

Medication Adherence of Older Adults with Diabetes Mellitus Type II

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Abstract

Older people with diabetes mellitus type II are more likely to develop hyperosmolar non-ketotic coma and have worst outcomes, like higher mortality than middle-aged people with diabetes mellitus type II. To prevent and control diabetes mellitus type II and complications for older adults by decreasing HbA1c and increase medication adherence and self-care behavior. Older adults who are unfunctional of their cognitive impact because of the process of ageing impaired cognitive behavior. To review the evidences of medication adherence in older adults with type II Diabetes Mellitus. The selection process of the articles have been done by using this data based provided by Prince of Songkla University. The data base was selected for this study are Cinahl, Proquest, Science Direct, and PubMed. By using this data base the search terms according to PICO a total of eighty (80) have been found. From the overall thirtieth (30) relevant articles closely related to this study. Five studies were reviewed with two types of interventions for medication adherence in older adult patients: Patient education (teaching), and nurse telephone call intervention. The result from this five studies the intervention successfully improved medication adherence in older adults patients. Diabetes mellitus is one of the most world wide prevalent of chronic disease, where it increasing globally to such a high levels. The management of lower blood glucose level is depend on many factors, including the management of diabetes mellitus in patient's health education in knowledge, and practice on medication adherence. Patient's ability to do self-care in their daily lives, and therefore patients education in knowledge, attitude, and practice on medication adherence is considered an essential element of diabetes management. Patient's education and knowledge is an important component in management of diabetes in medication adherence.

Keywords: Medication adherence, type II diabetes, older adults

I. INTRODUCTION

D diabetes mellitus is an endocrine disorder, characterized by hyperglycemia that caused high blood sugar levels (Rahman, Basunia, Khan, & Nag, 2005). Diabetes is a common and serious problem and it occurs all around the world. Diabetes can occur in men, women and all age of groups. The world prevalence of diabetes among adults to elderly (aged 20–79 years) is estimated to be 6.4% in 2010 and will increase to 7.7% by the year 2030 (Shaw, 2010). In Indonesia, the prevalence of diabetes mellitus was about 8.4 million in 2000 and is projected to increase up to 21.3 million in 2030 (Widjojo, 2011). The World Health Organization (WHO) has predicted that the worldwide prevalence of diabetes mellitus will increase to 300 million by the year 2025 (Pradeepa, 2002). The prevalence of diabetes in older adults is high in US, 29 % of people > 65 years old are diagnosed with diabetes mellitus (National diabetes fact sheet, 2011). As United States population ages and the rate

of individual who are overweight of obesity continue to rise, both the prevalence and burden of diabetes in the elderly is expected to increase substantially over the next decades (Imperatore, Boyle, Thompson, Case, Dabelea, Hamman & Standiford, 2012).

The American Diabetes Association (ADA) recommends that glycemic goals for elderly patients with diabetes should be individualized, based on the presence or absence of cognitive impairment, functional impairment, major comorbidities and limited life expectancy (Inzucchi, et al, 2012). However elderly people who tend to be less obese and are more likely to have significantly impaired insulin than people with middle-aged type II diabetes mellitus (Morley & Perry, 1991). Furthermore, ageing appears to interact with hyperglycemia to accelerate the onset of late diabetes complications, such as retinopathy and nephropathy, with their onset occurring within 5 years of diagnosis of diabetes. Older people with diabetes mellitus type II are more likely to develop hyperosmolar non-ketotic coma and have worst outcomes, like higher mortality than

middle-aged people with diabetes mellitus type II. There are several evidence have been proven that a good control of glucose will have a good quality of life (Morley, 1998).

The medical management of elderly adults with diabetes type II is challenging due to several factors such as elderly adults are more likely to have diabetes that is complicated by end-organ damage and in general, long duration of disease is associated with defective glucose counter-regulation leading to increased risk of hypoglycemia (Chiang, Kirkman, Laffel & Peters, 2014). Therefore there are many interventions programs to prevent and control diabetes mellitus type II and complications for elderly people by decreasing HbA1c by doing a good lifestyle such as using delivery meals and dietary counseling to reduce body weight, exercise to reduce the proportion of metabolic syndrome, and using diabetes empowerment to increase medication adherence and self-care behavior (Saengtipbovorn & Taneepanichskul, 2014). The maintenance of lower blood glucose level is depend on many factors, including the intervention programs of diabetes mellitus type II. The management of diabetes mellitus depends on patients ability to do self-care on medication adherence in their daily lives and considered medication adherence as an essential elements of diabetes management (AlMaskari, 2013). Medication Adherence is defined as a terms of person's behavior in taking medications, following diets, or changing lifestyle with medical or health device (Morisky, Green, & Levine, 1986) and has extent to which patients take medications as prescribed by their healthcare providers (Jimmy, Al-Hinai, Wadair & Al-Amri, 2014). Low of medication adherence has become a key health care issue as it greatly effects the benefits of medical care and improves a significant financial burden on the individual patient and health care system as a whole (Mahesh & Parthasarathi, 2004). The medication knowledge consisted of five spesific items of information regarding the patient's medications: name, dose, frequency, indication, and how the patient administered the medications which elderly people with diabetes mellitus type II should know and understand about the five spesific items of information (Krousel-Wood, Thomas, Muntner & Morisky, 2004).

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must receive diabetes care and the most problem in dealing with older adults is they tend to forget to take medication that are recommended by the health providers that is because of the process of ageing impaired cognitive behavior (Mahesh & Parthasarathi, 2004). For this problem the researcher want to know what is the best intervention for this problem, so the older adult able to consumed medication regularly and they can have a good quality of life.

METHOD

Review of the literature involved ProQuest, CINAHL, Pubmed, and Science searched for relevant articles published through the year 1997-2014

All the clinical trials are randomized control trials, experiment study, and quasi experiment, review articles were eligible according to the inclusion criteria. The articles for full text was also indentified. The relevant articles were graded by using of recommendation based on JBI, 2014.

RESULTS

The selection process of the articles have been done by using this data based provided by Prince of Songkla University. The data base was selected for this study are Cinanhl, Proquest, Science Direct, and PubMed. By using this data base the search terms according to PICO a total of eighty (80) have been found. The selection proses was done by re-read the abstract of each articles to make sure the articles meet with the inclusion criteria of this study.

From the Cinanhl data base, a total of thirtieth (30) articles were found. After re-read the abstract and skimming the whole articles, only ten articles were found related to this study. From tweenty articles was found by using the proQuest data base, only twenty (20) were found, only ten (10) articles was relevant to this study. The searching articles using Science Direct database, only ten (10) articles was found and only five (5) articles are related to this study. While from PubMed, a number of ten (10) artcils were found, related to this study only five (5) articles.

The articles that are relevant to this study was re-read and analyse carefully to synthesize the methodology. From the overall thirtieth (30) relevant articles closely related

to this study.

Concept of Medication Adherence

Adherence is defined as the extent in which the patients follow the instructions of the health care providers in practice and the desired of health behaviors that will achieve agreement between the health care providers and patients. Adherence focusses on the participants behavior of following the recommendation in order to produce an optimal outcome (Osterberg & Blaschke, 2005).

Medication adherence is the continuous of administering medicine from the first dose to the last dose without stopping drinking any medication beside the health care providers tells the patient to stop drinking the medicine or there is a agreement between the health care provider and patients (Haynes, Yao, Degani, Kripalani & McDonald, 2005).

Medication adherence for the older adults with diabetes mellitus type II can be classified into four components such as (1) voluntary willingness, (2) active participation, (3) persistence in following prescription and (4) continuity duration of the therapy

(Novityani, 2013).

Voluntary willingness refers the agreement of the patients in consuming medicines as recommended by the health care providers. It also the patients role for agreeing to consume medicine after the patients understands the required information about mechanism, side effect, dosis, and frequency of the medicine they consumed (Cohen, 2009). Active participants is the patients behaviors in responsible consume medicine and they are expected to prepare their own medicine, keep them in a proper place, remember the dose and the timing in drinking medicine, and remember the next appointment with the health providers (Novityani, 2013). Persistence indicates the patients prescription of taking medicines as prescribed by the health provider with the correct type of medicine, correct dose, and correct frequency, and at the right time. Continuity in medication adherence refers to the medicine until the last dose as describe by the health providers with out missing any medicine (Novityani, 2013).

Associated Factors Demographic factors

Demographic factors is one factors associated with medication adherence.

Demographic factors such as ethnic minority, age, gender, race, low socioeconomic status, and low levels of education have been associated with lower regimen adherence and greater diabetes-related morbidity (Delamater, Jacobson, Anderson, Fisher, Lustman, Rubin & Wysocki, 2001; Balkrishnan, Bhosle, Camacho & Anderson, 2006; Peyrot, Rubin, Lauritzen, Snoek, Matthews & Skovlund).

The effect of age on medication it would appear to the effect of age could be divided into 3 major groups: the elderly group (over 55 years old), the middle- age group (20 to 54 years old), and the young group (under 40 years old) (Jin, Sklar & Li, 2008). Certain studies reported that age affected medication adherence among older adults because of problems with visions, hearing, memory and have more difficulties in following instructions due to cognitive impairment or other physical difficulties, such as problems with swallowing tablets, opening the drug containers, distinguish colors, and identifying markings on drugs (Balkrishnan, Bole, Camacho & Anderson, 2006).

Another study also had found that gender has not been found to influence medication adherence on adherence to oral anti-diabetic medications (Peyrot, Rubin, Lauritzen, Snoek, Matthews & Skovlund 1999).

Psychological factors

Psychological factors are also linked with regimen adherence because of patient's beliefs, motivation, and negative attitude towards therapy (Jin, Sklar & Li, 2008)). Another researcher has also found Peyrot, Mchurry & Kruger, (1999) that patients with a good adherence will make sense to them, when it seems effective, when they believe the benefits exceed the costs, when they feel that they have the ability to succeed, and when their environment supports. Higher levels of stress and maladaptive coping have been associated with more adherence problems. Psychological problems such as anxiety, and depression have also been linked with worse diabetes management in older adults with diabetes mellitus (Peyrot, Mchurry & Kruger, 1999).

Social factors

Social factors play an important role in diabetes management, because patients who had emotional support and help from the family members, friends, or even health care providers were more adherence to the

treatment (Delameter Jacobson, Anderson, Cox, Fisher, Lustman, Rubin, Wysocki, 2001; Nagelkerk, Reick & Meengs, 2006). Social support may help patients in reducing negative attitudes to the treatment, giving patients motivation and remembering the patients to follow all treatment (Jin, Sklar & Li, 2008).

Health care system factors

The main factor relating to health care provider include availability and accessibility lack of accessibility to health care, long waiting time for clinic visits, and unhappy clinic visits all of these contribute to poor adherence (Jin, Sklar & Li, 2008). It was observed that the diabetes control and complications one of the key elements to success in achieving good glycemic control was supported the health care provider. In addition the ability to obtain support from the care team members, the quality of the patient-doctor relationship is very important determinant of regimen adherence (Auber et al, 2002). Disease and treatment related factors

Research has generally shown that lower regimen adherence can happen when health condition is chronic, when the course of symptoms varies or when a regimen is more complex, and when a treatment regimen requires lifestyle changes (Jin, Sklar & Li, 2008).

Treatment related factor associated with non-adherence in the management of type II diabetes include the number of medications (Pill burden), side effects, dosage, frequency, and the cost. While it is generally believed that diabetic patients who take multiple medications are less adherent to their diabetic regimens, the literature has conflicting information (Mahesh, 2004).

Knowledge factors

Patients knowledge about their disease and treatment is an important factor to control medication adherence (Xu, Tolbert, Savage, Pan, & Whiter, 2008; Omar & San, (2014). Some patients lack of understanding the role of the treatment, others lack of understanding the value of clinical visit (Jin, Sklar & Li, 2008). For these reasons patient's education is important to enhance medication adherence, and a good knowledge is one of the sources of self-efficacy to self-management of dietary

behaviors (Xu, Tolbert, Savage, Pan, & Whiter, 2008). Another study from Omar & San, (2014) have found that the knowledge the patient need is related to obedience in consuming medicine in the right time and right dose without missing any medication. The knowledge of the patients in consuming medicine, and have a good lifestyle would faster the strategies ability of patients to medication adherence.

Measurement of Medication Adherence

Medication adherence influenced by much different kind of factors it is measurement is often unreliable, costly or time consuming. There are three main methods of measuring medication adherence. These include clinical self-report (Questionnaire), pill counts, and Morisky Medication Adherence Scale (MMAS) (Thompson, Kulkarni & Sergejew, 2000).

Self-reporting

Methods for patients self-reporting include: (1) patients-kept diaries (2) patients interview, with specific questions regarding the accuracy of medication adherence (3) standard, validated, adherence specific questionnaire. (Farmer, 1999).

The instrument has three sets of questions: four regimen screen items: two belief screen items; and two recall screen items. For regimen screen items, each medication list consist of four questions: "How many days did you take it?", "How many times per day did you take it?", "how many pills did you take a day?" how many times did you miss taking a pill?". Belief screen consist of two questions: "How well does this medication work for you?" "This medication work for you" Recall screen, consist of one questions: "How hard is it for you to remember to take all the pills?" (Svarstad, Chewing, Sleath, & Claesson, 1999).

Pill counts

A pill count is simply counting the number of dosage units like tablets, and capsule. This provides the amount of medication used by the patient during this time. The amount used divided by the expected amount and multiplied by 100 to determine the percentage of compliance. For instance, a patient returns 12 tablets 30 days after receiving 60 tablets. The medication taken twice daily; therefore, 60 units should be consumed over a 30-day period. The compliance ratio is then calculated

as $(60 - 12) / 60 \times 100 = 80\%$. Another method for measuring. The use of pill counts to assess adherence also has other informational drawbacks. Even when accurate, pill counts can only document adherence as a percentage of total consumption. They cannot provide information regarding the nature of the adherence problem (the pattern of missed doses) or the reasons for the problem (side effects) (Farmer, 1999).

Morisky Medication Adherence Scales (MMAS)

MMAS is the subjective method of adherence assessment tool in patients with diabetes which is developed by Morisky in 1986. It is a multi-item scale consisting of 4 items that measure medication nonadherence due to 4 patient-related barriers such as forgetfulness, carelessness, feeling better and feeling worse but the reliability of this tool was low with Cronbach's alpha of .61. The tool was modified by Krousel Wood et al. in 2009.

This modified version of MMAS consists of 8 items assessing the behavior of medication taking rather than the factors affecting adherence. The seven items in the questionnaire have replies in the dichotomous form of 'yes' or 'no' and one of the items (how often do you have difficulty to remember to take medicines) is rated on a 5-point Likert type scale. The total score that can be obtained from the tool is 12 and the lowest score is 1. Higher the score it can be assumed that better is the adherence to medication. Further, the scores are categorized with 3 cut points to interpret 3 levels of adherence such as low adherence (less than 6), medium adherence (6 to 8) and high adherence (more than 8). The Cronbach's alpha was determined to be .83 for the new tool which is much better than the original one (Krousel-Wood et al., 2009).

Intervention to improve medication adherence

In order to achieve the desired goals of therapy in the management of patients presenting with type 2 diabetes, considerable attention must be given towards improving individual patient's adherence to his/her prescribed medications. Five studies were reviewed with two types of interventions: Patient education (teaching), and nurse telephone call intervention (Davies, Heller, Skinner, Campbell, Carey, Cradock &

Khunti, 2008; Zullig, Gellad, Moaddeb, Crowley, Shrank, Granger & Bosworth, 2015; Tessier & Lassmann-Vague, 2007; Osterberg & Blashacke, 2005; Kim & Oh, 2003; Alisha, Asgari, Khayeri, Ramazani, Farajzadegan, & Javaheri, 2013).

Patient education

Patient education can be used to improve the adherence. The educational intervention involving patients, their family members, or both can be effective in improving adherence (Osterberg & Blashacke, 2005).

The study done by (Davies, Heller, Skinner, Campbell, Carey, Cradock & Khunti, 2008). This study focused on the effectiveness of group education programme in older adult patients with type diabetes mellitus type II. The samples were 834 older adults. The intervention of patients education will be held for six hours long delivered in either one day or two half day equivalent and facilitated by two educators. The session which covers the patients thoughts and feeling of the disease of diabetes, Understanding diabetes and glucose: what really happens in the body, Understanding more about the importance of medication for diabetes and about how to monitor diabetes, and how to have a good lifestyle, and also discussion; asking questions, showing video about diabetes mellitus, and practicing with patient about consuming medication. (Davies, Heller, Skinner, Campbell, Carey, Cradock & Khunti, 2008). And the researcher would follow-up every 2 weeks and this program will last for 3 months. The result of this patient education Patients in the intervention group had a mean decrease of in HbA1c levels and those in the control group had a mean increase of in HbA1c levels. The intervention group had greater diet and blood glucose testing adherence than the control group. These findings indicate that the nurse intervention can improve HbA1c and diet and blood glucose testing adherence. This means that the intervention improved the medication adherence.

The study done by Zullig, Gellad, Moaddeb, Crowley, Shrank, Granger & Bosworth, (2015) conducted the information of education improving medication adherence for older adults. The intervention, a community health nurse conducted three

weekly 20-minute educational sessions. The interventionist used “teach back” to confirm the patient’s understanding. For example, “When you get home and your [partner] asks what the [doctor] said today, what will you tell them?” Patients in the pictorial image group were given the educational content via simple illustrated content. At the conclusion of the 3week study the mean scores for knowledge, adherence to medication (measured using the 8-item Morisky Medication Adherence Scale), and diet were significantly improved in the intervention relative to the control groups; these differences persisted 6 weeks after the intervention.

The result from this study the intervention successfully improved medication adherence, which was evaluated using pharmacy refill data to calculate a medication possession ratio. For the intervention group, at 6 months medication possession ratio had improved from 0.90 to 0.92 ($P=0.16$) and at 12 months from 0.85 to 0.90 ($P<0.01$).

Another study by Tessier & LassmannVague, (2007) about patient education is the key aspect of diabetes mellitus management in older adult. Perceptions of the patient, the participants of the caregivers, giving motivations of both, adapted teaching strategies, are the elements where education will improve the diabetes mellitus control. A collaborative approach to care patients who have difficulty with adherence need more intensive strategies than the patient who have less difficulty with adherence. New technologies such as reminders through cell phones or email may be used by the patient if they need any help to remind them about consuming medicine in the right time and living a healthy lifestyle (Osterberg & Blashacke, 2005).

Nurse telephone calls

The study done by Kim & Oh, (2003) focussed in the effect of nurse telephone calls on glycosylated hemoglobin (HbA1c) levels and adherence to diabetes control recommendations. The participants in the control group were sixtteen people and for the experimental group were 20 people so the total participants are 36 people. The goal of the intervention was to keep blood glucose concentrations close to the normal range ($HbA1c < 7\%$). Before the intervention was given, the researcher given the patients a booklet and a daily log. Each patient was instructed about the booklet and daily log for

40 minuets by the researcher. The booklet was 49 pages in length and was given without cost to the intervention group. It was contained infomation about the nature of disease, risk factors, diet, exercise, drug therapy, hypoglycemia, hyperglycemia management, and how to record a daily log. The telephone intervention was provided to the patients for 12 weeks. The 12 week intervention consisted of continuing education and reinforcement medication adjustment recommendations, and living an health lifestyle. The researcher contracted intervention at least twice a week for the first month, and then weekly for the second and third month. The frequency of telephone cells averaged 16 times for each patients and the duration for each session was an average 25 minuets. The call were scheduled when convenient to the patient.

In this study the researcher has found that Patients in the intervention group had a mean decrease in HbA1c levels and those in the control group had a mean increase of in HbA1c levels. The intervention group had greater diet and blood glucose testing adherence than the control group. The researcher conclude that a nurse telephone intervention can improve HbA1c, diet and blood glucose testing adherence, and medication adherence.

Another study by Alisha, Asgari, Khayeri, Ramazani, Farajzadegan, & Javaheri, (2013) focused on effects of diabetes self-care group education and nurse- telephone follow-up on glycemic control and compliance with treatment orders in patients with type 2 diabetes attending to diabetes clinic. There was 62 patients who attended he diabetes clinic selected and were randomly assigned to experiment and control groups. Self-care group education was applied for case group ($n = 31$) and they were followed up using telephone calls for 12 weeks by a nurse. The control group ($n = 31$) received the conventional management. Demographic characteristics, compliance with treatment recommendations (diet, drug use, exercise) and blood glucose control indices were recorded before and after interventions.

In this study, group education and nursetelephone follow-up calls were as independent variables, and fasting blood sugar (FBS), blood glucose 2 h after meals, glycosylated hemoglobin (HbA1C) and the patient's adherence to treatment programs and For data gathering there are two parts

questionnaire was used derived from Cheri Ann Hernandez study. This questionnaire was made of individual and socio demographic information section and 13 questions about adherence to treatment recommendations. Response to questions were classified as Likert spectrum consist of always (all of week), often (4-5 days a week), sometimes (at least three days a week) rarely (1-2 days a week) and never (not once a week). The results of this study of the current study self-care group education and 12 weeks follow-up by a nurse using telephone causes significant improvement in metabolic parameters and adherence to treatment recommendations in diabetic patients and in medication adherence.

Conclusion and Recommendations

Diabetes mellitus type II is characterized as a hyperglycemia due to insulin resistance. Diabetes mellitus type II very common among older adults people and the group that has rate of poor glycemic control (Marianas & Kong, 2014). The main problem of hyperglycemia among older adults people is the maintenance of lower of blood glucose level and it depends on many factors including management of diabetes mellitus, and practice on medication adherence (Henriquez, Costa & Cabrita, 2012).

Medication adherence is a behavior of a person in terms of taking medications according to agreed recommendations from a health care provider. Adherence to medication are influenced by several factors such as such as group that are accentuated, demographic factors, psychological factors, social factors, health care provider, disease and treatment related factors, and knowledge factors. These factor when trying to help older people to manage their medication regimen and increase adherence with the instruction given, should be identified and understood as early as possible to be controlled and monitor, in formulating strategies to ensure high adherence rate (Henriques, Costa & Cabrita, 2012). Several researcher has found that older people who are educated was found higher score than does who has low education even though they are older adults. The success in diabetes mellitus type II management requires patient participants must be unsure to receive adequate education. The insulin injection technique is very important for improvement of glycemic control among diabetes mellitus type II patients subsequently increased the treatment effectiveness of the patient's

medication adherence. The effectiveness of education intervention has demonstrated to increase knowledge adherence among older adult patients is patients education level (Omar & San, 2014). In addition, there are several tools to assess the medication adherence such as; self-report (Questionnaire), pill counts, and Morisky Medication Adherence Scale (MMAS). These tools can be used to measure medication adherence for diabetes mellitus type II in older adult (Thompson, Kulkarni & Sergejew, 2000).

Diabetes mellitus is one of the most world wild prevalent of chronic disease, where it increasing globally to such a high levels. The management of lower blood glucose level is depend on many factors, including the management of diabetes mellitus in patient's health education in knowledge, and practice on medication adherence. Patient's ability to do self-care in their daily lives, and therefore patients education in knowledge, attitude, and practice on medication adherence is considered an essential element of diabetes management. Patient's education and knowledge is an important component in management of diabetes in medication adherence.

For the recommendationns, the reasechers has limmitation in finding the intervention for medication adhrence in older adults, for the further must find more studies about the interventions for medication adhrence. And need more evidence to prove education program and telephone calls has improve the medication adherence.

Most of this study is quasi experimental, it will be better for the next study to find more evidence in a higher level of evidence such as RCT systematic review (level Ia, JBI 2014).

REFERENCES

- Achieng, L., Musangi, H., Billingsley, K., Onguit, S., Ombegoh, E., Bryant, L., ... & Keiser, P. (2013). The use of pill counts as a facilitator of adherence with antiretroviral therapy in resource limited settings. *PloS One*, 8(12), e67259.
- Ahmad, N. S., Ramli, A., Islahudin, F., & Paraidathathu, T. (2013). Medication adherence in patients with type 2 diabetes mellitus treated at primary health clinics in Malaysia. *Patient preference and adherence*, 7, 525.
- Alberti, K., & Zimmet, P. F. (1998).

- Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: diagnosis and classification of diabetes mellitus provisional report of a WHO consultation. *Diabetic medicine*, 15: 53953.
- Al-Maskari, F., El-Sadig, M., Al-Kaabi, J. M., Afandi, B., Nagelkerke, N., & Yeats, K. B. (2013). Knowledge, attitude and practices of diabetic patients in the United Arab Emirates. *Plops one*, 8(1), e52857.
- Al-Sultan FA, Al-Zanki N. (2001). Clinical Epidemiology of Type 2 Diabetes Mellitus in Kuwait. *Am Fam Physician*, 63:1747-1756.
- American Diabetes Association (ADA). Physical activity/exercise and diabetes. *Diabetes Care* 27(Suppl. 1): S58–62, 2004b.
- American Diabetes Association. (1999). Position Statement. Nutrition recommendations and principles for people with diabetes mellitus. *Diabetes Care* 20(1S)14-7.
- ADA. (2008). Nutritional recommendations and interventions for diabetes: A position statement of the American Diabetes Association. *Diabetes Care*, 32(2), S13S61.
- Ahmad, N. S., Ramli, A., Islahudin, F., & Paraidathathu, T. (2013). Medication adherence in patients with type 2 diabetes mellitus treated at primary health clinics in Malaysia. Patient preference and adherence, 7, 525.
- Aubert RE, Herman WH, Waters J, Moore W, Sutton D, Peterson BL, Bailey CM, Koplan Badrudin, N., A. Basit, M.Z.I. Hydrie and R. Hakeem, Nutrition Counseling in the Management of 2002. Knowledge, Attitude and Practices of patient Malnutrition among Juvenile Diabetics. *Ethno-Med.*, visiting a diabetes care unit. *Pak. J. Nutr.*, 1: 99-102.
- Bartels D. Adherence to oral therapy for type 2 diabetes: opportunities for enhancing glycemic control. *J Am Acad Nurse Pract.* 2004; 16(1):8–16.
- Balkrishnan, R., Bhosle, M. J., Camacho, F. T., & Anderson, R. T. (2006). Predictors of medication adherence and associated health care costs in an older population with overactive bladder syndrome: a longitudinal cohort study. *The Journal of urology*, 175(3), 1067-1072.
- Bezie Y, Molina M, Hernandez N, Batista R, Niang S, Huet D. (2001). Therapeutic compliance: a prospective analysis of various factors involved in the adherence rate in type 2 diabetes. *Diabetes Metab* 32(6):611–616.
- Boyle PJ. (2007). Diabetes mellitus and macrovascular disease: mechanisms and mediators. *Am J Med.* 120(9 S2):S12-17.
- Brownlee-Duffeck, M., Peterson, L., Simonds, J. F., Goldstein, D., Kilo, C., & Hoette, S. (1987). The role of health beliefs in the regimen adherence and metabolic control of adolescents and adults with diabetes mellitus. *Journal of consulting and clinical psychology*, 55(2), 139.
- Brown, S. A., Upchurch, S., Anding, R., Winter, M., & Ramirez, G. (1996). Promoting weight loss in type II diabetes. *Diabetes Care*, 19(6), 613-624.
- Centers for Disease Control and Prevention (CDC), & Centers for Disease Control and Prevention (CDC). (2011). National diabetes fact sheet: national estimates and general information on diabetes and prediabetes in the United States, 2011. *Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention*, 201.
- Chiang, J. L., Kirkman, M. S., Laffel, L. M., & Peters, A. L. (2014). Type 1 diabetes through the life span: a position statement of the American Diabetes Association. *Diabetes Care*, 37(7), 20342054.
- Cox DJ, Gonder F. (1992). Major development in Behavioral Research. *Journal of Consulting and Clinical Psychology* 60(4): 628-38
- Davies, M. J., Heller, S., Skinner, T. C., Campbell, M. J., Carey, M. E., Cradock, S., ... & Khunti, K. (2008). Effectiveness of the diabetes education and self management for ongoing and newly diagnosed (DESMOND) programme for people with newly diagnosed type 2 diabetes: cluster randomised controlled trial. *Bmj*, 336(7642), 491-495.
- Delamater AM, Jacobson AM, Anderson BJ, Cox D, Fisher L, Lustman P, Rubin R, Wysocki T (2001) Psychosocial therapies in diabetes: report of the

- Psychosocial Therapies Working Group. *Diabetes Care* 24:1286–1292, 2001. de Oliveira-Filho, A. D., Morisky, D. E., Neves, S. J. F., Costa, F. A., & de Lyra, D. P. (2014). The 8-item Morisky Medication Adherence Scale: validation of a Brazilian– Portuguese version in hypertensive adults. *Research in Social and Administrative Pharmacy*, 10(3), 554-561.
- Droumaguet C, Balkau B, Simon D, Caces E, Tichet J, Charles MA, Eschwege E. (2006). the DESIR Study Group. Use of HbA1c in predicting progression to diabetes in French men and women: data from an Epidemiological Study on the Insulin Resistance Syndrome (DESIR) *Diabetes Care* 2006; 29: 1619– 1625.
- Duke SA, Colagiuri S, Colagiuri R (2009) Individual patient education for people with type 2 diabetes mellitus. *Cochrane Database Syst Rev Jan 21;(1):CD005268*.
- Edelman D, Olsen MK, Dudley TK, Harris A, Oddone EZ. (2004). Utility of hemoglobin A1c in predicting diabetes risk. *J Gen Intern Med* 19: 1175–1180.
- Ehtisham, S., Barrett, T. G., & Shaw, N. J. (2000). Type 2 diabetes mellitus in UK children—an emerging problem. *Diabetic medicine*, 17(12), 867-871. Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. (1997). Report of the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care* 20:1183– 1197.
- Fan, L., & Sidani, S. (2009). Effectiveness of diabetes self-management education intervention elements: a metaanalysis. *Canadian Journal of Diabetes*, 33(1), 18-26.
- Farmer, K. C. (1999). Methods for measuring and monitoring medication regimen adherence in clinical trials and clinical practice. *Clinical therapeutics*, 21(6), 10741090.
- Fowler MJ. (2008). Microvascular and macrovascular complications of diabetes. *Clin Diabetes*. 26(2):77-82. Geiss LS, Pan L, Cadwell B, Gregg EW, Benjamin SM, Engelgau MM. (2006). Changes in incidence of diabetes in U.S. adults, 1997–2003. *Am J Prev Med* 30:371– 377.
- Girach A, Vignati L. (2006). Diabetic microvascular complications--can the presence of one predict the development of another? *J Diabetes Complications*. 20(4):228-237.
- Goran, M. I., Ball, G. D., & Cruz, M. L. (2003). Obesity and risk of type 2 diabetes and cardiovascular disease in children and adolescents. *The Journal of Clinical Endocrinology & Metabolism*, 88(4), 14171427.
- Gutschall, M. D., Miller, C. K., Mitchell, D. C., & Lawrence, F. R. (2009). A randomized behavioural trial targeting glycaemic index improves dietary, weight and metabolic outcomes in patients with type 2 diabetes. *Public health nutrition*, 12(10), 1846-1854.
- Haynes, R. B., Yao, X., Degani, A., Kripalani, S., Garg, A., & McDonald, H. P. (2005). Interventions for enhancing medication adherence. The Cochrane Library.
- Haynes RB, Taylor DW, Sackett DL. *Adherence in Health Care*. Baltimore, MD: The Johns Hopkins University Press; 1979.
- Henriques, M. A., Costa, M. A., & Cabrita, J. (2012). Adherence and medication management by the elderly. *Journal of clinical nursing*, 21(21-22), 3096-3105.
- Henry, J. L., Wilson, P. H., Bruce, D. G., Chisholm, D. J., & Rawling, P. J. (1997). Cognitive-behavioural stress management for patients with noninsulin dependent diabetes mellitus. *Psychology, Health & Medicine*, 2(2), 109-118.
- Henriques, M. A., Costa, M. A., & Cabrita, J. (2012). Adherence and medication management by the elderly. *Journal of clinical nursing*, 21(21-22), 3096-3105. diabetes mellitus. *Psychology, Health & Medicine*, 2(2), 109-118.
- Hoehn, K. L., Salmon, A. B., HohnenBehrens, C., Turner, N., Hoy, A. J., Maghzal, G. J., ... & James, D. E. (2009). Insulin resistance is a cellular antioxidant defense mechanism. *Proceedings of the National Academy of Sciences*, 106(42), 17787-17792.
- Horne R. (1999). Patients'beliefs about treatment: the hidden determinant of treatment outcome? *J Psychosom Res*, 47(6):491–495.
- Horne R. (1999). Patients'beliefs about treatment: the hidden determinant of treatment outcome? *J Psychosom Res*, 47(6):491–495.

- Imperatore, G., Boyle, J. P., Thompson, T. J., Case, D., Dabelea, D., Hamman, R. F., & Standiford, D. (2012). Projections of Type 1 and Type 2 Diabetes Burden in the US Population Aged < 20 Years Through 2050 Dynamic modeling of incidence, mortality, and population growth. *Diabetes Care*, 35(12), 2515-2520.
- Inzucchi, S. E., Bergenstal, R. M., Buse, J. B., Diamant, M., Ferrannini, E., Nauck, M., ... & Matthews, D. R. (2012). Management of hyperglycemia in type 2 diabetes: a patient-centered approach position statement of the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetes care*, 35(6), 1364-1379.
- Jin, J., Sklar, G. E., Oh, V. M. S., & Li, S. C. (2008). Factors affecting therapeutic compliance: A review from the patient's perspective. *Therapeutics and clinical risk management*, 4(1), 269.
- Jimmy, B., Jose, J., Al-Hinai, Z. A., Wadair, I. K., & Al-Amri, G. H. (2014). Adherence to Medications among Type 2 Diabetes Mellitus Patients in Three Districts of Al Dakhliyah Governorate, Oman: A cross-sectional pilot study. *Sultan Qaboos University medical journal*, 14(2), e231.28.
- Johnson SB. *Insulin Dependent Diabetes Mellitus in childhood*. In Michael C, Roberts (Ed) handbook of Pediatric Psychology. 2nd ed. The Guildford Press; 1995. JP: Nurse case management to improve glycemic control in diabetic patients in a health maintenance organization: a randomized, controlled trial. *Ann Intern Med* 129:605–612, 1998.
- Kahn, S. E. (2003). The relative contributions of insulin resistance and beta-cell dysfunction to the pathophysiology of type 2 diabetes. *Diabetologia*, 46(1), 3-19.
- Kim, H. S., & Oh, J. A. (2003). Adherence to diabetes control recommendations: impact of nurse telephone calls. *Journal of advanced nursing*, 44(3), 256-261.
- Klein, S., Sheard, N. F., Pi-Sunyer, X., Daly, A., Wylie-Rosett, J., Kulkarni, K., & Clark, N. G. (2004). Weight Management Through Lifestyle Modification for the Prevention and Management of Type 2 Diabetes: Rationale and Strategies A statement of the American Diabetes Association, the North American Association for the Study of Obesity, and the American Society for Clinical Nutrition. *Diabetes Care*, 27(8), 2067-2073.
- Krasnegor, N. A., Epstein, L., Johnson, S. B., Yaffe, S. J., & Epstein, L. H. (Eds.). (2013). *Developmental aspects of health compliance behavior*. Psychology Press.
- Krentz AJ, Bailey CJ. (2005). Oral antidiabetic agents: current role in type 2 diabetes mellitus. *Drugs*. 65:385-411.
- Krousel-Wood, M., Thomas, S., Muntner, P., & Morisky, D. (2004). Medication adherence: a key factor in achieving blood pressure control and good clinical outcomes in hypertensive patients. *Current opinion in cardiology*, 19(4), 357-362.
- Kyngas, H., Duffy, M. E., & Kroll, T. (2000). Conceptual analysis of compliance. *Journal of clinical nursing*, 9(1), 5-12.
- Landon MB, Spong CY, Thom E, Carpenter MW, Ramin SM, Casey B, Wapner RJ, Varner MW, Rouse DJ, Thorp JM Jr, Sciscione A, Catalano P, Harper M, Saade G, Lain KY, Sorokin Y, Peaceman AM, Tolosa JE, Anderson GB, Eunice Kennedy Shriver. (2009). National Institute of Child Health and Human Development MaternalFetal Medicine Units Network. A multicenter, randomized trial of treatment for mild gestational diabetes. *N Engl J Med*, 361:1339–1348.
- Lipson LG. (1986). Diabetes in the elderly: diagnosis, pathogenesis, and therapy. *Am J Med* 80 Suppl. 5A: 10-21.
- Leslie, R. D., & Pozzilli, P. (1994). Type I diabetes masquerading as type II diabetes: possible implications for prevention and treatment. *Diabetes Care*, 17(10), 1214-1219.
- Meneilly, G. S., Cheung, E. L. S. I. E., & Tuokko, H. O. L. L. Y. (1994). Altered responses to hypoglycemia of healthy elderly people. *The Journal of Clinical Endocrinology & Metabolism*, 78(6), 1341-1348.
- Meneilly, G. S. (1999). Pathophysiology of type 2 diabetes in the elderly. *Clinics in geriatric medicine*, 15(2), 239-253.
- Meneilly, G. S., & Tessier, D. (2000). Diabetes in the elderly. In *Endocrinology of Aging* (pp. 181-203). Humana Press.
- Meneilly, G. S., & Tessier, D. (2001).

- Diabetes in elderly adults. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, 56(1), M5-M13.
- Mahesh PA, Parthasarathi G. *Medication Adherence*. In: Parthasarathi G, NyfortHansen K, Nahata MC (Eds). *A Textbook of Clinical Pharmacy Practice: Essential Concepts and Skills*. 1st ed. Hyderabad, India: Sangam Books Ltd, Orient Blackswan Publishing, 2004. Pp. 54–70.
- Mohan D, Raj D, Shanthiram CS. (2005). Awareness and knowledge of diabetes in Cheruiai-The Chennai urban rural epidemiology study. *J Assoc Physicians India* 53: 283-5.
- Morisky, D. E., Green, L. W., & Levine, D. M. (1986). Concurrent and predictive validity of a self-reported measure of medication adherence. *Medical care*, 24(1), 67-74.
- Morley, J. E. (1998). The elderly type 2 diabetic patient: special considerations *Diabetic Medicine Chichester* 15, S41-S46.
- Morley, J. E., & Perry III, H. M. (1991). The management of diabetes mellitus in older individuals. *Drugs*, 41(4), 548-565.
- Nathan, D. M. (2003). Long-term complications of diabetes mellitus. *New England Journal of Medicine*, 328(23), 1676-1685.
- National Collaborating Centre for Primary Care (UK). (2009). Medicines adherence: Involving patients in decisions about prescribed medicines and supporting adherence.
- Nelson, K. M., Reiber, G., & Boyko, E. J. (2002). Diet and exercise among adults with type 2 diabetes findings from the third national health and nutrition examination survey (NHANES III). *Diabetes care*, 25(10), 1722-1728.
- Nagelkerk, J., Reick, K., & Meengs, L. (2006). Perceived barriers and effective strategies to diabetes self-management. *Journal of advanced nursing*, 54(2), 151-158.
- OMAR, M. S., & SAN, K. L. (2014). Diabetes knowledge and medication among geriatric patient with type 2 diabetes mellitus. *Malay*, 36, 53.
- Osterberg L, Blaschke T. (2005). Adherence to medication. *N Engl J Med*.353(5):487-497. people with type 2 diabetes mellitus. *Cochrane Database Syst Rev Jan 21*; (1): CD005268.
- Peyrot M, McMurry JF, Kruger DF: A biopsychosocial model of glycemic control in diabetes: stress, coping, and regimen adherence. *J Health Soc Behav* 40:141– 158, 1999.
- Pradeepa R, Deepa R, Mohan V. (2002). Epidemiology of Diabetes in India-current prespective and future projections. *J Indian Med Assoc* 100 (03): 144-8.
- Prevention. Available from: http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2011.pdf. Accessed 7 Jun 2013.
- Ponzo, M.G., Gucciardi, E., Weiland, M., Masi, R., Lee, R., & Grace, S.L. (2006). Gender, ethnocultural, and psychosocial barriers to diabetes self-management in Italian women and men with type 2 diabetes mellitus. *Nurse Media Journal of Nursing*, 1(1), 61-73.
- Rahman, M. R., Basunia, M. R. A., Khan, M. M. Z. A., & Nag, D. C. (2005). Diabetes mellitus: An easy approach. *ORION*, 22.
- Reaven GM, Clinkingbeard C, Jeppesen J, et al. (1988). Comparison of the hemodynamic and metabolic effects of low-dose hydrochlorothiazide and lisinopril treatment in obese patients with high blood pressure. *Am J Hypertens* 8: 461-6.
- Riddle MC. (1999). Oral pharmacologic management of type 2 diabetes. *Am Fam Physician*. 60:2613-2620.
- Roberts, A. W., Thomas, A., Rees, A., & Evans, M. (2003). Peroxisome proliferator-activated receptor- γ agonists in atherosclerosis: current evidence and future directions. *Current opinion in lipidology*, 14(6), 567-573.
- Saengtipbovorn, S., & Taneepanichskul, S. (2014). Effectiveness of lifestyle change plus dental care (LCDC) program on improving glycemic and periodontal status in the elderly with type 2 diabetes. *BMC oral health*, 14(1), 72.
- Sato KK, Hayashi T, Harita N, Yoneda T, Nakamura Y, Endo G, Kambe. (2009). Combined measurement of fasting plasma glucose and A1C is effective for the prediction of type 2 diabetes: the Kansai Healthcare Study. *Diabetes Care* ;32: 644– 646.
- Savoca, M., & Miller, C. (2001). Food selection and eating patterns: themes found among people with type 2 diabetes mellitus. *Journal of Nutrition Education*, 33(4), 224-233.
- Shaw, J. E., Sicree, R. A., & Zimmet, P. Z.

- (2010). Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes research and clinical practice*, 87(1), 4-14.
- Smeltzer CS, Bare GB. Brunner and Suddarth's *Text book of Medical Surgical Nursing* 7th ed. Philadelphia: Lippincott; 2009.
- Sorkhou I, Hajia A, Al-Qallaf B, El-Batish. (2002). Screening for risk factors in diabetic patients in Mishref area. *Kuwait Med J* 34(3):209-212.
- Stratton, I. M., Adler, A. I., Neil, H. A. W., Matthews, D. R., Manley, S. E., Cull, C. A., ... & Holman, R. R. (2000). Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. *Bmj*, 321(7258), 4054-12.
- Svarstad, B. L., Chewning, B. A., Sleath, B. L., & Claesson, C. (1999). The Brief Medication Questionnaire: a tool for screening patient adherence and barriers to adherence. *Patient education and counseling*, 37(2), 113-124.
- Tessier, D. M., & Lassmann-Vague, V. J. R. (2007). Diabetes and education in the elderly. *Diabetes & metabolism*, 33, S75-S78.
- Thompson, K., Kulkarni, J., & Sergejew, A. A. (2000). Reliability and validity of a new Medication Adherence Rating Scale (MARS) for the psychoses. *Schizophrenia research*, 42(3), 241-247.
- Tuomilehto, J., Lindström, J., Eriksson, J. G., Valle, T. T., Hämäläinen, H., IlanneParikka, P., ... & Uusitupa, M. (2001). Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *New England Journal of Medicine*, 344(18), 1343-1350.
- UK Prospective Diabetes Study (UKPDS) Group. (1998). Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *Lancet*. 352:837-853.
- Widjojo, B. (2011). *The rapid rise of Diabetes in Indonesia*. Retrieved on June, 20, 2011.
- Fitzgerald, J. T., Funnell, M. M., Hess, G. E., Barr, P. A., Anderson, R. M., Hiss, R. G., & Davis, W. K. (1998). The reliability and validity of a brief diabetes knowledge test. *Diabetes care*, 21(5), 706-710.
- Zullig, L. L., Gellad, W. F., Moaddeb, J., Crowley, M. J., Shrank, W., Granger, B. B., ... & Bosworth, H. B. (2015). Improving diabetes medication adherence: successful, scalable interventions. *Patient preference and adherence*, 9, 139.
- Zygmunt, A., Olfson, M., Boyer, C. A., & Mechanic, D. (2002). Interventions to improve medication adherence in schizophrenia. *Interventions*, 159(10).