DIETARY DIVERSITY AMONGST ADULTS WHO BUY AT SHOPPING MALLS IN THE NELSON MANDELA BAY AREA

Eunice de Bruin & Annelie Gresse*

ABSTRACT

Dietary diversity is recognized as vital for health. The level of dietary diversity and contributing factors could possibly be used as proxy indicators for food insecurity and nutritional quality, as well as to highlight gaps in nutrition interventions, policies and programmes, which aim at combating over- and under-nutrition.

The aim of this study was to determine the level of dietary diversity and associated factors among adults in the Nelson Mandela Bay area. A convenience, stratified sample of 480 adult participants was used in a survey to determine the level of dietary diversity and identify contributing factors.

Adults in the Nelson Mandela Bay area who shopped at shopping malls had a medium level of dietary diversity. Participants consumed on average food from 6.88 ± 1.73 food groups out of twelve, including sugars and fats. Dietary patterns found were not in line with the South African Food Based Dietary Guidelines. Factors that had a significant association with the level of dietary diversity included ethnicity, level of education, amount of money spent on food purchase per month, distance travelled to purchase food, and nutrition knowledge on dietary diversity. The results are a cause for concern, and justify a call for immediate and effective intervention, including nutrition education promotion and the implementation of current policies and programmes.

— ***Ms E de Bruin***
Dora Nginza Hospital
Port Elizabeth
South Africa
6005

Tel: +27 (0) 82 552 2258
Email: eunicempehlo@gmail.com

— ***Dr A Gresse***
Department of Dietetics
Nelson Mandela University
Port Elizabeth
South Africa
6031
Tel: +27 (0) 41 504 2048
Email: annelie.gresse@mandela.ac.za
*Corresponding author

ARTICLE INFO

Article history
Received February 2018
Revision April 2018
Final Submission September 2018

Keywords
dietary diversity, food security, dietary recall, dietary diversity score

INTRODUCTION AND BACKGROUND

South Africa is classified as a middle-income developing country, facing under-nutrition, especially with reference to low energy intake and micronutrient deficiencies, that are not yet successfully addressed, while obesity and non-communicable diseases (NCDs) are increasing as evidence of the nutrition transition (Vorster et al., 2011). Malnutrition is a global health challenge that is defined by both under- and over-nutrition (Leenstra et al., 2005). According to the World Health Organization (WHO) (WHO, 2015: 1), globally, 39% of adults were found to be overweight and 13% obese, and negative changes in lifestyle have led to an increase in NCDs. According to the South African Demographic and Health Survey (SADHS)

(National Department of Health, 2017:45, 46), adult males over the age of 20 years had a mean body mass index (BMI) of 24.4 kg/m2, compared to a BMI of 29.9 kg/m2 for females. The prevalence of overweight and obesity was also significantly higher in females, as 72.6% were found to be overweight or obese, compared to 38.5 % for males.

Dietary diversity (DD) is recognized globally and nationally as important by nutrition professionals and other health professions and has been shown to be vital for health, as nutrient adequacy, or lack thereof, can either cause a decrease or an increase in mortality rates respectively, as well as alleviate or aggravate the rise of the double burden of malnutrtion and NCDs (Bernstein, 2002; Lee, 2011; Lo, 2011). Ruel (2003:231) defined DD as " the number of different foods or food groups consumed over a given reference period".

Dietary diversity has been proven useful as a proxy indicator of dietary quality and could serve as guideline as whether people has an adequate intake of nutrients in order to promote good health; however it can neither ensure the adequate intake nor the provision of adequate nutrients (Ruel, 2003). The rationale for emphazising DD in a middle-income developing country, such as South Africa, stems mainly from a concern related to nutrient deficiency, NCDs and the recognition of the importance of increasing food and food group variety to ensure nutrient adequacy. Thus, one can only speculate on the relationship between a lack in DD and an increase in the double burden of malnutrition.

The development of the South African Food Based Dietary Guidelines (SAFBDGs) was initiated in 1997 (Vorster & Browne, 2001). The SAFBDGs are science-based policy and evidence-based nutrient recommendations in the form of guidelines for healthy eating and were implemented in 2004 and later revised. The first guideline recommends: "Eat a variety of foods" and indicates the importance of dietary variety in the diet, as there is sufficient evidence to show that certain population groups have little variety in their diet. The national mean dietary diversity score of 4.02 was just above the official cut-off point for low dietary diversity (DDS = 4) when the SAFBDGs were revised (Steyn & Ochse, 2013: 15).

The current study was undertaken to determine whether this situation is still relevant, four years later and in an urban area such as Nelson Mandela Bay (NMB). The aim of the study was to determine the level of dietary diversity and associated factors among adults in the NMB area. Steyn and Ochse (2013:15) found that the Eastern Cape was shown to be one of the provinces with the lowest DD, with 59.6% of the population with a DD below four.

RESEARCH METHODOLOGY

Shopping malls were purposely selected for this study to ensure the inclusion of a wide spectrum of socio-economic groups in the NMB area. Malls that gave permission for the survey to be conducted and that were included, where Greenacres Shopping Mall, Walmer Park, Daku Centre in Ibayhi, Pier 14 Shopping Mall and Summerbreezz Spar Centre.

Ethical clearance for the study was granted by the Research Ethics Committee (Human) at Nelson Mandela University before the commencement of the study (REC-H ref: H16-HEA-DIET-007).

Study design, sampling and participants

A cross-sectional, quantitative study design with a qualitative component was conducted on a convenience stratified sample of 492 participants. Strata were selected in relation to location (that was an indication of socio-economic groups), food accessibility, gender and race; as well as the accessibility of participants for the researcher and fieldworkers. Informed consent was obtained upon meeting the inclusion requirements of being above the age of 18 years, speak either Afrikaans, English or IsiXhosa, being present at a selected shopping mall, and have a physical address and be living in the NMB area.

Data collection

Twenty BSc Dietetics students from the Nelson Mandela University were recruited and trained during a one-day training session, by the principal researcher, a registered dietitian, as

fieldworkers. These fieldworkers had previously received training regarding the 24-hour dietary recall method and interviewing techniques, by staff of Nelson Mandela University, and received refresher training to ensure the accuracy and reliability of data captured. The fieldworkers were familiarized with the questionnaire so as to ensure that there was no interviewer bias and a manual with standard operating procedures was provided to each of the fieldworkers.

A questionnaire was developed and piloted (11 February 2017) at one shopping centre and the study was implemented over four weekend days of two consecutive weeks (25, 26 February 2017 and 04, 05 March 2017). The questionnaire included four categories of information, namely socio-demographic information, food availability, nutrition attitudes and knowledge, and a non-quantifying 24-hour recall. Information on the socio-demographics (interviewer administered) section included gender, age, ethnicity, nationality, religion, employment status, level of education, place of residence, number of dependents and average monthly household income. These questions were based on self-reporting and the answers were obtained at the beginning of the interview. The food availability section (interviewer administered) addressed frequency of purchasing food and/or food products, amount spent (Rands), access to food and the distance travelled to be able to access food and food products, number of times meals and/or snacks are consumed in a day, hunger experienced, food variety and availability and self-procurement of foods. The nutrition knowledge and attitudes section (participant administered) assessed participants' understanding and knowledge of and attitudes towards the terms 'diet' and 'dietary diversity', whether or not religious or cultural practices influence dietary intake and knowledge relating to the South African Food Based Dietary Guidelines (SAFBDGs).

A 24-hour dietary recall was used to assess the level of dietary diversity (FAO, 2010: 8; National Cancer Institute, 2016a; National Cancer Institute, 2016b: 1; Schatzkin et al., 2003; Shim et al., 2014; Subar, 2009; Wrieden et al., 2003). This method requires participants to recall all food and beverages consumed during the previous 24-hours. Only one 24-hour recall was accounted for and included either a weekday or weekend day recall. A multi-pass method was administered to obtain an accurate recall from participants (Wrieden et al., 2003).

Data analysis

A DD scoring sheet was developed from sheets previously tested in research of the Food and Agricultural Organization of the United Nations (FAO) (FAO, 2010; Swindale & Bilinsky, 2006; Taruvinga et al., 2013). Twelve food groups were included, namely: cereals; white roots and tubers; other non-starchy vegetables; other fruits; organ meat and/or flesh meat; eggs; fish and seafood; legumes, nuts and seeds; milk and milk products; oils and fats; sweetening agents and sweets; and spices, condiments and beverages. The twelve food groups were selected on recommendations of previous studies that have been conducted (Taruvinga et al., 2013), and which were based on synthesis of current available research results (FAO, 2010 and Swindale & Bilinsky, 2006). A specific group for vitamin A fruit and vegetables was not included, as the study did not specifically investigate nutrient intake. Groups for oils and fats and sweetening agents and sweets were included as there is an association between these groups and obesity. In the analysis of the data, special attention was given to investigate the use of these groups. Low dietary diversity (LDD) was scored from 1-4; medium dietary diversity (MDD) was scored from 5-8 and high dietary diversity (HDD) was scored from 9-12. Each participant's 24-hour recall was transcribed onto the DD scoring sheet by underlining foods and food items that were mentioned in the 24-hour recall on the scoring sheet and marking the groups that the foods were chosen from. Thereafter a total out of twelve was awarded to each participant according to the groups that were marked, as the dietary diversity score (DDS).

The data were captured on a spreadsheet and stored in a computer database. After cleaning the data, checking for missing values and capturing errors, the complete database existed for 480 participants. IBM SPSS (Statistical Package for Social Sciences) Statistics, Statistica Version 12 and Microsoft Office Excel 2007 were used to analyze the data, and

descriptive statistics were used to describe study population characteristics. Spearman's rho correlation coefficient (r) was used to measure the strength and direction of the association between variables, and Pearson's chi-square test was used to identify the significance of the correlations ($p<0.05$). Associations between ordinal response variables and/or nominal response variables were analyzed, using appropriate analysis of variance by performing Chi-square tests. A p-value < 0.05 represented a statistically significant association between the variables.

Although a total of 480 participants were included in the study, the recalls of only 381 participants were valid to be included in the multinomial logistic regression model that was used (Gujarati & Porter, 2010), which was as follows:

$$\text{Logit } (P1) = \ln (P1 / 1- P1) = \alpha + ß1X1 + \ldots + ßnXn + Ut \quad \ldots\ldots\ldots (1)$$

Where:

- ln (P1 / 1- P1) = logit for DD categories
- P1 = MDD
- 1- P1 = LDD or HDD
- ß = coefficient
- X = covariates
- Ut = error term

Note: MDD (Medium Dietary Diversity); LDD (Low Dietary Diversity) and HDD (High Dietary Diversity)

This multinomial logistic regression model was used to determine the risk of the LDD versus MDD as well as the HDD versus MDD. This assessed the probability of the three different DD categories, where the probability lying between zero and one ($0 \leq P1 \leq 1$) represents the MDD category, and ($1 – P1$) represents the probability of DD in either the LDD or HDD categories. In simpler terms; the logistic regression model used, assessed the predictability of a falling either in a LDD or HDD for any given factor, such as age, gender, education level and so on.

RESULTS AND DISCUSSION

This study explored the level of DD of adults living in the NMB area. The participants (n=480) were shoppers at various popular shopping centres around NMB.

The logistic regression model set the MDD level as the base group for comparison, and the risk of associated factors to be in either an LDD or an HDD group rather than in the base group, MDD. Certain variables were left out of the

TABLE 1: THE SOCIO-DEMOGRAPHIC DETAILS OF THE RESPONDENTS

Category	Sub-category	Participants	
		n = 480	%
Gender	Male	204	42,5
	Female	275	57,3
	Unanswered	1	0,2
Age	18-35	328	68,33
	>36	152	31,67
Ethnicity	Black	238	49,6
	White	150	31,3
	Coloured	73	15,2
	Other	16	3,3
	Unanswered	3	0,6
Employment status	Unemployed	75	15,6
	Employed	226	47,1
	Student	147	30,6
	Retired	31	6,5
	Unanswered	1	0,2
Level of education	Did not matriculate	73	15,2
	Matric	266	55,4
	Diploma/Degree/Post-Grad	137	28,5
	Unanswered	4	0,8

regression for one of two reasons; either the ratio of the number of people in particular categories was too large or the variable was highly correlated with another variable (e.g.. Monthly income and how much is spent on groceries).

The results showed that 57.3% of the participants were female, 49.6% were black, followed by 31.3 % white participants and that the majority had matric (55,4%) and were employed (47,1%). See Table 1 for demographical data.

Twelve food groups were assessed from which the DSS were calculated. Although the majority of the participants obtained an MDD score, it is important to analyze which foods were consumed most commonly amongst the participants. These dietary patterns, i.e. the frequency of consumption of food items chosen based on cultural, religious, educational and other such preferences, were used to establish the compliance with the SAFBDGs. This information is important as the variety of distribution amongst participants needs to be known to identify the nutrition gap in relation to the SAFBDGs which has created a national recommendation to optimize health through nutrition.

Participants consumed on average 6.88 ± 1.73 different food groups, within an average range of approximately 5–9 different food groups (see Figure 1 and Table 2). If one takes into account that DD indicates the number of foods or food groups consumed over a given time; an MDD does not mean that the diet is nutritiously adequate, although it may serve as a proxy of both dietary quality and food security. In comparison, an HDD is defined as a high variety of foods and LDD as a low variety of foods, consumed over a reference period of time. A variety of foods was assessed, but neither nutritional quality, nor nutritional adequacy was assessed; only associations were assessed between level of DD obtained and various contributory factors to that DDS. As 61.5 % and 89.2 % of the participants reported the food groups fats and oils and sugars and sweetening agents and sweets as part of their intake, the average score of 6.88 indicates that the dietary diversity was lower than indicated by the average score as these food are energy dense.

Although the majority of participants obtained a medium DD score (see Figure 1), it was also necessary to investigate the frequency and types of foods that were consumed. The results showed that the consumption of the following groups were high, which was not the case for the more nutritious food groups: sweetening

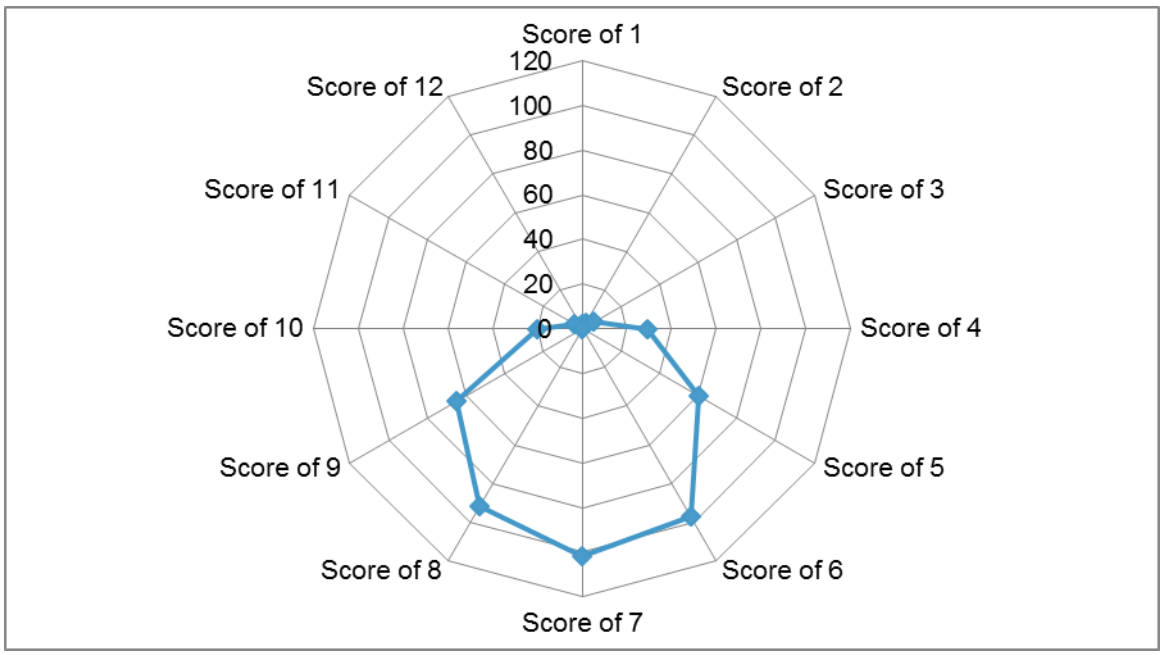

FIGURE 1: NUMBER OF PARTICIPANTS PER SCORE

TABLE 2: FOOD GROUPS CONSUMED BY PARTICIPANTS

Food Group	Number of participants (n = 480)	Percentage of participants (%)
Cereals	457	95.2
White roots and tubers	176	36.7
Other non-starchy vegetables	311	64.8
Fruit	217	45.2
Organ meat and/or flesh meat	391	81.5
Fish and seafood	64	13.5
Eggs	131	64.8
Milk and milk products	350	72.9
Legumes, nuts and seeds	68	14.2
Oils and fats	295	61.5
Sweetening agents and sweets	428	89.2
Spices, condiments and beverages	415	86.5

TABLE 3: FACTORS SIGNIFICANTLY ASSOCIATED WITH DIETARY DIVERSITY

Type of factor	Factor	Probability (p- value)	Measure of association (Cramer's V)
General	Ethnicity	<0.001	Moderate (df = 4: 0.182). Black participants more likely to have a low DDS and white participant more likely to have a high DDS.
	Level of education	0.021	*
	Amount of money spent on food per month	<0.001	*
	Distance to travel to buy food	0.040	*
	Knowing about dietary diversity	0.001	Moderate (df = 2: 0.209). Not knowing leads more likely to a low DDS
Amount of money spent on food	Level of employment	<0.001	Moderate (df = 6: 0.176) Lower level more likely leads to low DDS
	Number of meals eaten per day	0.050	Small (df = 6, 0.121)
	How often hunger is experienced	<0.001	Moderate (df = 6: 0.180)
How often hunger is experienced per month	How often there is no money to buy food	0.000	Large (df = 3: 0.503) Often having no money leads to a lower DDS

*The logistic regression model does not measure association, and thus cannot be commented on

agents and sweets (consumed by 89.2%), spices, condiments and beverages, including sugar sweetened beverages (86.5%) and oils and fats (61.5%). See Table 2.

Various factors were found to have significant positive or negative associations with the level of DD. The significant probability values (p-values) and measures of association are discussed in Table 3. The logistic regression model has shown no significant differences between people of different gender (p = 0.272), age (p = 0.081), employment status (p = 0.161), having access to a vegetable garden (p = 0.645), having access to life stock (p = 0.795), number of meals eaten per day (p = 0.195), number of persons in the household (p = 0.195), how often food is purchased (p = 0.330) or knowledge about the SAFBDG (p = 0.345). When attitudes were measured, 82.3% of the participants also said that religion did not make a different to their dietary diversity.

Using both a chi-square test and the logistic regression model, it was found that ethnicity had a significant association with the level of DD. The chi-square test revealed a significant difference (p < 0.001) between the various ethnic groups, with a moderate measure of association (df* = 4; 0.182) between ethnicity and DDS measured from 461 participants. The logistic regression model revealed that there

was an expected risk of being in the LDD versus the MDD group for both Black (p = 0.044) and White (p = 0.031) ethnic groups, compared to the Coloured participants. The logistic regression model also classified the Black ethnic group at an expected risk to be in the HDD versus the MDD group (p = 0.035) compared to those participants of either White or Coloured ethnicity.

The Black ethnic group has a higher percentage of participants with an LDD (12%), and a lower HDD (10%) compared to Coloured participants (10% have an LDD and 23% have an HDD) and White participants, of whom only 3% of participants have an LDD. Of the three ethnic groups discussed, the latter has the highest percentage of participants in the HDD (29%) group.

The research study shows a significant association (p = 0.021) of level of education to level of dietary diversity for persons who did not matriculate. Thus, for this group in particular, there is an expected risk of having a LDD versus a MDD when compared to the other 'level of education' groups, namely; 'matric', and 'diploma/degree/post-grad'.

Participants who spent between R0 and R1 000.00 on buying food per month, were at a higher expected risk, with the logistic regression model showing significance (p < 0.001), of rather having a LDD than a MDD, compared to participants who spent more than R1 000.00 on buying food per month.

The majority of participants (n=189) reported that they were required to travel less than two kilometres, 158 participants (33%) reported that they needed to travel between 2 km and 4.9 km and 27% of participants reported that they needed to travel more than five kilometres to purchase food and food products at their nearest shopping centre.

An explanation for the term 'dietary diversity' was asked, to determine whether participants understood the concept, which may be an effecting factor in either improving or limiting the intake of different foods or food groups. A significance (p = 0.001) with a moderate association (df* = 2; 0.209) was found in participants who did not know the definition of 'dietary diversity' as 'consuming a variety of foods/drinks', compared to those who did. Participants who defined 'dietary diversity' as 'don't know' also showed a significant difference (p < 0.001), with a moderate level of association. Of the participants who had less than matric, 57% defined the term 'dietary diversity' incorrectly, whereas participants who had a degree, diploma or post-graduate qualification (43%) had correctly defined the term 'dietary diversity'. Therefore, it was concluded that the better a participant's level of nutrition knowledge, the better his or her level of DD.

A significant difference (p < 0.001) with a moderate measure of association (df* = 6; 0.176) was found between level of employment and how much money is spent on food per month. Participants (n=428) who were employed, spent more money on food compared to unemployed, retired and student participants. The amount of money that is spent monthly on purchasing food differs significantly (p = 0.050), with a small level of association (df* = 6; 0.121), when the number of meals that are eaten per day is taken into consideration. Speculated reasons for this include that when more money is available, more food is available for preparation and more meals are enjoyed. Lifestyle factors such as how busy people are could also be a cause for fewer meals being prepared and eaten. A significant difference (p < 0.001) was shown between the associations of how much money is spent on food per month and how often hunger is experienced. Participants who spent more than R3 000.00 per month on food, experienced the least hunger per month. The majority of participants (n=284) reported never experiencing hunger, but of the participants who did experience hunger, the majority (n=84) reported that they did so two to three times a week, 47 participants reported being hungry daily, and the least 15 reported being hungry four to seven times a week. A moderate measure of association (df* = 6; 0.180) was drawn between the frequency of hunger experienced and amount spent on food per month.

The study participants fairly represented the population when compared to the Statistics

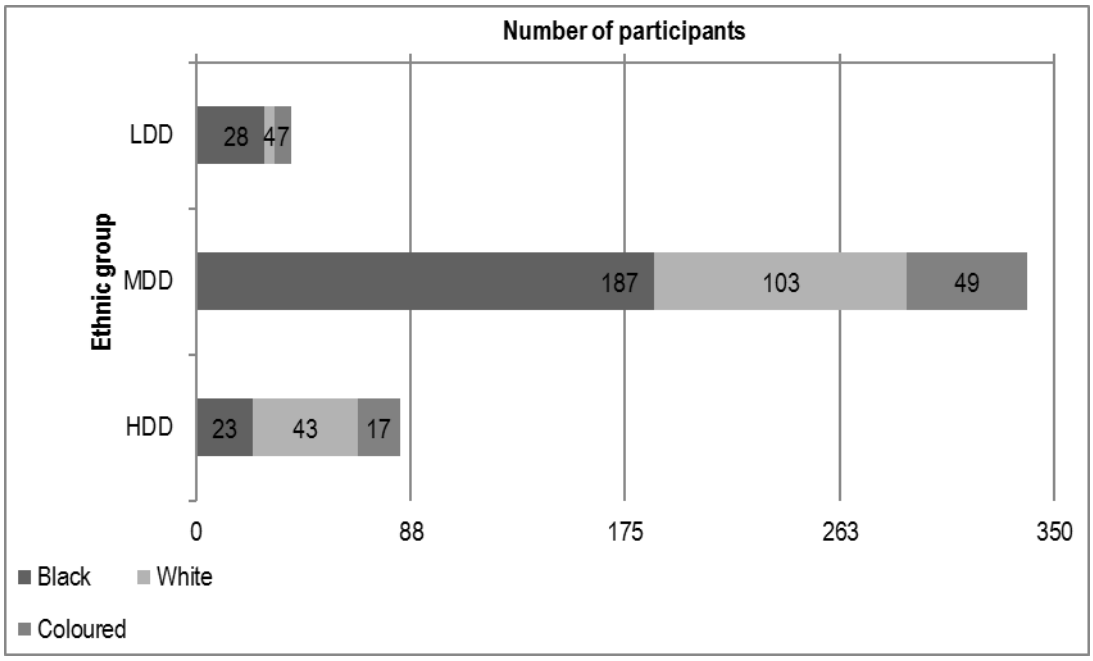

FIGURE 2: PARTICIPANT NUMBERS IN THE VARIOUS DIETARY DIVERSITY GROUPS ACROSS THE VARIOUS ETHNIC GROUPS

South Africa report (2011; 2015), with the exception of fewer participants of Coloured ethnicity compared to citizens of White ethnicity. Within the NMB population group, the majority of citizens had an education level of less than matric, whereas within the research study, most participants had an education level of matric. This result was possibly obtained because citizens of a very low socio-economic group may only shop infrequently at a shopping mall and therefore less than a representative sample of this group was included in the study.

The usual cut-off point of four for low dietary diversity was used. The intake of the various food groups were not in line with the SAFBDGs, which are supported by the Department of Health, and this trend is a cause for concern and justify a call for effective intervention. The most neglected food groups were fish and seafood, and legumes, nuts and seeds at 14% each. Food groups that are renowned for protecting against NCDs were not often eaten by participants, namely vegetables, fruits, and legumes, nuts and seeds (Bernstein, 2002; Lee, 2011; Lo, 2011). The most consumed food items from a particular food group were foods and food products classified under cereals (95%), followed by the food group sweetening agents and sweets, with 89% of participants having consumed at least one item from this food group. These commonly consumed food groups are known to aggravate risks of developing diabetes mellitus, hypertension, cancers and cardiovascular diseases (Bernstein, 2002; Lee, 2011; Lo, 2011).

Previous South African studies have found similar results to that of the recent study. A survey in Sekhukune, Limpopo, found a definite association between food security and DD (Faber et al., 2008) and a study in Sharpeville showed a DDS of 3.41 (Oldewage-Theron & Kruger, 2008) in participants with a lower food security level. A sub-optimal DD score is not limited to the NMB population, nor the South African population, poor dietary variety has also been found in other developing countries. (Kennedy et al., 2009).

Along with Taravinga et al. (2013), the authors agree with the recommendation of Kennedy et al. (2009) that, in order to ensure a higher quality of diet, education on dietary diversity should be started early in life. More attention should be given to nutrition in primary schools as a significant difference was found between level of education and nutrition knowledge. It was concluded that participants with a lower level of education were at a higher expected risk

of having a low DDS than a medium DDS classification.

CONCLUSION AND RECOMMENDATIONS

The present study found a mean DD score of 6.88 out of twelve food groups and revealed a higher incidence of a medium level of DD (73%) than an ideal high level of DD (19%). Furthermore, diets were high in the food groups 'cereals'; 'sweetening agents and sweets'; 'spices, condiments and beverages' and low in 'fish and seafood' and 'legumes, nuts and seeds'. As this was not a randomized controlled study, it was not possible to show cause and effect, but it was clear that factors such as level of education, employment status, ethnicity, money to spend on food, how often there is not enough money to buy food, how often hunger is experienced and access to either livestock or a vegetable garden, are associated with the chances of a HDD or even MDD, or increase in the risk of LDD or MDD (see Table 3). Confounding results showed that various factors can have a significant association on one another, thus affecting the outcome of a DDS, highlighting the complexity of factors influencing an optimal DDS (see Table 3).

This study does not show a significant association between knowledge about the SAFBDG and DDS ($p = 0.345$) (and therefore the implementation of the knowledge) and supports the conclusions of other researchers that knowledge alone does not influence health behaviour (Connor and Norman, 2017), but there was a positive association ($p = 0.001$) between knowledge about DD and the DDS. It is therefore important that both current and future nutrition education and promotion interventions that focus on SAFBDGs and knowledge on dietary diversity, should be strengthened in their implementation. Even though no significant association between knowledge and implementation, repetition of the message may increase the possibility that nutrition knowledge will lead to better implementation (Connor and Norman, 2017). Without access to related resources, including knowledge, there can be no success in efforts to improve health and nutrition in a sustainable manner. Platforms for raising awareness of the importance of consuming a diverse diet may include nutrition education in all schools, health awareness days, mass media via radio, television and social media platforms, to name only a few. The stakeholders on these platforms should be well equipped to ensure that nutrition knowledge and skills are correctly implemented, monitored and sustained. As mentioned, nutrition education should start early to ensure DD and government authorities have the responsibility of ensuring that teachers in schools are well equipped with nutrition knowledge and skills to administer the correct implementation of interventions. Furthermore, tools should be designed to facilitate the understanding and management of nutrition-based activities, aimed at improving health and nutritional status and change in behaviour.

ACKNOWLEDGEMENTS

We hereby acknowledge Prof du Randt for her contributions and insight, as well as the fieldworkers for their assistance and the participants for partaking in the research study.

REFERENCES

Bernstein, M. 2002. Higher dietary variety is associated with better status in frail elderly people. Journal of the American Dietetic Association, 102(8): 109–114.

Conner, M & Norman, P. 2017. Health behaviour: Current issues and challenges, Psychology & Health, 32(8): 895-906, Available online from DOI: 10.1080/08870446.2017.1336240. Accessed on 5 May 2018

Faber, M., Schwabe, C., & Drimie, S. 2008. Dietary diversity in relation to other household food security indicators. International Journal of Food Safety, Nutrition Public Health, 1(2): 157–171.

FAO. 2010. Guidelines for measuring household and individual dietary diversity. Available online from http://www.fao.org/fileadmin/user_upload/wa_workshop/docs/FAO-guidelines-dietary-diversity2011.pdf. Accessed 15 June 2017.

Gujarati, D., & Porter, D. 2010. Essentials of Econometrics, 4th ed. New York: MacGraw-Hill.

Kennedy, G., Pedro, M., Seghieri, C., Nantel, G., & Brouwer, I. 2009. Evaluation of dietary diversity scores for assessment of micronutrient

intake and food security in developing countries. (PhD). University of Wageningen, Wageningen.
Lee, M. 2011. A simple food quality index predicts mortality in elderly Taiwanese. The Journal of Nutrition, Health and Ageing, 15(10): 815-821.
Leenstra, T., Petersen, L., Kariuki, S., Oloo, A., Kager, P., & Ter Kuile, F. 2005. Prevalence and severity of malnutrition and age at menarche; cross-sectional studies in adolescent schoolgirls in western Kenya. European Journal of Clinical Nutrition, 59: 41–48.
Lo, Y. 2011. Dietary diversity and food expenditure as indicators of food security in older Taiwanese. Appetite. 58(1): 180-187.
National Cancer Institute. 2016a. Instrument Profiles. Available online from https://dietassessmentprimer.cancer.gov/profiles/questionnaire/. Accessed 14 May 2017.
National Cancer Institute. 2016b. Summary Tables: Recommendations on Potential Approaches to Dietary Assessment for Different Research Objectives Requiring Group-level Estimates. Available online from https://dietassessmentprimer.cancer.gov/approach/table.html. Accessed 14 May 2017.
National Department of Health (NDoH), Statistics South Africa (Stats SA), South African Medical Research Council (SAMRC), and ICF. 2017. South Africa Demographic and Health Survey 2016: Key Indicators. Pretoria, South Africa, and Rockville, Maryland, USA: NDoH, Stats SA, SAMRC, and ICF.
Oldewage-Theron, W., & Kruger, R. 2008. Food variety and dietary diversity as indicators of the dietary adequacy and health status of an elderly population in Sharpeville, South Africa. Journal of Nutrition: Elderly, 27(1–2): 101–133.
Ruel, M. 2003. Is dietary diversity an indicator of food security or dietary quality? A review of measurement issues and research needs. Food Nutrition Bulletin, 24(2): 231–2.
Schatzkin, A., Kipnis, V., Carroll, R., Midthune, D., Subar, A., Bingham, S., Schoeller, D., Troiano, R., & Freedman, L. 2003. A comparison of a food frequency questionnaire with a 24-hour recall for use in an epidemiological cohort study: results from the biomarker-based Observing Protein and Energy Nutrition (OPEN) study. International Journal of Epidemiology, 32(6): 1054–1062.
Shim, J., Oh, K., & Kim, H. 2014. Dietary assessment methods in epidemiologic studies. Journal of Epidemiology and Health, 36. Available online from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4154347/. Accessed 15 June 2017.
Statistics South Africa. 2011. Nelson Mandela Bay: Quick Fact- Census 2011. Statistics South Africa. Available online from www.statssa.gov.za/?page_id=1021&id=nelson-mandela-bay-municipality. Accessed 15 June 2017.
Statistics South Africa. 2015. General household survey. Statistics South Africa. Available online from www.statssa.gov.za/publications/P0138/P03182013.pdf. Accessed 15 June 2017.
Steyn N.P. & Ochse, R. 2013. “Enjoy a variety of foods”: as a food-based dietary guideline for South Africa, South African Journal of Clinical Nutrition, 26(3)(Supplement):S13-S17
Subar, A. 2009. Methods of Measuring Usual Dietary Intake for Risk Assessment. PowerPoint Presentation. PDF. Online. Available. presented at the National Cancer Institute, National Institute of Health. Available online from http://www.nationalacademies.org/hmd/~/media/Files/Activity%20Files/Nutrition/NutritionalRiskAssess/Subar.pdf. Accessed on 14 May 2017.
Swindale, A., & Bilinsky, P. 2006. Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide VERSION 2. FANTA: Food And Nutrition Technical Assistance. Available online from https://www.fantaproject.org/sites/default/files/resources/HDDS_v2_Sep06_0.pdf. Accessed on 8 January 2018.
Taruvinga, A., Muchenje, V., & Mushunje, A. 2013. Determinants of rural household dietary diversity: The case of Amatole and Nyandeni districts, South Africa. International Journal of Development and Sustainability, 2(4): 2233–2247.
Vorster, H., & Browne, C. 2001. Development of FBDGs for South Africa: the process. South African Journal of Clinical Nutrition, 14(3), S3–S6.
Vorster, H.H., Kruger, A. & Margetts, B.M. 2011. The Nutrition Transition in Africa: Can It Be Steered into a More Positive Direction? Nutrients, 3, 429-441. Available from http://www.mdpi.com/2072-6643/3/4/429. Accessed on 5 May 2018.
WHO. 2015. Obesity and overweight, Fact Sheet N°311. World Health Organization.

Available online from http://www.who.int/mediacentre/factsheets/fs311/en/. Accessed on 14 May 2017.

Wrieden, W., Peace, H., Armstrong, J., & Barton, K. 2003. A short review of dietary assessment methods used in National and Scottish Research Studies. Foods Standards Agency. Available online from https://www.food.gov.uk/sites/default/files/multimedia/pdfs/scotdietassessmethods.pdf. Accessed on 15 June 2017.