Knowledge of Nutrition and Exercise Diabetes Care Among Patients and their Family Members in Limpopo Province

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Abstract: Inadequate nutrition and exercise diabetes knowledge adds to expanding diabetes prevalence, as well as to poor diabetes control. Involvement of none-diabetic family members in the care of patients improves their knowledge, lead to changes in lifestyle and eventually lessen chances of developing diabetes, despite that they are in danger due family history. This study was aimed at assessing knowledge of patients and family members regarding nutrition and exercise diabetes care. A quantitative, descriptive study design was conducted. 400 participants were used (200 diabetes patients and 200 family members). Multi-sampling was used. Patients were selected using systematic random sampling from clustered clinics, and same patients were used to select family members. Data was collected using 2 close-ended questionnaires (for patients and family members), analysed using SPSS Software v24.0 and using descriptive statistical analysis. Only 45% and 31% of diabetes patients and family members had excellent overall knowledge of nutrition and exercise diabetes-care respectively. Moreover, 81% and 90% of patients and family members respectively know that nutrition is important in diabetes care, while 84% and 85% respectively know that exercise is important in diabetes care. Only 7% and 4% of patients and family members respectively know exercise prescription. The Majority of both patients and their family members had inadequate knowledge regarding nutrition and exercise diabetes-care. Accordingly, patients are in danger of poor diabetic control, while family members at more risk of developing diabetes. Therefore, there is a need to improve knowledge about nutrition and exercise diabetes-care among patients and their family members.

Keywords: Diabetes; Family members, Exercise, Knowledge, Nutrition, Patients

1. Introduction

As per International Diabetes Federation (IDF) (2015:12) prevalence rates of Diabetes Mellitus (DM) is rising globally. In 2013, South Africa (SA) was positioned in the main 5 African countries with higher population of diabetes at 2.6 million and prevalence of diabetes at 9.3% (IDF, 2013:56). In Sub-Saharan Africa, SA has highest prevalence of Type-2 Diabetes Mellitus (T2DM), with 2 million persons diagnosed and more than 1.5 million people with undiagnosed diabetes mellitus (Okonta, Ikombele & Ogunbango, 2014, p.1). Diabetes is the seventh most common cause of death (Statistics South Africa, 2014: 51). The death rate among people living with DM is higher compared with non-diabetes patients, with an excess mortality of 45% announced in 2010 (Lawrie & Good, 2013:451).

Poor nutrition and exercise diabetes care knowledge contributes fundamentally to both increasing diabetes prevalence and poor diabetes control (Spronk *et al*., 2014: 1723). It likewise adds towards complications associated with diabetes and increasing diabetes mortality rate. It likewise adds to ignorance, which contributes to increasing prevalence particularly among those with a family history of diabetes, since heredity is found to significantly contributing to diabetes diagnosis (Scott *et al*., 2013: 2). Poor nutrition and exercise knowledge also normalizes lifestyle which immensely contributes to obesity, which is recognized as one of the main predisposing factors to diabetes (Ganu, Fletcher & Caleb, 2016:13).

However, Ajzen, Joyce, Sheikh *et al*. (2011:116) contended that knowledge is no assurance for healthy behaviour, much as ignorance adds to unhealthy behaviour. Diabetes patients with good knowledge of the disease and its dire complications turn to take appropriate measures to control the disease (Shrivastava, Shrivastava & Ramasamy, 2013:2),

by honoring their medical appointments and adherence to diabetes treatment. Involvement of none-diabetic persons in the care of family member with diabetes, leads to improvement of knowledge on healthy lifestyle; and lessening their chances of being diagnosed (Mayberry, Rothman & Osborn, 2014:133). Adequate nutrition and exercise diabetes care knowledge improves Quality of Life (QoL) of patients which is impacted by mere presence of the disease (Mohammadi *et al*., 2016:52). It also limits risk of comorbidity which essentially impact QoL of patients (Nguyen *et al*., 2019:9).

Nutrition and exercise are the key in diabetes management (WHO, 2016:51). Knowledge deficient in this regard may lead to poor diabetes control and add to the increasing prevalence rates, which threatens health budget. At the point when budget is threatened and strained, the health department will not afford diabetes drugs to give to the public. As a result, it is failing to fulfil its obligation of improving health status of the public. Diabetes drugs improves the health status of patients. Nutrition and exercise diabetes knowledge is the key to prevent complications and curb prevalence rate. Therefore, this study is aimed at determining knowledge of diabetes patients and their family members.

2. Method and Materials

2.1 Design

A quantitative approach, descriptive study design was used. The design was relevant because it enabled the researcher to obtain data from both patients and family members about nutrition and exercise diabetes knowledge.

2.2 Population and Sampling

Population in this study were diabetes patients and their non-diabetic family members. A sum of 400 participants (200 patients and 200 family members) was used. A multi-stage sampling was used. Clinics of Blouberg Municipality in Limpopo Province were clustered according to their areas, and those in excess of 20 patients were included. Sample was calculated using formula of Yamane (1967). Recruitment was done verbally, and those who agreed were selected from each clinic at 55% response rate using systematic random sampling where every second patient was chosen. Family members were selected through sampled diabetes patients.

2.3 Data Collection

Data was collected using two close-ended questionnaires. First questionnaire was for diabetes patients while second questionnaire was for family members. All questionnaires had two sections i.e. demographic-profile and knowledge about nutrition and exercise diabetes care. Twenty-three questions were used to establish knowledge, using a 3-point likert scale: *"Yes, Not Sure, and No*". Pre-validated questionnaire was used.

2.4 Data Analysis

Data was coded and entered into the Statistical Package for Social Sciences (SPSS) version 24.0 for analysis. Scores for knowledge was added and percentages were generated. For the purpose of this study, knowledge was scored on an overall scale of 100% and classified into 4 categories: *poor, fair, good and excellent*. *Poor* knowledge refers to achievement of a total score of between 0-50%, *fair* knowledge 51-60%, *good* knowledge 61-74%, and *excellent* knowledge ≥75%. Descriptive statistics was used.

2.5 Ethical Considerations

This study is essentially part of the bigger study; which was approved by Turfloop Research Ethical Committee (TREC) and allocated clearance certificate number TREC/35/2019: PG. Permission granted by Limpopo Department of Health (DOH) with Ref: LP 201903-007. Operational managers also gave permission to conduct the study. Data was voluntarily obtained from participants who provided written informed consent. Participants were made aware about their rights to withdraw from the study at any stage without penalty. Privacy and confidentiality of participants was ensured through coding of questionnaires.

3. Literature Review

3.1 Nutrition Care

Medical nutrition therapy is essential in diabetes management, prevention and delaying of complications (Evert *et al.,* 2014:s120), It is also an indispensable tool to achieve good glycaemic control, a lipid profile that reduces the risk of CVD, and achieving controlled blood pressure control (Branchi *et al*., 2011:1). Diet quality and quantity

are relevant to the prevention and management of diabetes (Sami *et al*., 2020:1). Nutritional counselling should be sensitive to individual needs (American Diabetes association (ADA), 2008:563). CHO from low Glycemic Index (GI) and high-fibre foods contribute up to 60% of total energy, with improvements in glycemic and lipid control in adults with T2DM (Barnard *et al.,* 2006:1780).

As per van Wyk, Davis and Davies (2016:149), systematic reviews and meta-analyses of controlled trials of CHO-restricted diets for T2DM patients have not shown consistent improvements in HbA1C compared to control diets. Concerning weight reduction, low-CHO diets for T2DM patients have not shown significant advantages for weight loss over the short term (van Wyk, Davis & Davies, 2016:152). Optimum micronutrients can be obtained from healthy diet with an optimal composition of macronutrients and minimally processed food items (Sami *et al.*, 2017:67). However, multivitamin supplementation can be recommended in elderly, pregnant or lactating women (US Department of Agriculture, 2000:293).

3.2 Exercise Care

The remedial impact of exercise differs according to the type of diabetes. Roughly, 80% of T2DM patients are obese and insulin resistant; only 35% require insulin therapy (Colberg *et al*., 2010:e157). Exercise is encouraged in combination with healthy diet and medication, keeping in mind the end goal to accomplish weight control and enhance blood glucose control (Paul, Rheeder & Van Heerden, 2012:453). Regular exercise is an important contributor to overall energy balance, maintenance of blood glucose weight control, and prevention of obesity (Romieu *et al*., 2017:249). The global target of a 10% relative reduction in physical inactivity is therefore strongly associated with the target of halting the risk in diabetes (WHO, 2016: 16). Exercise is contraindicated in the presence of ketones, illness or infection; blood glucose of above 13.8mmol/l and also blood glucose of 4.4 to 5.5 mmol/l because of the threat of hypoglycaemia (ADA, 2016:2071).

3.3 Family Support

Family support in diabetes care is essential and beneficial to health of both patient and family members. Family support may improve QoL of patients (Gasparini *et al.,* 2015:30). Considerable amount of diabetes management happens at household and communities. In caring for diabetes patients, families may redistribute responsibilities and modify daily routines and renegotiate family (Pendley *et al.,* 2002:430). Therefore, it is important to also assess diabetes care knowledge of family members. Patients getting support from spouses adhere to medical treatment (DiMatteo, 2004:207). Benefits to FMs include reduction of psychological distress resulting from not knowing how best to care for loved ones (Sorkin *et al.,* 2013:120). It also lessens the risk of FMs developing diabetes (Baig *et al.,* 2015:90).

3.4 Diabetes Knowledge

Knowledge plays a crucial part in any disease development, prevention and management. Knowledge alone is not sufficient for behaviour change; attitudes, practices are essential (Ajzen *et al.,* 2011:105). Elements of Knowledge, Attitude and Practices (KAP) are interrelated and dependent to one another. In the event one element is higher, the other two factors must be positively affected. KAP regarding diabetes vary substantially and relies on socio-economic conditions, cultural beliefs and habits (Fatema *et al*., 2017:5). Knowledge of diabetes limits chances of comorbidities which worsens QoL of diabetes patients. Knowledge enables people to assess their risk of diabetes, additionally motivate them to seek proper treatment and care, and also inspire them to lead a healthy lifestyle to defeat their disease (Moodley & Rambiritch, 2007:40).

Unwin and Marlin (2004:27) are worried that international knowledge and awareness of diabetes stays low, irrespective of increasing prevalence. There have been hardly any clinical based studies in Bangladesh on diabetes knowledge including patients and none-diabetes individuals as participants (Farzana *et al.,* 2012:2). A South African study reported low diabetes and self-management knowledge among T2DM patients (Okonta, Ikombele & Ogunbanjo, 2014:5).

4. Results and Discussion

4.1 Results of Diabetes Patients

The results are shown in Tables 1 - 3 and Figure 1 on the following pages.

Table 1: Demographic Profile of Participants

Demographic data of participants		Diabetes patients (n=200)	Family members (n=200)
Age	≤50yrs	21 (10,5%)	116(58%)
	51-60yrs	49 (24,5%)	30(15%)
	61-70yrs	75 (37,5%)	36(18%)
	>70yrs	55 (27,5%)	18(9%)
Gender	Male	37 (18,5%)	48(24%)
	Female	163 (81,5%)	152(76%)
Education	Primary or never been to school	162 (81%)	72(36%)
	Secondary or higher	38 (19%)	128(64%)
Marriage	Single	51(25,5%)	108(54%)
	Married	149(74,5%)	92(46%)

Source: Authors

Table 2: Knowledge of Participants Related to Nutrition Diabetes Care

Nutrition diabetes knowledge of participants	Diabetes patients (n=200)			Family members (n=200)		
	Yes	Not sure	No	Yes	Not sure	No
Nutrition plays an important part in diabetes management.	162(81%)	3(1,5%)	35(17,5%)	181(90,5%)	1(0,5%)	18(9%)
Fruits and vegetables must be eaten because they are good in managing blood sugar.	177(88,5%)	1(0,5%)	22(11%)	177(88,5%)	4(2%)	19(9,5%)
It is good for patients to eat small, frequent meals regularly to manage blood sugar.	165(82,5%)	5(2,5%)	30(15%)	162(81%)	4(2%)	34(17%)
Whole-grains high in fiber are recommended as a healthy source of carbohydrate.	159(79,5%)	2(1%)	39(19,5%)	153(76,5%)	5(2,5%)	42(21%)
When overweight and diabetes, it is good to skip meals to lose weight.	*134(76%)*	*11(5,5%)*	*55(27,5%)*	*106(53%)*	*10(5%)*	*84(42%)*
When preparing meat, it is recommended to remove visible fats from red meat, and also to eat chicken without skin.	174(87%)	6(3%)	20(10%)	128(64%)	2(1%)	70(35%)
Eating a large portion size of food at once may lead to increased blood sugar.	163(81,5%)	6(3%)	31(15,5%)	129(64,5%)	3(1,5%)	68(34%)
High fat dairy products including high animal proteins must be avoided.	163(81,5%)	4(2%)	33(16,5%)	118(59%)	5(2,5%)	77(38,5%)
It is good to cut back on salty food including high sodium food such as processed food.	172(86%)	2(1%)	26(13%)	140(70%)	4(2%)	56(28%)
It is good to cut back on sugary food including avoiding added sugar in drinks and food.	177(88,5%)	5(2,5%)	18(9%)	143(71,5%)	6(3%)	51(25,5%)
Fried food and other food high in fats must be avoided.	168(84%)	5(2,5%)	27(13,5%)	147(73,5%)	3(1,5%)	50(25%)

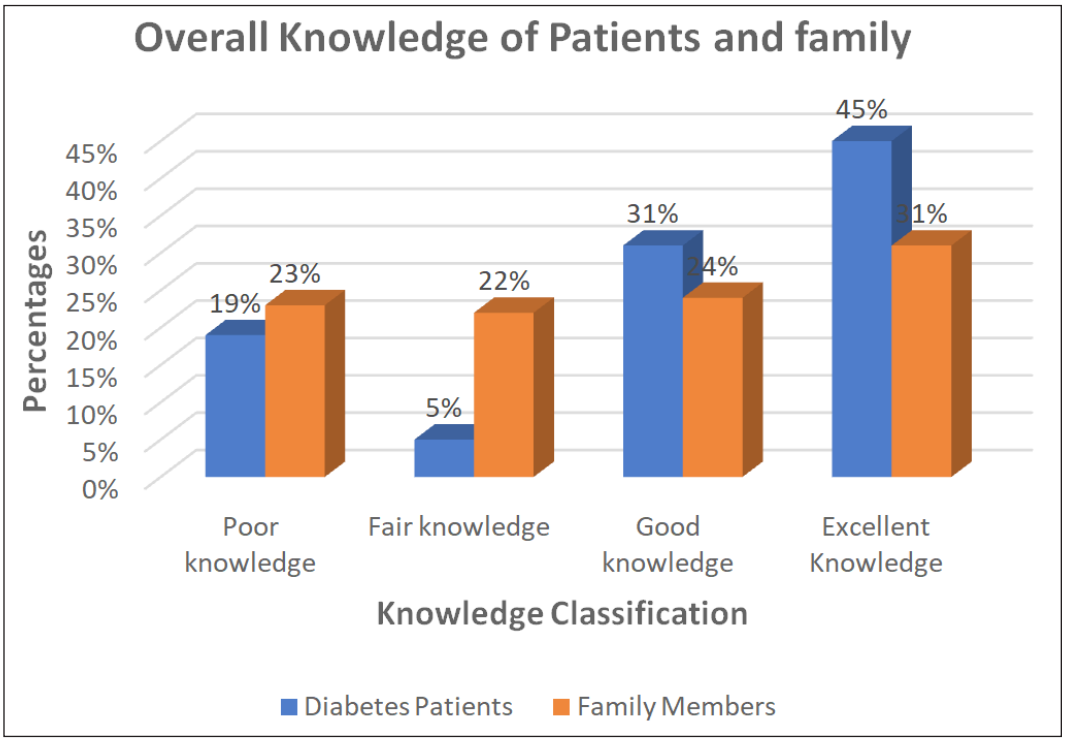
Source: Authors

Table 3: Knowledge of Participants Related to Exercise Diabetes Care

Exercise diabetes knowledge of participants	Diabetes patients (n=200)			Family members (n=200)		
	Yes	Not sure	No	Yes	Not sure	No
Exercise is important in diabetes management and help control blood sugar	168 (84%)	4 (2%)	28 (14%)	170 (85%)	3 (1,5%)	27 (13,5%)
Blood sugar, blood pressure and cholesterol levels stay on track with exercise.	159 (79,5%)	2 (1%)	39 (19,5%)	167 (83,5%)	2 (1%)	31 (15,5%)
Exercising can reduce diabetes-related health problems or complications.	164 (82%)	3 (1,5%)	33 (16,5%)	162 (81%)	6 (3%)	32 (16%)
It is good for patients to stop exercising, in the event of feeling dizziness, shortness of breath and pains	160 (80%)	5 (2,5%)	35 (17,5%)	148 (74%)	5 (2,5%)	47 (23,5%)
When engaging in prolonged exercise, patients should eat before and after exercise, including drinking fast acting carbohydrate drinks during exercise.	152 (76%)	2 (1%)	46 (23%)	151 (75,5%)	3 (1,5%)	46 (23%)
It is recommended for patients to check blood sugar before and after exercise.	151 (75,5%)	5 (2,5%)	44 (22%)	150 (75%)	4 (2%)	46 (23%)
Patient should wait till blood sugar becomes normal after discovering it is high just before exercise.	139 (69,5%)	3 (1,5%)	58 (29%)	135 (67,5%)	10 (5%)	55 (27,5%)
30 minutes, 3 days is recommended minimum amount of exercise that a person with diabetes should get in a week.	*13 (6,5%)*	*10 (5%)*	*177 (88,5%)*	*7 (3,5%)*	*14 (7%)*	*179 (89,5%)*
A diabetes patient on insulin and does running exercises, should not inject themselves on thighs.	*3 (1,5%)*	*10 (5%)*	*187 (93,5%)*	*6 (3%)*	*10 (5%)*	*184 (92%)*
The amount of insulin in the body decreases during exercise.	*54 (27%)*	*15 (7,5%)*	*131 (65,5%)*	*48 (24%)*	*13 (6,5%)*	*139 (69,5%)*
The acceptable blood glucose levels of a diabetes patients is a range of 4-8mmol/L.	*37 (18,5%)*	*10 (5%)*	*153 (76,5%)*	*38 (19%)*	*11 (5,5%)*	*151 (75,5%)*

Source: Authors

Figure 1: Overall Knowledge of Participants



Source: Authors

5. Discussions

Only 45% and 31% of patients and family members in this study had excellent overall nutrition and exercise diabetes care knowledge, respectively. Therefore, this study affirms various studies which indicated diabetes knowledge deficit (Olatona *et al.*, 2019:91; Breen *et al*., 2015:440), despite growing diabetes prevalence (IDF, 2015:12). Participants in this study are at risk of developing diabetes, complications and comorbidity. Therefore, there is an urgent need to strengthen diabetes education particularly with regard to nutrition and exercise care. Nutrition and exercise are extremely important in diabetes care (WHO, 2016:50).

Both diabetes patients (81%) and family members (90,5%) overwhelmingly know that nutrition is important in diabetes care. This gives hope that patients will eat healthy food for better glycemic control (Ronquest-Ross, Vink & Sigge, 2015:1). Additionally, it promises that support patients get from family members will positively influence diabetes outcomes, because adequate nutrition diabetes knowledge of family members is associated with adherence to diabetes treatment and better outcomes (Carman, Dardress, Mauer *et al*., 2013:225). Family members shall too eat healthy meals to avoid developing diseases, since improved knowledge leads to the prevention of diseases. Availability and affordability affect food intake (Campbell *et al*., 2017:1), therefore may prohibit patients and family members with improved knowledge from consuming healthy diet.

An overwhelming majority of both patients (82,5%) and family members (81%) know that it is important for diabetes patients to consume small frequent meals. Food portion control is critical for better glycaemic control (Pedersen, Kang & Kline, 2007:1277). Therefore, this study affirms the need to assess knowledge of FMs regarding self-care and support to diabetes patients (Carman *et al*., 2013:228), considering that patients consume meals prepared by family members. Moreover, results worryingly reveal that two-thirds of patients (66%) and over half of family members (53%) said it is good for overweight patients to skip meals to lose weight. Skipping of meals may lead to hypoglycaemia, which contribute significantly in diabetes mortality (Lawrie & Good, 2013:452). A retrospective cohort study, highlighted that hypoglycaemia is associated with higher mortality rates (Boucai *et al.,* 2011:6).

Our results show overwhelming majority of both patients (84%) and family members (85%) know that exercise is important in diabetes care. Our study differs with an Indian study which highlighted that only 40% of diabetes patients regard regular exercise and weight control as possible treatment options (Benjamin *et al*., 2017:37). Urbanization negatively impact on exercise in rural areas ((Pirgon & Aslan, 2015:165). Democracy in South Africa (SA) brought along changes in lifestyle and abandoning of active lifestyle of walking longer distance. These led to adoption of inactive lifestyle predisposing people to diseases of lifestyle including diabetes. Benefits of regular exercise include improved blood glucose control, lipids, blood pressure and QoL including prevention of T2DM and its complications. It also reduces mortality and cardiovascular diseases among DM patients (Qui *et al*., 2012:1). Adoption of inactive lifestyle robbed South Africans at rural areas of benefiting from advantages of exercise. There is a need for further assessment of factors such as family support and culture which may negatively impact on ability of participants to exercise so as to enable them to reap the benefits of exercise.

The results of our study showed that only 7% and 4% of patients and family members know exercise prescription respectively, which raises concern of improper exercise. During exercise, blood glucose falls prompting decreased secretion of insulin (Yurkewicz *et al*., 2017:59), however, our results showed that 27% and 24% of patients and family members respectively know that insulin decreases during exercise. A study by Yurkewicz *et al*. (2017:61) reported that most studies recommended checking of blood glucose before and after exercise including every 30 minutes during exercise, which is consistent with our study which found that most participants know that it is important for patients to measure blood glucose before and after exercise. Only 19% of participants know glucose readings, which implies that they will proceed to exercise even when glucose is at its lowest or highest, despite associated risks. Therefore, it is important that in strengthening diabetes education, emphasize on glucose readings and dangers of exercising when glucose is at its lowest or highest should be included.

6. Conclusion and Recommendations

Diabetes patients and family members are at risk of complications and comorbidity and developing disease due to inadequate nutrition and exercise

diabetes care knowledge, respectively. In order to improve knowledge of both patients and family members, there is a need to strengthen nutrition and exercise diabetes education. Strengthening of diabetes education should include glucose readings. The study recommends the following:

- Improving knowledge of patients and family members for better diabetes outcomes and minimizing chances of developing diabetes.
- Strengthening of nutrition and exercise diabetes education by incorporating glucose readings for better glycemic control.

7. Limitations of the Study

Participants were only 400 (200 patients and 200 family members) from one sub-district; therefore, it is difficult to generalize that thousands of diabetes patients in Limpopo Province together with their families have insufficient nutrition and exercise diabetes care knowledge.

8. Strengths

The most important strength of this study is the fact that it highlights the need to improve knowledge of patients and family members and also strengthen nutrition and exercise diabetes education.

References

Ajzen, I., Joyce, N., Sheikh, S. *et al.* 2011. Knowledge and the prediction of behavior: The role of information accuracy in the theory of planned behavior. *Basic Appl Soc Psych*. 33(2): 101-117.

Baig, A.A., Benitez, A., Quinn, M.T. & Burnet, D.L. 2015. Family interventions to improve diabetes outcomes for adults. *Annals of the New York Academy of Sciences,* 1353(1):89-112. Available in PMC 2016 September 01.

Benjamin, B.B., Patel, P.P., Iyer, G.S., Gandhi, A. & Dikshit, R.K. 2017. Knowledge, attitude and practice about diabetes and its treatment in patients attending the speciality clinic. *Int. Res. J. Pharm*. 8(6):35-38. Available at: http://dx.doi.org/10.7897/2230-8407.08693.

Branchi, A., Torri, A., Berra, C., Colombo, E. & Sommariva, D. 2012. Changes in Serum Lipids and Blood Glucose in Non Diabetic Patients with Metabolic Syndrome after Mixed Meals of Different Composition. *Journal of Nutrition and Metabolism,* 1-8.

Breen, C., Ryan, M., Gibney, M.J. & O'Shea, D. 2015. Diabetes-related nutrition knowledge and dietary intake among adults with type 2 diabetes. *Br. J. Nutr.* 114:439-447.

Campbell, D.J.T., Manns, B.J., Weaver, R.G., Hemmelgarn, B.R., King-Shier, K.M. & Sanmartin, C. 2017. Financial barriers and adverse clinical outcomes among patients with cardiovascular-related chronic diseases: a cohort study. *BMC Medicine*, 15(33):1-13.

Carman, K.L., Dardess, P., Maurer, M. *et al.* 2013. Patient and family engagement: A framework for understanding the elements and developing interventions and policies. *Health Affirmation (Millwood) [Internet]. Project HOPE – The People-to-People Health Foundation, Inc.,* 32(2):223-31. Available at: http://www.ncbi.nlm.nih.gov/pubmed/23381514.

Colberg, S., Sigal, R.J., Fernhall, B.O., Rubin, R.R., Chasan-Taber, L., Albright, A.L. & Braun, B. 2010. Exercise and Type 2 Diabetes. The American College of Sports Medicine and the American Diabetes Association: Joint position statement. *Diabetes care*, (33):e147-167.

DiMatteo, M.R. 2004. Social Support and Patient Adherence to Medical Treatment: A Meta-Analysis. *American Psychological Association*, 23(2):207-218.

Evert, A.B., Boucher, J.L., Cypress, M. *et al.* 2014. Nutrition therapy recommendations for the management of adults with diabetes. *Diabetes Care*. 37(1):S120-143.

Farzana, S., Mumu, S.J., Ferdous, A., Begum, H.A. & Ali, L. 2012. Knowledge and self-care practices regarding diabetes among newly diagnosed type 2 diabetics in Bangladesh: A cross-sectional study. *BMC Public Health,* 12(1112):1-8.

Fatema, K., Hossain, S., Natasha, K., Chowdhury, H.A., Akter, J., Khan, T. & Ali, L. 2017. Knowledge attitude and practice regarding diabetes mellitus among Nondiabetic and diabetic study participants in Bangladesh. *BMC Public Health*, 17(1):364-378. Available at: https://doi.org/10.1186/s12889-017-4285-9.

Ganu, D., Fletcher, N. & Caleb, N.K. 2016. Physical disability and functional impairment resulting from type 2 diabetes in sub-Saharan Africa: A systematic review. *African Journal of Diabetes Medicine*. 24(1):10-14.

Gasparini, R., Champagne, M., Stephany, A., Hudson, J. & Fuchs, M.A. 2015. Policy to practice: increased family presence and the impact on patient- and family-centred care adoption. *Journal of Nursing Administration.* 45(1):28-34.

International Diabetes Federation. 2013. *IDF Diabetes Atlas*. Fifth Edition. Brussels, IDF.

International Diabetes Federation. 2015. *IDF Diabetes Atlas*. Seventh Edition. Brussels, IDF.

Lawrie, M. & Good, A. 2013. Increasing pathology utilization lies behind increasing pathology costs. *South African Medical Journal*; 103(7):451-452.

Mayberry, L.S., Rothman, R.L. & Osborn, C.Y. 2014. Family members' obstructive behaviors appear to be more harmful among adults with type 2 diabetes and limited health literacy. *Journal of health communication*. 19(2):132-143.

Mohammadi, S., Karim, N.A., Talib, R.A. & Amani, R. Evaluation of quality of life among type 2 diabetes patients. *Int J Community Med Public Health,* 2016:3:51-6.

Moodley, L.M. & Rambiritch, V. 2007. An assessment of level of knowledge about diabetes mellitus among diabetic patients in primary healthcare setting. *South African Family Practice,* 49(10):16-49.

Nguyen, V.H., Tran, T.T., Nguyen, C.T. *et al.* 2019. Impact of Comorbid Chronic Conditions to Quality of Life among Elderly Patients with Diabetes Mellitus in Vietnam. *Int. J. Environ. Res. Public Health,* (16)531:1-11.

Okonta, H.I., Ikombele, J.B. & Ogunbanjo, G.A. 2014. Knowledge, attitude and practice regarding lifestyle modification in Type 2 diabetic patients: original research. *African Primary Health-care and Family Medicine*, 6(1):1-6.

Olantona, F.A., Airede, C.A., Aderibigbe, S.A. & Osibogun, A. 2019. Nutritional Knowledge, Dietary Habits and Nutritional Status of Diabetic Patients Attending Teaching Hospitals in Lagos, Nigeria. *Journal of Community Medicine and Primary Health Care,* 31(2):90-103.

Paul, Y., Rheeder, P. & Van Heerden, J. 2012. Physical activity: One of the cornerstones in the management of type 2 diabetes mellitus. *African Journal for Physical, Health Education, Recreation and Dance (AJPHERD),* 1(2):444-459.

Pedersen, S.D., Kang, J. & Kline, G.A. 2007. Portion Control Plate for Weight Loss in Obese Patients with Type 2 Diabetes Mellitus. A Controlled Clinical Trial. *Archives of Internal Medicine*, 167:1277-1283.

Pendley, J. & Kasmen, L. 2002. Peer and family support in children and adolescents with type 1 diabetes. *Journal of Paediatric Psychology,* 27:429-438.

Pirgon, O. & Aslan, N. 2015. The Role of Urbanization in Childhood Obesity. *Journal of Clinical Research Paediatrics and Endocrinology*, 7(3):163-167.

Qui, S.H., Sun, Z.L., Cai, X., Liu, L. & Yang, B. 2012. *Improving patients' adherence to physical activity in diabetes mellitus.* Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3283821/. Accessed 14 February 2013.

Romieu, I., Dossus, L., Barquera, S. *et al*. 2017. Energy balance and obesity: What are the main drivers? *Cancer Causes Control*, 28:247-258.

Ronquest-Ross, L-C., Vink, N. & Sigge, G.O. Food consumption changes in South Africa since 1994. *S Afr J Sci*, 2015: 111(9/10):1-12.

Sami, W., Alabdulwahhab, K.M., Ab Hamid, M.R. & Alasbali, T.A. 2020. Dietary Knowledge among Adults with Type 2 Diabetes-Kingdom of Saudi Arabia. *International Journal of Environmental Research. Public Health. Int. J. Environ. Res. Public Health*, 17(858):1-8.

Sami, W., Ansari, T., Butt, N.S. & Ab Hamid, M.R. 2017. Effect of diet on type 2 diabetes mellitus: A review. *International Journal of Health Sciences*, 11(2):65-71.

Scott, R.A., Langenberg, C., Sharp, S.J. *et al*. 2013. The link between Family History and risk of Type 2 Diabetes is Not Explained by Anthropometric, Lifestyle or Genetic Risk Factors: the EPIC-InterAct Study. *Diabetologia*, 56(1):60-69.

Shrivastava, S.R., Shrivastava, P.S. & Ramasamy, J. 2013. Role of Self-Care in Management of Diabetes Mellitus. *Journal of Diabetes & Metabolic Disorders*, 12(14):1-5.

Spronk, I., Kullen, C., Burdon, C. & O'Connor, H. 2014. Relationship between nutrition knowledge and dietary intake. *Br. J. Nutr,* 111:1713-1726.

Statistics South Africa. 2014. Patterns of morbidity and mortality in older persons in South Africa, 2013. 1-55. Available at: http://www.statssa.gov.za. Accessed 19 September 2015.

United States (US) Department of Agriculture and Department of Health and Human Services. 2000. *Nutrition and Your Health: Dietary Guidelines for Americans.* 5th ed. Home and Garden Bulletin No. 232.

Unwin, N. & Marlin, A. 2004. Diabetes Action Now: World Health Organization and International Diabetes Federation working together to raise awareness world-wide. *Diabetes Voice,* 49(2):27-31.

van Wyk, H.J., Davis, R.E. & Davies, J.S. 2016. A critical review of low-carbohydrate diets in people with type 2 diabetes. *Diabetes Medicine*, 33:148-157.

Yamane, Taro. 1967. Statistics, An Introductory Analysis, 2nd Ed., New York: Harper and Row.

Yurkewicz, M., Cordas Jr, M., Zellers, A. & Sweger, M. 2017. Diabetes and Sports: Managing Your Athlete with Type 1 Diabetes. *American Journal of Lifestyle Medicine,* 11(1):58-63.