians used FELs at least three times per week, even though nearly one third was unsure when last the FEL has been updated. Nonetheless, this was not the main reason indicated why an update was perceived necessary;

- The larger proportion of dietitians reported that FELs are due for an update, mainly given that new food items on the market should be added to the FEL, FELs are outdated, and portion sizes and recipes of products have changed.

While the majority of dietitians reported obtaining FELs from universities, there was a significant association between area of employment and the source of FELs. A significantly larger proportion of dietitians working in private settings self-designed FELs compared to government settings, which may have been related to the increased knowledge of FELs among the larger proportion of older dietitians employed in private settings. Consequently, the reported time since the FEL was last updated was significantly less among dietitians working in private and tertiary education settings compared to the government sector. However, given that the majority of dietitians working in the public sector obtained FELs from universities, where tertiary education dietitians were employed, the FELs used by dietitians working in government settings may therefore, unknowingly, also have been

updated recently. Given the significant influence of knowledge of FELs on the modification of FELs, it is essential that dietitians receive continuous training on FELs. Especially, as even though dietitians used FELs often, almost one third were unaware of the when the FELs was last updated and even so, this was not the main concern raised by dietitians in the motivations for updating the FEL. Therefore, it may be that dietitians are unaware of how often FELs should be updated, seeing as no clear guidelines exist for FELs used in South Africa, as was the case with the ADA FEL. Additionally, given that FELs are updated and adjusted by individual dietitians, large variations may exist between the FELs used in practice and those provided to patients. Particularly, as the majority of dietitians reported providing patients with a simplified, personalised FEL, which is important given the influence of various patient-specific factors, like language, literacy, disease condition and patient preferences on the decision to provide a patient with a FEL. With no significant differences between dietitians' perceptions of available resources or time to update FELs and area of employment, the majority of dietitians used food labels and nutritional databases to update FELs. The main reasons for updating FELs included new food items on the market, FELs being outdated, and changes in recipes and portion sizes of products. It is therefore essential that FELs remain relevant, especially given the increased use of FELs by dietitians who have kept FELs updated. One aspect which may have a positive influence on dietitians' practices and perceptions regarding the updating / modification of FELs is knowledge. By increasing dietitians' knowledge of FELs, a larger percentage of dietitians may be more inclined to keep FELs relevant.

6.3.2.3 Domain 3: the relevance of food exchange lists

- Given that the majority of dietitians perceived it necessary to adapt FELs for various ethnic groups, the groups for which most dietitians recommended FELs should be adapted included various cultural groups, speaking different languages;

- Even though religion itself was not considered by the majority of dietitians as one of the aspects for which FELs should be adapted, vegetarians /vegans was suggested by more than half of the dietitians as one of the groups for which FELs should be adapted;

- Although there is an association between cultural eating habits and socio-economic status, and given the significant percentage of the South African population that is food insecure, it was unexpected that less than half of the dietitians perceived it necessary to adapt FELs according to the socio-economic status of patients;

- While the majority of dietitians used FELs in the management of NCDs, the patient group for which most dietitians suggested FELs should be adapted included patients in various stages of the lifecycle. This may indicate that the use of FELs in these population groups may have been low due to the current FELs not being appropriate in these groups.

In conclusion, dietitians recommended that FELs be adapted for various ethnic population groups, including the African and Indian cultures, isiZulu, isiXhosa and Afrikaans language, Muslim, Hindu and Jewish religions, vegetarian / vegan lifestyle, and healthy individuals within various stages of the life cycle. Of significance was the low percentage of dietitians suggesting that FELs should be adapted for various religions and according to socio-economic status; the literacy level for which the majority of dietitians suggested FELs be adapted; and lastly, the high percentage of dietitians reporting FELs should be adapted for various stages of the life cycle, even though a small proportion of dietitians reported using FELs in the nutritional management of various stages of the life cycle. While dietitians in South Africa may require more training and knowledge about some of the influencing factors, there is still much research to be done on the effects of amongst others, the religion and socio-economic status on the nutritional intake and management of these patients in the South African setting. Although, a specific area which not only seemed to be lacking in the South African setting, but also globally, was information on portion sizes in the paediatric population.

6.3.2.4 Domain 4: the use, advantages, limitations, and format of nutrition-related mobile or web-based applications as part of the nutrition care process

- Less than half of the dietitians are using health applications in practice;

- A larger percentage of dietitians recommend applications to patients compared to the percentage using applications themselves in practice;
- A significantly larger proportion of dietitians working in private settings recommended applications to patients compared to government settings;
- Although the main factors informing the decision to use health applications included trustworthiness and accuracy, the main limitations to using health applications reported, were accessibility and relevance. This difference could be explained by nearly two thirds of dietitians reporting that applications are evidence-based, although the available literature suggested otherwise. Therefore, it may indicate that dietitians are using applications which they believe are evidence-based, even though it may not be;
- A significantly larger proportion of older dietitians and those with more years' experience considered ease of use in the decision to use health applications;
- No significant association was found between the use of applications and dietitians' age;
- Health applications were mainly used for dietary counselling and meal planning, similar to FELs;
- Similar to FELs, patients' literacy level, diagnosis and preference informed dietitians' decision to recommend applications to patients;
- Most dietitians used smartphone applications, which correlated with the platform suggested for an electronic FEL.

The use of health applications by dietitians in South Africa is still limited; however, dietitians reported using mainly smartphone applications. Additionally, the phases of the NCP for which applications were used were comparable to that mentioned for FELs. As most applications target the general population instead of healthcare practitioners, applications were mainly used in counselling, which may explain why a larger percentage of dietitians recommended applications compared to the percentage using applications in practice. Seeing as a higher percentage of

dietitians recommended applications to patients as opposed to using applications in practice, like FELs, the main factor influencing the decision to recommend health applications to patients was literacy level. Also, like FELs, a significantly larger proportion of dietitians employed in the private sector recommended applications to patients compared to government institutions. As accuracy and trustworthiness were the main factors determining the use of FELs in practice, the majority of dietitians reported that the applications being used are evidence-based; however, this was not corroborated by research studies. Therefore, dietitians may be using applications that are not evidence-based in the dietary counselling of patients. Furthermore, the main perceived advantage to using applications was convenience, which agreed with the reason dietitians reported using alternative tools to the FEL; hence, convenience forms an integral part of dietetic practices.

6.3.2.5 Domain 5: the acceptability, advantages, limitations, value, and expectations of electronic food exchange lists

- Majority of dietitians agreed that an electronic FEL would be useful;
- Older dietitians who designed FELs themselves were more reluctant to pay for a well-maintained FEL, seeing as there was a lower demand for an updated FEL among them; even so, the majority of dietitians reported to be willing to pay up to R100 per month for a well-maintained FEL;
- A significantly larger proportion of dietitians working in government settings were concerned about limitations pertaining to the electronic FEL, involving the same criteria reported under health applications, with the exception of adjustability;
- The smartphone format of an electronic FELs preferred by the majority of dietitians correlated with the format of applications currently being used by dietitians;
- Characteristics reported by the majority of dietitians describing a good FEL included convenience and comprehensiveness;

- Convenience may be the reason why the majority suggested it would be beneficial if the electronic FEL could analyse the cost of a meal plan, especially given the lower percentage of dietitians recommending that FELs be adapted according to patients' socio-economic status.

In conclusion, an electronic FEL was met with great enthusiasm by the majority of dietitians, with most dietitians advocating for a smartphone-based application even though less than half of the dietitians reported currently using applications. The main reasoning behind the support of an electronic FEL may have been convenience, given that this was not only one of the characteristics of a good FEL reported by dietitians, but also the reason for using alternative tools to the current FELs. While the majority of dietitians would be willing to incur financial costs to some extent for access to a well-maintained FEL, dietitians who developed and maintained their own FELs were less willing to pay for an updated FEL, seeing as the need for such a FEL was less significant.

6.3.2.6 Domain 6: portion sizes and the need for nutrient values of additional elements and micronutrients in the food exchange lists

- Regarding portion sizes in the FEL, the majority of dietitians suggested that portion sizes should remain per exchange, in cooked format, and the unit of measure should be in household measures;

- Perceptions regarding portion sizes in FELs were mainly affected by convenience and the characteristics of a food item;

- Less than half of the dietitians motivated for the addition of information on micronutrients to the FEL. The main micronutrients that dietitians suggested should be added to FELs included iron, calcium and the main electrolytes (magnesium, phosphate and potassium), which corresponded with both, the micronutrients that have been added to the Spanish FEL, as well as South African legislation regarding fortification;

- While the majority of dietitians preferred the addition of information about fibre content to FELs, the main motivation involved the value it may have in healthy dietary choices;

- Dietitians indicated that information about fluid content of food products is population specific; thus, impractical to add to FELs;

- Majority of dietitians supported the addition of information on sodium content of food to FELs, which correlated with the South African sodium legislation, as well as the disease conditions for which the majority dietitians reported using FELs. Significantly more dietitians employed in government institutions reported that information on sodium content of food would be useful in dietary analysis;

- The addition of products' sugar content to FELs was recommended by the majority of dietitians, which was supported by South Africa's sugar tax of sugar-sweetened beverages. Also, literature about sugar intake in South Africa, specifically in lower socio-economic settings, supported the significantly higher proportion of dietitians working in government settings who suggested sugar information in FELs would assist in dietary counselling;

- Seeing as FELs are used by the majority of dietitians in the management of DM, it was to be expected that the majority would support the addition of information on glycaemic index of food to FELs; although, significantly more dietitians in private settings recommended the addition of glycaemic index to FELs;

- Just over half of the dietitians suggested that information about fatty acid content should be added to FELs, with the main motivation relating to the usefulness it may have in dietary analysis. A greater proportion of older compared to younger dietitians argued that the addition of information about fatty acid content to FELs would make FELs too complicated;

- While additions were preferred to be part of the FEL by the greater proportion of dietitians, the majority recommended that instead of presenting exact values, items should rather be flagged to indicate high / low sources.

In conclusion, dietitians' perceptions regarding the addition of certain elements to the FELs correlated with the patient profile for which dietitians reported using FELs, as well as available literature, and South African legislation. Instead of exact

values, dietitians preferred high / low food sources to be indicated by means of flagging as part of the existing FELs. Furthermore, a larger proportion of older dietitians seemed to prefer FELs to be more basic and convenient to use; thus, older dietitians were more reluctant to add elements to the current FELs, as it may cause FELs to become too complicated. Even so, a higher proportion of younger dietitians suggested that a good FEL is comprehensive, which was also one of the limitations experienced with the current FELs. Therefore, FELs should be comprehensive enough, but information should be presented in a practical manner that will not cause FELs to become too complicated.

6.3.2.7 Domain 7: the demand, advantages, and limitations for / of mixed or combined meals and fast food in the food exchange list

- Majority of dietitians supported the incorporation of mixed meals into the FELs;
- The main limitation to the inclusion of mixed meals into the FEL reported by dietitians was the variation between recipes, with a significantly larger proportion of dietitians employed in the private settings reporting this as a limitation compared to dietitians employed in the government sector;
- Mixed meals as part of the FELs were perceived to be useful throughout all stages of the NCP; although, a larger percentage of dietitians reported that mixed meals would be useful in dietary counselling;
- As a significantly larger proportion of dietitians working in government settings reported that FELs are effective in dietary analysis compared to dietitians working in private setting; it was not surprising, that a significantly larger proportion of dietitians employed in the public sector also reported the inclusion of mixed meals in FELs as useful in dietary analysis as part of the NCP;
- Majority of dietitians supported the inclusion of fast-food items in the FEL. While the addition of mixed, ready-made meals and fast food items to FELs would allow dietitians to incorporate a wider range of patient preferences into the nutrition intervention, the majority of dietitians perceived the addition of mixed meals as useful in dietary counselling and meal planning; particularly, as a

personalised approach to nutrition therapy is more effective than generalised interventions,

Thus, while the accuracy of nutritional analysis may be lower when mixed meals are analysed as separate components, this was not the main advantage reported by dietitians of the inclusion of mixed meals to FELs; even though accuracy in nutritional management of patients was perceived as an important aspect of nutritional therapy. The advantages of including mixed meals in FELs correlated with the phases of the NCP for which dietitians reported mainly using FELs. While dietitians reported variations in recipes as the main limitation to the inclusion of mixed meals, among characteristics of a good FEL reported by dietitians were the addition of recipes to the FEL. Thus, mixed meals could be included in FELs and the variations may partly be accounted for by adding standardised recipes, for which the analysis were performed, as addendums to the FEL.

6.3.3 Summary

Overall, dietitians in South Africa are using FELs in various phases of the NCP, although the majority use FELs for counselling and meal planning. The use of FELs may be of particular importance given the increased need for time-efficient methods to nutritional therapy. While the majority of dietitians obtained FELs from Universities, a great proportion of dietitians employed in private and tertiary education / research settings self-designed FELs, which appeared to be associated with dietitians perceived knowledge of FELs. Furthermore, there is a need for population-specific FELs in South Africa, especially given the unique profile of the South African population with regards to ethnicity, socio-economic status, literacy and health / disease conditions. Also, the value and effectiveness of tools like the FEL may be increased when population-specific FELs are used by the specific audience it was intended for. Additionally, FELs for the nutritional management of patients in various stages of the life cycle are lacking, particularly paediatric patients. Although the use of health applications by South African dietitians is not extensive, dietitians welcomed the idea of an electronic FEL in the form of a smartphone application. Seeing as convenience affected dietitians' decisions regarding the use of certain tools as part of the NCP, the prospects of an electronic FEL is promising. Also, given the increased adaptability of electronic sources, the update and modification of an electronic FEL

may enhance the relevance of South African FELs, which may not only improve nutritional outcomes but also increase the use of FELs by dietitians. Additionally, by providing a common platform for dietitians to modify and update FELs, an electronic FEL, which could potentially be regulated by ADSA or higher education institutions, may encourage the use of standardised FELs by South African dietitians and thereby promote the dietetics profession, seeing as dietitians would be able to build on the previous work of others instead of reinventing nutritional management tools. Lastly, dietitians' knowledge appeared to play an essential role in various aspects of dietetic practices and perceptions, therefore it is essential to establish ways to promote dietitians' knowledge, not only of FELs, but also factors influencing the nutritional management of patients in the South African setting.

6.4 Recommendations

The recommendations will be presented in two sections, namely, recommendations for practice and recommendations for future research.

6.4.1 Recommendations for practice

- South African standards for the development of FELs should be compiled, as this will provide guidance to dietitians when updating FELs assisting with the standardisation of self-designed FELs.

- Given that dietitians' knowledge seems to significantly impact dietetic practices and perceptions, continuous professional development activities should include information on the use of FELs as part of the NCP, as well as guidelines on the development of FELs.

- Dietitians may benefit from trainings relating to the impact of religion, culture, socio-economic status, literacy and language on the dietary practices of the South African population. While dietitians receive extensive training on the impact of disease on the nutritional status of patients, little attention is given to patient-specific factors that influence dietary intake. This is particularly important, as nutritional therapy that has been tailored to the needs of the patient has been found to be more effective than a generalised approach to nutritional management.

- Dietitians may benefit from training on criteria to evaluate health applications, seeing as dietitians reported that health applications used in practice are evidence-based. However, this finding was not corroborated by available literature. Also, the evaluation of health applications for appropriateness has only recently become a topic of interest in research; therefore, criteria for evaluating applications has not yet been clearly defined.

- Dietitians need to establish ways to share knowledge and prevent working in isolation, as by sharing knowledge and building on previous work, the dietetics profession can be promoted. This is especially important in South Africa, given that the majority of dietitians are younger of age with less year's practice experience.

- FELs and databases should clearly define the food item for which nutritional information is provided, especially relating to the preparation method used.

6.4.2 Recommendations for research

The findings from this study provided the following insights for future research:

- A natural progression of the current study is to analyse the dietary habits of the various South African population groups. This would provide a basis for the development of a South African FEL that is sensitive towards various population groups. Although the current study provided guidance with regards to the populations that need to be investigated, a better understanding of the specific food items consumed by certain population groups in South Africa is still required.

- In accordance with the above recommendation, photographs of various portion sizes of the foods commonly consumed by the South African population should be gathered for the update of South African specific tools, like the guide for dietary assessment and education kit (DAEK) by Steyn and Senekal (2004), which can be used in combination with or incorporated into an electronic FEL, for portion size estimation, as described by (Amoutzopoulos et al., 2020).

- As part of preliminary work for the development of a new South African based FEL, recipes of various dishes used by the general population should be evaluated. It would prove useful to determine the difference between the nutritional composition of various recipes used for the preparation of the same dish in different settings, seeing as the majority of the dietitians in the current study reported that variations in recipes was the main limitation to including mixed meals in FELs.

- As part of preliminary work for the development of a new South African based FEL, and also as part of investigating the effect of socio-economic status on dietary practices, the cost of commonly consumed foods and the retailers from which the majority of the population buy these food items could be determined. This information would also assist dietitians in planning appropriate menus based on the socio-economic status of patients.

- A similar study should be repeated, targeting student and community service dietitians, as the current study did not include student dietitians and only comprised a small number of community service dietitians. The association between newly / nearly qualified dietitians and qualified dietitians' practices and perceptions regarding FELs as part of the NCP would be insightful.

- As a larger proportion of dietitians working in private settings reported self-designing FELs, future research, targeting dietitians who work in the private sector, should evaluate the difference or associations between the different FELs used by these dietitians in practice. Alternatively, dietitians may be provided with standardised information to incorporate into FELs, and the differences in interpretation / outcomes could be measured. This information would be extremely valuable in the motivation of the need for using standardised FELs, especially as it is hypothesised that large variations exist between self-designed FELs. Also, differences between nutritional analysis using FELs compared to other methods, such as food composition databases could be evaluated to determine the accuracy of FELs in dietary analysis as part of the NCP.

- Additional information on the use of FELs by dietitians in specific areas of employment would assist in establishing a greater degree of accuracy on this matter. By targeting dietitians employed in government institutions separately, the reasons behind the larger proportion of this group reporting FELs as effective for dietary analysis could be investigated. Also, more information on the use of FELs in counselling by private practising dietitians may assist in a better understanding of the difference observed in the use of FELs for counselling between dietitians employed in private and government. Also, by comparing dietitians' practices and perceptions regarding the use of FELs of dietitians employed in the same area of practice but located in various geographical locations, a better understanding of geographical influences on the use of FELs could be achieved.

- The effects of dietitians' socio-demographic information on dietary practices and perceptions should be evaluated further, seeing as age, language, years of experience and area of practice were all significantly associated with the use of FELs in practice; however, whether dietitians' socio-demographics influence other aspects of South African dietetic practices and perceptions is unknown.

- Seeing as the use of FELs in training was not a main focus of the current study, future research may target dietitians working in tertiary education and student dietitians to determine the use and value of FELs in the training of dietitians.

- Given the prevalence of illiteracy in South Africa, the significance of literacy in the decision to provide patients with FELs, and the small percentage of dietitians who reported using visual aids instead of FELs as part of the NCP, future research should investigate dietitians' use of visual tools as part of the NCP in patients who are illiterate.

- Further information should be gathered on the use of health applications by dietitians in South Africa, and dietitians' evaluation of health applications for appropriateness in South Africa.

- Future studies investigating a topic for which there is limited research available, may consider a mixed method study design instead, involving both a

questionnaire and focus group interviews, to gather rich data without having participants complete a long questionnaire.

- Portion sizes used by paediatric patients should be defined to assist with meal planning, counselling, and dietary analysis of this patient group. Especially, as FELs developed for paediatric patients referred to portion sizes used by an adult population. Even though some guidelines exist concerning paediatric dietary intake, no clear definitions of paediatric portion sizes could be found in the literature search for FELs used in the paediatric population. Undefined portion sizes may result in inappropriate nutritional diagnosis / interventions and children may incorrectly be labelled as “picky eaters”.

- While the current study investigated dietitians’ perceptions of the usefulness of FELs for patients, future research may be directed at patients receiving FELs and their perceptions and experiences with using these FELs.

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Appendix A: Ethics approval

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
HEALTH SCIENCES
GESONDHEIDSWETENSKAPPE

Health Sciences Research Ethics Committee

26-Aug-2019

Dear Miss **Desiré Brand**

Ethics Clearance: **South African dietitians' practices and perceptions regarding food exchange lists, as part of the food exchange system, in the nutrition care process**

Principal Investigator: **Miss Desiré Brand**

Department: **Human Nutrition Department (Bloemfontein Campus)**

APPLICATION APPROVED

Please ensure that you read the whole document

With reference to your application for ethical clearance with the Faculty of Health Sciences, I am pleased to inform you on behalf of the Health Sciences Research Ethics Committee that you have been granted ethical clearance for your project.

Your ethical clearance number, to be used in all correspondence is:**UFS-HSD2019/1317/0110**

The ethical clearance number is valid for research conducted for one year from issuance. Should you require more time to complete this research, please apply for an extension.

We request that any changes that may take place during the course of your research project be submitted to the HSREC for approval to ensure we are kept up to date with your progress and any ethical implications that may arise. This includes any serious adverse events and/or termination of the study.

A progress report should be submitted within one year of approval, and annually for long term studies. A final report should be submitted at the completion of the study.

The HSREC functions in compliance with, but not limited to, the following documents and guidelines: The SA National Health Act. No. 61 of 2003; Ethics in Health Research: Principles, Structures and Processes (2015); SA GCP(2006); Declaration of Helsinki; The Belmont Report; The US Office of Human Research Protections 45 CFR 461 (for non-exempt research with human participants conducted or supported by the US Department of Health and Human Services- (HHS), 21 CFR 50, 21 CFR 56; CIOMS; ICH-GCP-E6 Sections 1-4; The International Conference on Harmonization and Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH Tripartite), Guidelines of the SA Medicines Control Council as well as Laws and Regulations with regard to the Control of Medicines, Constitution of the HSREC of the Faculty of Health Sciences.

For any questions or concerns, please feel free to contact HSREC Administration: 051-4017794/5 or email EthicsFHS@ufs.ac.za.

Thank you for submitting this proposal for ethical clearance and we wish you every success with your research.

Yours Sincerely

Dr. SM Le Grange
Chair : Health Sciences Research Ethics Committee

Health Sciences Research Ethics Committee
Office of the Dean: Health Sciences
T: +27 (0)51 401 7795/7794 | E: ethicsfhs@ufs.ac.za
IRB 00006240; REC 230408-011; IORG0005187; FWA00012784
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Appendix B: Survey advertisement

South African dietitians' practices and perceptions regarding food exchange lists, as part of the food exchange system, in the nutrition care process

The aim of this survey is to investigate the use of food exchange lists by dietitians in South Africa.

- Do you make use of food exchange lists?
- What are your experiences with using food exchange lists?
- Do you think food exchange lists are/ could be useful?

Share your perceptions on whether the current food exchange lists used, should be adapted, updated, standardised or made available electronically. Participate and include your email address to stand a chance of winning one of five lucky draw gift vouchers, each worth R250!!

The survey will should take about 20-25 minutes to complete. View the consent form and take the online survey here.

Institution: Department of Nutrition and Dietetics, University of the Free State

Type of project: MSc Dietetics

Contact person: Desiré Brand | 083 256 7403 | desiremichelle0@gmail.com

For more information: Department of Nutrition and Dietetics, University of the Free State (UFS) on 051 401 2894

Appendix C: Questionnaire

1. Information and consent

Dear dietitian colleagues

This study will investigate South African dietitians' practices and perceptions regarding **food exchange lists**, used as part of the food exchange system, in the nutrition care process.

By completing this survey, **you will contribute much-needed insights into how food exchange lists are used by dietitians in South Africa,** thereby helping to **identify the need for adapting, updating, standardising or making South African food exchange lists electronically available**.

The study has been approved by the UFS Heath Sciences Research Ethics Committee. The study procedures involves no foreseeable risks or harm to you and entail a questionnaire which will take about 15 minutes to complete. You are only eligible to partake in this study if you are a registered dietitian at the Health Professions Counsel of South Africa (HPCSA) and reside in South Africa.

By choosing to proceed to the questionnaire, you agree that you have read the above information and voluntarily give consent to participate in this study. All data collected in this study will be kept strictly confidential and results will only be disseminated in such a way that individuals cannot be identified in any way. If you have questions about your rights as a research subject, you may contact the Secretariat of Health Science Research Ethics Committee at the University of the Free State: Tel: +27 (0)51 401 7795/ 7794| E: ethicsfhs@ufs.ac.za. For further information, concerns or inquiries please feel free to contact the Department of Nutrition and Dietetics, University of the Free State (UFS) on 051 401 2894.

You will not be charged or paid to participate, however by completing and submitting the following questionnaire, you stand a **chance to win one of five lucky-draw prizes of R250 each**. Only questionnaires that are fully completed, and in which the email address is provided on the questionnaire, will be eligible for the lucky-draw.

Note that your HPCSA registration number (DT number) will only be used to ensure that the data obtained is valid (to ensure that only registered dietitians are completing the survey). To protect your privacy, the biostatistician will remove the email addresses and DT numbers from the data set before the research team has access to the data in order to make it impossible to link answers to specific respondents.

Your participation will be highly valued.
Desiré Brand,
Student: MSc.Dietetics, UFS.

1.1 I agree to participate in this survey. ☐ Yes ☐ No

2. General

2.1 Do you have a HPCSA registration number (DT number)? ☐ Yes ☐ No

2.2 What is your HPCSA registration number (DT number)?

Note that this information is only to verify your registration with the HPCSA and will be removed by the biostatistician before the research team has access to the data.

2.3 Under which category are you registered at the HPCSA?
☐ Independent practice dietitian ☐ Community service dietitian ☐ Student dietitian
☐ I am not registered at the HPCSA

2.4 Please specify in which year of study you are? (year)

2.5 How many years have you been practising as a dietitian after completing your community service? (years)

2.6 What is your e-mail address?

Note that this information should only be supplied if you want to be entered into the lucky draw, and will be removed by the biostatistician before the research team has access to the data.

3. Socio-demographic information

3.1 What is your age? (years)

☐☐

3.2 What is your gender? ☐ Male ☐ Female

3.3 What is your home language(s)?

All relevant options may be selected.

☐ isiZulu	☐ isiXhosa	☐ Afrikaans
☐ English	☐ Sepedi	☐ Setswana
☐ Sesotho	☐ Xitsonga	☐ Siswati
☐ Tshivenda	☐ isiNdebele	☐ Other

3.4 If you have chosen 'other' in Q3.3, please specify?

3.5 In which language(s) do you practice?

All relevant options may be selected.

☐ isiZulu	☐ isiXhosa	☐ Afrikaans
☐ English	☐ Sepedi	☐ Setswana
☐ Sesotho	☐ Xitsonga	☐ Siswati
☐ Tshivenda	☐ isiNdebele	☐ Other

3.6 If you have chosen 'other' in Q3.5, please specify?

3.7 Which area do you work in?

All relevant options may be selected.

☐ Food service management	☐ Food industry	☐ Government hospital (District)
☐ Government hospital (Regional)	☐ Government hospital (Tertiary)	☐ Government specialised hospital
☐ Public sector (Community setting)	☐ Public sector (Other)	☐ Private general hospital
☐ Private specialised hospital	☐ Private clinic	☐ Private practice
☐ Consultancy	☐ Tertiary education	☐ Research
☐ Corporate health	☐ Pharmaceutical company	☐ Other

3.8 If you have chosen 'other' in Q3.7, please specify?

3.9 In which province are you based?

☐ Eastern Cape	☐ Free State	☐ Gauteng
☐ KwaZulu-Natal	☐ Limpopo	☐ Mpumalanga
☐ Northern Cape	☐ North West	☐ Western Cape

4. Practices regarding the use of food exchange lists, as part of the food exchange system, in the nutrition care process [Continue]

4.1 Do you make use of food exchange lists?
☐ Yes, currently ☐ Not at the moment, but I did in the past ☐ No

4.2 If you make use/ have used food exchange lists, please specify what you use/ have used food exchange lists for?
All relevant options may be selected.
☐ Dietary analysis (e.g. converting a 24 hour recall to exchanges)
☐ Meal planning and compiling menus
☐ Nutrition counselling and education
☐ Training of students
☐ Other

4.3 If you have chosen 'other' in Q4.2, please specify?

4.4 If you never use/ have not used food exchange lists recently, please specify the reasons for not using food exchange lists?

4.5 How often do you use/ have you used food exchange lists?
☐ Every day ☐ 2 to 3 times per week ☐ Once a week
☐ < Once per week

4.6 For which type of patients do you/ have you, personally use(d) food exchange lists?
All relevant options may be selected.
☐ Diabetes (all types)
☐ Cardiovascular disease/ hypertension
☐ Renal disease
☐ Weight management (for weight loss)
☐ Undernutrition/ malnutrition (for weight gain)
☐ Eating disorders
☐ Food allergies
☐ Upper gastrointestinal tract disease
☐ Lower gastrointestinal tract disease
☐ Hepatobiliary and pancreatic disorders
☐ Pulmonary disease
☐ Cancer
☐ HIV/AIDS
☐ Neurological disorders including dysphagia
☐ Pediatric intellectual and developmental disabilities
☐ Metabolic stress (e.g. sepsis, trauma, burns, surgery)
☐ Sports nutrition
☐ Healthy pregnant women
☐ Healthy toddlers/children
☐ Micronutrient malnutrition management
☐ Enteral feeding (e.g. gastrostomy feeding)
☐ Other

4.7 If you have chosen 'other' in Q4.6, please specify?

4.8 Do you give food exchange lists to patients as part of the nutrition intervention?
☐ Yes, I always give the patient a food exchange list. ☐ Yes, depending on the patient/ situation. ☐ I never give patients food exchange lists .

4.9 When you give food exchange lists to patients, which lists do you provide them with?
All relevant options may be selected.
☐ The same food exchange list I use in dietary analysis and meal planning.
☐ A simplified, generic food exchange list.
☐ A simplified, personalised food exchange list.

4.10 Which factors influence your choice to give the patient a food exchange list, or not?
All relevant options may be selected.
☐ Disease/ condition
☐ Literacy level of the patient
☐ I ask the patient if they would like to use food exchange lists (do they prefer it).
☐ Age
☐ Gender
☐ Language
☐ Other

4.11 If you have chosen 'other' in Q4.10, please specify?

4.12 If you have assessed the patient/ situation, and have decided not to give the patient a food exchange list, what do you use in the place of a food exchange list during the nutrition intervention?

All relevant options may be selected.

- ☐ Sample meal plans and menus that don't require the patient to use food exchange lists, e.g. cycle menus.
- ☐ Nutrition guidelines, related to the specific disease/ condition, including educational materials e.g. pamphlets.
- ☐ Sample meal plans and menus where you use the "OR" method, e.g. 2 starch exchanges = 2 small slices of bread OR 1 cup of soft maize meal OR 1 cup of cooked brown rice, etc.
- ☐ Other

4.13 If you have chosen 'other' in Q4.12, please specify?

4.14 If you use/ have used food exchange lists, where did you obtain them from?

All relevant options may be selected.

- ☐ Self designed
- ☐ University
- ☐ American Diabetes / Dietetic Association
- ☐ Unsure
- ☐ Other

4.15 If chosen 'other' in Q4.14, please specify?

4.16 If you have developed a food exchange list, which resources did you use?

All relevant options may be selected.

- ☐ Product packaging (e.g. nutritional information on labels)
- ☐ Food analysis software (e.g. Foodfinder/ Foodfundi)
- ☐ South African Food Composition Database
- ☐ Text books (specify)
- ☐ Other

4.17 If you have chosen 'text books' in Q4.16, please specify?

4.18 If chosen 'other' in Q4.16, please specify?

4.19 When last has the food exchange list that you are using, been updated?

- ☐ <1 year ago
- ☐ 1 to 2 years ago
- ☐ 3 to 5 years ago
- ☐ >5 years ago
- ☐ Unsure

5. Perceptions regarding food exchange lists, used as part of the food exchange system, in the nutrition care process

5.1 Do you think that the food exchange lists available to you are outdated and require updating? ☐ Yes ☐ No ☐ Unsure

5.2 Please motivate your response?

5.3 Do you think that you have enough knowledge to develop your own food exchange list? ☐ Yes ☐ No ☐ Unsure

5.4 In your opinion, do you have enough resources to develop your own food exchange list? ☐ Yes ☐ No ☐ Unsure

5.5 Which resources do you feel are currently lacking, that would assist you in developing your own food exchange list?

5.6	In your opinion, do you have enough time to develop you own food exchange list?	☐ Yes	☐ No	☐ Unsure
5.7	Do you think that the current food exchange lists available to you are useful for you as a dietitian?	☐ Yes	☐ No	☐ Unsure

5.8 Please motivate your response?

5.9	In your experience, do patients find food exchange lists useful?	☐ Yes	☐ No	☐ Unsure

5.10 Please motivate your response?

5.11 In your opinion, what are the advantages of using food exchange lists?

All relevant options may be selected.

- ☐ All dietitians in South Africa have access to some form of food exchange lists.
- ☐ Food exchange lists can be used in dietary analysis based on a diet history.
- ☐ The use of food exchange lists in dietary analysis, based on a diet history, is faster than using nutrient analysis software (e.g. Foodfinder/ Foodfundi).
- ☐ The use of food exchange lists in dietary analysis, based on a diet history, is faster than using nutrient analysis software (e.g. Foodfinder/ Foodfundi).
- ☐ The use of food exchange lists in dietary analysis, based on a diet history, is easier than using nutrient analysis software (e.g. Foodfinder/ Foodfundi).
- ☐ The use of food exchange lists in dietary analysis, based on a diet history, is faster than using a food composition data base.
- ☐ The use of food exchange lists in dietary analysis, based on a diet history, is easier than using a food composition data base.
- ☐ The use of food exchange lists in dietary analysis, based on a diet history, provides me with the necessary information to make a nutrition diagnosis.
- ☐ It is more convenient working with average nutrient values, such as those in food exchange lists, than more specific nutrient values like the values found in food composition databases or analysis software.
- ☐ Food exchange lists contain generic information and not all the different brands available on the market.
- ☐ The use of food exchange lists is an easy method to meal planning.
- ☐ The use of food exchange lists is a quick method to meal planning.
- ☐ The use of food exchange lists in meal planning, is the only method to calculate a meal plan and menus, based on the nutrition prescription.
- ☐ The use of food exchange lists make the adjustment of menus and meal plans easier when the nutrtition prescription changes.
- ☐ Using food exhange lists in meal planning saves time and labour for me as a dietitian.
- ☐ Food exchange lists can be used in counselling of patients.
- ☐ Using food exchange lists in meal plans, give patients a feeling of control.
- ☐ Using food exchange lists in meal plans, provides patients with a variety of food to choose from.
- ☐ Concepts, e.g. carbohydrate counting, are easier understood by patients when a food exchange list is used as a counselling tool.
- ☐ Dietetic students understand portion estimations better, when explained in conjunction with the use of food exchange lists.
- ☐ Dietetic students understand meal planning better, when explained in conjunction with the use of food exchange lists.
- ☐ Dietetic students understand certain disease specific dietary management, e.g. diabetes or chronic kidney disease, better when explained in conjunction with the use of food exchange lists.
- ☐ Other

5.12 If you have chosen 'other' in Q5.11, please specify?

5.13 What challenges do you experience with using food exchange lists?

All relevant options may be selected.

- ☐ Food exchange lists are not sensitive to the different cultural eating habits for the patients that I see.
- ☐ Food exchange lists are not sensitive to different disease conditions (e.g. kidney disease vs sports nutrition).
- ☐ Food exchange lists are not sensitive to population groups where there is limited money available for food.
- ☐ Food exchange lists are too complicated for my patients.
- ☐ Food exchange lists can not be used for patients that are illiterate.
- ☐ Food exchange lists can not be used for patients speaking different languages.
- ☐ Food exchange lists that I use are not comprehensive enough; many of the foods that my patients consume are not on the lists.
- ☐ Food exchange lists can contain mistakes, which can negatively influence my patients.
- ☐ Food exchange lists contain generic information and are not product specific, making comparison of products difficult.
- ☐ Food exchange lists do not distinguish between total carbohydrate and carbohydrate from added sugar.
- ☐ Food exchange lists do not distinguish between total carbohydrate and available carbohydrate (e.g. fibre content).
- ☐ Food exchange lists do not distinguish between raw vs cooked portion sizes, and therefore could be used incorrectly.
- ☐ Food exchange lists become outdated quickly - food products are constantly added or removed from the market.
- ☐ Food exchange lists contain portion sizes that are impractical for patients eating away from home, where there are no measuring utensils available.
- ☐ There is a risk that food exchange lists will be distributed and used incorrectly by the wrong population groups.
- ☐ Other

5.14 If you have chosen 'other' in Q5.13, please specify?

5.15	Do you think that food exchange lists are effective for use during **dietary analysis** of the nutrition care process?	☐ Yes	☐ No	☐ Unsure
5.16	Do you think that food exchange lists are effective for use in **dietary interventions** (e.g. meal planning and menus) as part of the nutrition care process?	☐ Yes	☐ No	☐ Unsure
5.17	Do you think that food exchange lists are effective for use in **counselling and education** as part of the nutrition care process?	☐ Yes	☐ No	☐ Unsure
5.18	Do you think it would be beneficial for South African dietitians to all make use of the same food exchange lists, specifically designed for various ethnic (e.g. culture/ religion) groups with different eating habits?	☐ Yes	☐ No	☐ Unsure
5.19	Do you feel that food exchange lists should be available in more languages?	☐ Yes	☐ No	☐ Unsure

5.20 In which other languages do you think that food exchange lists should be available in South Africa?

5.21	Do you think that there is a need for food exchange lists to be adapted for different cultural groups with different eating habits in South Africa?	☐ Yes	☐ No	☐ Unsure

5.22 In your opinion, for which cultural groups in South Africa should the food exchange list be adapted?

5.23	Do you think that there is a need for food exchange lists to be adapted for different religions with different eating habits in South Africa?	☐ Yes	☐ No	☐ Unsure
5.24	In your opinion, for which religious eating habits should the South African food exchange list be adapted?			
5.25	Do you think that food exchange lists should to be adapted according to the amount of money available for food in a household?	☐ Yes	☐ No	☐ Unsure
5.26	Do you think that there is a need for a separate food exchange list for South African vegans/ vegetarians?	☐ Yes	☐ No	☐ Unsure
5.27	Do you think that there is a need for food exchange lists to be adapted for specific patient groups, e.g. diabetes or toddlers?	☐ Yes	☐ No	☐ Unsure
5.28	In your opinion, for which specific patient groups (e.g. conditions/ diseases/ stages of the life cycle) should the food exchange list be adapted?			
5.29	In your opinion, is there a need to develop food exchange lists for South African patients with different literacy levels?	☐ Yes	☐ No	☐ Unsure
5.30	To which literacy level do you think food exchange lists that are given to patients should mainly be adapted to in South Africa?	☐ Grade 1-3 ☐ Grade 10-11	☐ Grade 3-7 ☐ Obtained matric	☐ Grade 8-9 ☐ Tertiary education

6. Alternatives used instead of or in combination with food exchange lists, as part of the nutrition care process

6.1	Do you use other tools instead of food exchange lists during the different steps of the nutrition care process?	☐ Yes	☐ No	☐ Unsure
6.2	What other tools do you use instead of food exchange lists for **dietary analysis** as part of the nutrition care process?			
6.3	What other tools do you use instead of food exchange lists for **dietary interventions such as meal planning and menus** as part of the nutrition care process?			
6.4	What other tools do you use instead of food exchange lists for **counselling and education** as part of the nutrition care process?			
6.5	Please motivate why you prefer using the specified tool(s) instead of the food exchange list?			
6.6	Are you using any nutrition related health applications, either web-based or smartphone, in the dietary management of patients?	☐ Yes	☐ No, I am not using any health applications	

6.7 Please specify which applications you are using?

6.8 What factors influence/ would influence your decision to use nutrition related health applications?

All relevant options may be selected.

- ☐ Whether it can be used free of charge.
- ☐ Whether it is easy to use.
- ☐ Whether it is accurate.
- ☐ Whether it is based on scientific evidence.
- ☐ Whether it is web- vs smartphone based.
- ☐ Other

6.9 If you have chosen 'other' in Q6.8, please specify?

6.10 Please indicate for which part of the nutrition care process do you use applications?

All relevant options may be selected.

- ☐ Dietary analysis
- ☐ Dietary interventions for meal planning and menus
- ☐ Counselling and education
- ☐ Other

6.11 If you have chosen 'other' in Q6.10, please specify?

6.12 Are the nutrition related health applications you are using, based on scientific evidence? ☐ Yes ☐ No ☐ Unsure

6.13 In your opinion, what are the advantages of using nutrition related health applications?

6.14 In your opinion, what are the limitations of using nutrition related health applications?

6.15 Do you recommend the use of nutrition related health applications to patients? ☐ Yes ☐ No

6.16 What factors influence your decision to recommend nutrition related health applications to patients?

All relevant options may be selected.

- ☐ The reason for the consult (e.g. medical and nutritional diagnosis).
- ☐ The patient will be followed up by the same dietitian/ institution.
- ☐ The age of the patient.
- ☐ The literacy level of the patient.
- ☐ The occupational status of the patient.
- ☐ Patient compliance to previous dietary guidelines provided.
- ☐ Patient preference.
- ☐ Unsure
- ☐ Other

6.17 If you have chosen 'other' in Q6.16, please specify?

7. Perceptions regarding electronic food exchange lists, used as part of the food exchange system, in the nutrition care process [Continue]

7.1 In your opinion, would an **electronic food exchange list** be useful for you as a dietitian? ☐ Yes ☐ No ☐ Unsure

**An electronic food exchange list is a food exchange list which will automatically calculate the number of food exchanges based on a diet history or based on calculated requirements. This can be in the form of software, used on a PC, a web-based or smartphone application.*

7.2 If you have answered 'No' in Q7.1, please motivate your response?

7.3 In which format would you prefer an electronic food exchange list?
☐ Web-based application ☐ Smartphone application ☐ Software (e.g. on a CD)
☐ Other

7.4 If you have chosen 'other' in Q7.3, please specify?

7.5 Do you think it would be beneficial if the electronic food exchange list could also provide an estimate of the cost of the calculated or analysed diet? ☐ Yes ☐ No ☐ Unsure

7.6 Do you think there are advantages to using an electronic food exchange list? ☐ Yes ☐ No ☐ Unsure

7.7 In your opinion, what are the limitations of an electronic food exchange list?

7.8 Would you pay for access to food exchange lists which are kept updated? ☐ Yes ☐ No ☐ Unsure

7.9 If you have answered 'yes', please indicate how much would you be willing to pay?

7.10 If you have answered 'no', please motivate your response?

8. Preferred specifications of food exchange lists, used as part of the nutrition care process

8.1 In your opinion, what are the qualities/ characteristics of a good food exchange list?

8.2 Do you prefer portion sizes on a food exchange list to refer to raw or cooked portion sizes?

All relevant options may be selected.

☐ Raw ☐ Cooked ☐ Other

8.3 Please motivate your response?

8.4 If you have chosen 'other' in Q8.2, please specify?

8.5 Do you prefer portion sizes on food exchange list to be in weight, volume or household measures?

☐ Weight ☐ Volume ☐ Household measures, such as cups, teaspoons etc.

☐ Other

8.6 If you have chosen 'other' in Q8.5, please specify?

8.7 Do you prefer the analysis of food on exchange lists to be per exchange or per 100 g of the product for better comparison between products?

☐ Per exchange ☐ Per 100 g ☐ Other

8.8 If you have chosen 'other' in Q8.7, please specify?

8.9 Do you think food exchange lists should contain micronutrient values? ☐ Yes ☐ No ☐ Unsure

8.10 Which micronutrients do you think are the most important to include in the food exchange list?

8.11 Do you think food exchange lists should contain information on the amount/ type of fiber? ☐ Yes ☐ No ☐ Unsure

8.12 Please motivate your answer?

8.13 Do you think food exchange lists should contain information on the amount of fluid content of products? ☐ Yes ☐ No ☐ Unsure

8.14 Please motivate your answer?

8.15 Do you think food exchange lists should contain information on the amount of sodium? ☐ Yes ☐ No ☐ Unsure

8.16 Please motivate your answer?

8.17 Do you think food exchange lists should contain information on the amount of sugar? ☐ Yes ☐ No ☐ Unsure

8.18 Please motivate your answer?

8.19 Do you think food exchange lists should contain information on the glycaemic index? ☐ Yes ☐ No ☐ Unsure

8.20 Please motivate your answer?

8.21 Do you think food exchange lists should contain information on the fatty acid content of food? ☐ Yes ☐ No ☐ Unsure

8.22 Please motivate your answer?

8.23 Should nutrient values of either/ both micronutrients or/and other elements (e.g. fibre content) be added to existing food exchange lists or should separate food exchange list be developed for various elements? ☐ As part of the existing exchange list ☐ As part of a separate exchange list ☐ Unsure

8.24 If micronutrients and/or other elements (e.g. fibre content) are incorporated into the food exchange list, in which format would you prefer it?

☐ The exact amount per exchange should be next to each food item
☐ The highest or lowest sources of a specified nutrient/ element should be indicated by means of flagging (e.g. foods with higher fiber content should be highlighted in green etc.)
☐ Unsure
☐ Other

8.25 If you have chosen 'other' in Q8.24, please specify?

8.26 Do you think mixed meals/ meals consisting of various components (e.g. lasagne) should be included in food exchange lists? ☐ Yes ☐ No ☐ Unsure

8.27 What are the limitations to the inclusion of mixed meals/ combined foods in the exchange list?

All relevant options may be selected.

☐ Differences in recipes used to prepare the dishes would affect the nutrient values of mixed meals/ combined meals.
☐ The food exchange list would become too complex.
☐ Unsure
☐ Other

8.28 If you have chosen 'other' in Q8.27, please specify?

8.29 What are the advantages of including mixed meals/ combined foods in the food exchange list?

All relevant options may be selected.

☐ It would save time analysing a diet history.
☐ It would save time during meal planning.
☐ It would assist in counselling, as differences between various dishes would be more apparent.
☐ The nutrient value of the mixed/ combined food would be more accurate than the nutrient value obtained by combining the exchanges of all the ingredients of the recipe separately.
☐ Unsure
☐ Other

8.30 If you have chosen 'other' in Q8.29, please specify?

8.31 Do you think fast food (e.g. KFC etc.) meals should be included in food exchange lists? ☐ Yes ☐ No ☐ Unsure

9. Comments

9.1 Any other comments regarding the use of food exchange lists in the South African setting?

10. End of Survey: Thank you for taking the time!