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Review Article

**DIETARY INTAKE AND TYPE 2 DIABETES MELLITUS-A
BRIEF REVIEW****Prof. J.S Venkatesh¹, Dr. Upendra N², Sampad S Patali³, Rispa Mariyam Raju⁴,
Shalu Shajan⁵**¹ Professor, SCS College Of Pharmacy, Harapanahalli² Assistant Professor, SCS College Of Pharmacy, Harapanahalli³⁻⁵ Pharm D Interns, SCS College Of Pharmacy, Harapanahalli**Article Received:** November 2022 **Accepted:** December 2022 **Published:** January 2023**Abstract:**

Type 2 diabetes mellitus (T2DM) is regarded as one of the most widespread illnesses on a global scale. Complex risk variables, including age, genetics, race, and ethnicity, as well as modifiable risk factors, including dietary habits, physical activity levels, and smoking, are linked to the aetiology of T2DM. This review's goals are to look at diverse research to study how T2DM and various dietary patterns, practices, and behaviors relate to one another, as well as the difficulties that can result. The main causes of the rapidly increasing incidence of diabetes mellitus in emerging countries are dietary practices and a sedentary lifestyle. Recent studies have linked raised HbA1c levels in type 2 diabetics to a higher risk of microvascular and macrovascular problems. Dietary control is one way to reduce the increased HbA1c level;

Thus, the patients' development of diabetes problems might be stopped. Better nutritional knowledge, attitudes, and habits are brought about by increased awareness of the problems of diabetes. Patients should be encouraged to appreciate the significance of nutrition, which may aid in disease management, adequate self-care, and higher quality of life, by the stakeholders (healthcare providers, health facilities, agencies involved in diabetes care, etc.).

Keywords: Type 2 diabetes mellitus, Diet, Complications, Knowledge, Practices

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INTRODUCTION:

Ancient Egyptians and Indians first identified diabetes mellitus (DM) as a disease roughly 3000 years ago, demonstrating several clinical characteristics that are quite similar to what we today know as diabetes¹. DM is a mix of the Latin word "mellitus" which means honeyed or sweet and the Greek word "diabetes" which means syphon - to pass through. The first instance of high sugar in blood and urine was documented in Great Britain in 1776^{2,3}. With the passage of time, a thorough understanding of the etiology and pathophysiology of diabetes has been attained. A metabolic illness called diabetes mellitus is described as having hyperglycemia that "results from either the lack in insulin secretion or the effect of insulin."

Poorly managed diabetes can harm a number of organs, particularly the heart, kidneys, nerves, and eyes⁴. Based on the etiology and clinical characteristics, there are three main forms of DM. These are gestational DM, type 1 DM (T1DM), and type 2 DM (T2DM) (GDM). Absolute insulin insufficiency results from T1DM due to the pancreatic cells being destroyed by a cellularly mediated autoimmune response. Insulin resistance and relative insulin insufficiency are both present in T2DM. Any level of glucose intolerance that is identified during pregnancy is referred to as GDM. Certain diseases such as genetic syndrome, surgery, infections, malnutrition can cause DM⁵⁻⁷.

Age, genetics, race, and ethnicity are T2DM risk variables that cannot be changed, although smoking, physical inactivity, and diet may^{8,9}.

EPIDEMIOLOGY

T2DM is currently one of the most prevalent diseases in the world, and its prevalence is steadily increasing. Around 366 million people globally, or 8.3% of those between the ages of 20 and 79, were estimated to have T2DM in 2011. By 2030, this number is anticipated to increase to 552 million (9.9%)¹⁰.

Diabetic retinopathy, which is also a leading cause of blindness in adults due to retinal damage (DR). T2DM patients may have a 25 times higher risk of lower limb amputation than people without the condition¹¹.

PHYSICAL ACTIVITY AND LIFESTYLE

Numerous cross-sectional studies, as well as prospective and retrospective ones, have discovered a strong link between T2DM and a lack of physical activity¹². Over a thousand non-diabetics from the high-risk Pima Indian population participated in a

prospective study. It was discovered that the incidence rate of diabetes remained higher in less active men and women from all BMI groups during the course of an average follow-up period of six years¹³.

First, it has been hypothesised that exercise improves insulin sensitivity. According to a thorough analysis released by the US Department of Health and Human Services in 2015, exercise greatly improved abnormal glucose tolerance when it was predominantly brought on by insulin resistance rather than by low levels of circulating insulin¹⁴. Second, prior to the need for insulin therapy, the early phases of T2DM are probably when physical activity will be most effective in halting the disease's progression. Exercise's protective mechanism and insulin seem to work in concert to safeguard the body. Skeletal muscular contraction during a single, sustained physical exercise session increases glucose uptake into the cells. This impact promotes glucose transfer into the muscle cell and increases blood flow within the muscle¹⁵.

Third, it has been discovered that exercise also lowers intra-abdominal fat, a known risk factor for insulin resistance. Physical activity has been shown to lower body fat reserves and to have an inverse relationship with intra-abdominal fat distribution in several other research. 16 The dramatic rise in the incidence of T2DM is thought to be mostly caused by environmental and lifestyle factors¹⁷.

PATIENT'S KNOWLEDGE REGARDING DM

Diabetes management and patient awareness continue to be the biggest problems for all parties involved globally. Numerous research from poor nations suggest that there is a lack of understanding about diabetes¹⁸. According to several studies, the prevalence of diabetes varies among different ethnic groups¹⁹. To improve adherence to medical therapy, knowledge is a necessity²⁰. A study by Mohammadi²¹ found that DM patients' knowledge and self-care management were insufficient. Diabetes outcomes are impacted by low DM awareness. Magurová²² conducted a second investigation in Slovakia in which she compared two patient groups (those who received diabetes education and those who did not). The findings showed that receiving diabetes education significantly raised patients' knowledge of the condition (p 0.001).

The study also found that educating patients about their condition can greatly improve their quality of life and lessen the burden it places on their relatives.

In a cross-sectional survey for the Dussa²³, diabetes awareness in India was assessed. The survey indicated that diabetes knowledge was low among both patients and the general public. In a different study conducted in India by Shah²⁴, 63% of T2DM patients reported not knowing what diabetes is or what its consequences are.

A study by Bani²⁵ in Saudi Arabia found that there was no significant gender difference in the percentage of patients who were uninformed of the value of monitoring their diabetes, with 97.3% of men and 93.1% of women. Type 2 diabetics in Qatar were also studied with regard to their knowledge, attitudes, and practices. The patients' knowledge of diabetes was quite limited, and their understanding of how diabetes affects foot was also very limited²⁶. A study conducted in Najran, Saudi Arabia²⁷ found that over half of the patients lacked sufficient understanding of the condition. In this study, patients who were male had more knowledge of diabetes than those who were female.

In Al-Khobar, Saudi Arabia, researchers looked at the diabetes knowledge of female instructors who self-identified as diabetic²⁸. The study found that female teachers with diabetes had relatively little knowledge of diabetes. The understanding of diabetes gives information on diet, exercise, weight monitoring, blood glucose levels, and medication use, as well as on eye and foot care and the management of diabetic complications²⁹.

DIET AND DIABETES MELLITUS CORRELATION

As was previously mentioned, Indians proposed that diet may play a role in the etiology of T2DM. They did this after noticing that wealthy individuals who consumed large amounts of flour, sugar, and oil were disproportionately affected by the disease³⁰. Diabetes mortality rates decreased during the First and Second World Wars as a result of famines and food shortages in the affected nations, including Germany and other European nations. The mortality rate for diabetes in Berlin decreased from 23.1/100,000 in 1914 to 10.9 in 1919. Other nations, like Japan and North American nations, which did not have a food crisis during the same time period, did not experience a shift in the mortality rate due to diabetes³¹.

Numerous studies have found a link between a high sugar diet and the emergence of T2DM³². In a research, Ludwig³³ spent 19 months observing more than 500 pupils of various racial backgrounds. After taking into account several factors like dietary,

demographic, anthropometric, and lifestyle choices, it was discovered that the frequency of obesity rose for each additional serving of carbonated beverages eaten. Patients with various levels of glycemic control who were diabetic were involved in a study. The mean daily plasma glucose levels and the diurnal glucose patterns did not differ. The relationship between dietary lipids and T2DM was similarly erratic, similar to that of carbs³⁴.

Numerous prospective studies have discovered links between dietary fat intake and the risk of later acquiring T2DM. In a diabetes study at San Louis Valley, over a thousand subjects without a past diabetes diagnosis underwent a prospective 4-year investigation. In that study, the researchers discovered a link between dietary fat, type 2 diabetes, and poor glucose tolerance^{35,36}. Another study looked at the association between two groups of women's diets, including fat, fibre, and sugar, and their chance of developing type 2 diabetes. After normalisation, no links between the consumption of fat, sucrose, carbohydrates, or fibre and the risk of diabetes were discovered in either group³⁷.

Due to the massive volumes of high fructose corn syrup used in the production of soft drinks, which boosts blood glucose levels and BMI to dangerous levels, there has recently been evidence linking consumption of soft drinks with obesity and diabetes³⁸. Assy³⁹ said that glycated compounds found in diet, soft drinks significantly increase insulin resistance. Obesity has a strong relationship with food intake, which is influenced by the quantity of food consumed as well as the kind and quality of diet⁴⁰. Increased risk of insulin resistance and T2DM is attributed to a high intake of red meat, sweets, and fried meals⁴¹.

On the other hand, intake of veggies was found to be negatively correlated with T2DM. Fruits and vegetables are rich in nutrients, fibre, and antioxidants, which are thought to act as a barrier against disease and may prevent the development of T2DM⁴². A recent study on Japanese women found that eating more white rice was linked to a higher risk of developing type 2 diabetes⁴³. This necessitates a pressing need for the entire community to change their lifestyles and for all groups to become more conscious of good eating habits.

DIETARY KNOWLEDGE OF T2 DM

According to the American Diabetes Association, self-dietary management is a crucial first step in giving diabetics the knowledge and skills they need

to manage their condition's complications, nutritional needs, and medical conditions. A study revealed that the targeted group, who were at a high risk of developing T2DM, had low dietary awareness. Males consumed more red meat and fried food than females did. In terms of daily rice consumption, there were significantly more men than women⁴⁴.

Food options, portion sizes, and sedentary behaviour have all substantially expanded recently in Saudi Arabia, raising the prevalence of obesity. Because fast food is so convenient, a lot of Saudis are regrettably growing more obese, which raises the alarming diabetes numbers⁴⁴. Saudis, meanwhile, consume an excessive amount of sugary beverages. An important component that affects dietary practises, according to Backman⁴⁶, is dietary knowledge. Another study by Savoca and Miller⁴⁷ shown that having a thorough understanding of the diabetes diet recommendations may have an impact on patients' food choices and dietary behaviours.

Knowledge of the diabetic diet and the required number of calories were found to be significantly positively correlated ($r = 0.27$, $p 0.05$)⁴⁸. The study came to the conclusion that in order to develop improved eating habits, understanding about the diabetic diet is crucial. According to the findings of a study done in Saudi Arabia²⁵, more than half of diabetic patients denied altering their food habits, losing weight, or engaging in exercise.

According to the National Center for Health Statistics, socioeconomic status is a significant factor in the development of T2DM, which was formerly thought of as a disease of the wealthy.⁴⁹ On the other hand, the same source said that T2DM was more common in people with lower income levels and less education. The variations may result from the sort of food eaten.⁵⁰

T2 DIABETICS PERSPECTIVE ON FOOD

Through an improvement in the patient's dietary knowledge, attitudes, and habits, DM can be controlled. These elements are seen as being essential to complete diabetes care⁵¹. The importance of nutrition in managing diabetes is still not well understood by patients, despite the high prevalence of DM in gulf nations⁵². Studies carried out in Egypt found that the patients' attitudes concerning food, adherence to therapy, dietary control with and without medicine use, and foot care were all subpar⁵³. Additionally, a study found a link between eating disorders brought on by psychological distress and weight gain in diabetic patients⁵⁴. Another study that

looked at eating disorder-related symptoms in T2DM patients made the suggestion that diabetics, especially obese diabetic patients, can use the dieting-binging sequence⁵⁵. The main causes of diabetes are unhealthy eating patterns and inactivity. The most common reasons for difficulties in T2DM patients include failing to adhere to a strict diet and exercise regimen as well as taking prescribed medicines⁵⁶.

Studies conducted in Saudi Arabia in the past have shown that diabetic patients do not take their doctors' recommendations for diet planning, food adjustment, and exercise seriously.

T2 DIABETICS DIETARY HABITS

The primary eating habits of diabetics are impacted by their cultural backgrounds. There were substantial positive associations between knowledge of the diabetic diet and dietary behaviours for each of the dimensions of dietary practises. A key element in the management of dietary behaviours was knowledge⁴⁶. Additionally, patients' awareness of a suggested diet demonstrates their comprehension of dietary recommendations, which influenced their food choices and eating habits⁴⁷. The previous studies found mixed results on the relationship between dietary knowledge and dietary behaviours among T2DM patients. Another study found no connection between nutritional knowledge and adherence to dietary behaviours⁵⁸. On the other hand, the same study discovered that patients who scored well on nutritional knowledge were more likely to adhere to dietary guidelines and were better at performing self-management tasks.

Dietary knowledge has a big impact on how people eat. An investigation of the eating habits of diabetes patients was carried out in Indonesia, and the results revealed that the population there favoured eating meals high in fat, which raised their risk of cardiovascular disease (CVD)⁵⁹. Over the past ten years, children, teenagers, and adults have all experienced a sharp rise in the practice of skipping breakfast^{60,61}. There is mounting evidence linking skipping breakfast to obesity and other health problems⁶². Additionally, frequent eating or snacking may raise the risk of metabolic disorders and body weight^{63,64}. Rimm⁶⁵ distinguished between western and responsible eating habits. A rise in the consumption of fish, poultry, diverse vegetables, and fruits was a hallmark of the prudent dietary pattern.

The western eating pattern, in contrast, was marked by an increase in the intake of processed and red meat, chips, dairy products, refined cereals, and

sweets and desserts. In the past, these patterns were linked to the risk of T2DM. The glycemic index measures how well a food affects blood sugar levels after meals when compared to a reference food like white bread or glucose. As a result, the glycemic load reflects both the type and amount of carbohydrates ingested⁶⁶⁻⁶⁹. An inverse link was found between the traditional dietary pattern and T2DM among Lebanese individuals in the same study, however a different study carried out in Lebanon showed a direct correlation between refined grains, desserts, and fast food patterns and T2DM⁷⁰.

TYPE 2 DIABETES COMPLICATIONS

DM is the fourth most common cause of complications-related deaths worldwide. More than three million individuals lose their lives to diabetes or its complications each year. This condition burdens health systems around the world as well as patients and their families who must deal with excessive financial, social, and emotional stress. Patients with diabetes are more likely to experience consequences such as coronary artery disease, stroke, and myocardial infarction. But side effects like retinopathy, nephropathy, and neuropathy can distressingly affect a patient's quality of life and greatly raise their financial burden. The prevalence reported from research on T2DM problems that was done globally showed varying rates.

The prevalence of cataracts was 26-62%, that of retinopathy 17-50%, that of blindness 3%, that of nephropathy 17-28%, that of cardiovascular issues 10-22.5%, that of stroke 6-12%, that of neuropathy 19-42%, and that of foot issues 5-23%. Between 14% and 40% of deaths were reported to be due to all causes⁷¹. Researchers discovered that emerging countries have a 15.8% incidence of DR. In Saudi Arabia, Sri Lanka, and Brazil, the prevalence of DR was reported to be 30%, 31.3%, and 35.4%, respectively; in Kashmir, it was 27%, while in South Africa, it was 40%. 3000 diabetic patients from Pakistan had a DR prevalence of 26.1%, which was much higher than the rates reported for Malaysia (14.9%) and India (18%).⁷²⁻⁷⁶

In Saudi Arabia, there have only been a small number of studies on the complications of diabetes. According to a 1992 Saudi Arabian study, individuals with T2DM had an incidence rate of cataract of 42.7%, neuropathy of 35.9%, retinopathy of 31.5%, hypertension of 25%, nephropathy of 17.8%, ischemic heart disease of 41.3%, stroke of 9.4%, and foot infections of 10.4%. The study did note consequences for both types of diabetes, though⁷⁷.

RELATION BETWEEN DIETARY PRACTICES AND DIABETIC COMPLICATIONS

Interventional investigations revealed that while glucose disposal dietary strategies are the first line of defence for controlling dyslipidemia in diabetic patients, high carbohydrate and high monounsaturated fat diets increase insulin sensitivity⁷⁸. Nutrition therapy and lifestyle modifications were suggested as the initial treatments for dyslipidemia in a number of dietary interventional studies^{79,80}. The cornerstone of managing diabetes and its consequences might be considered to be metabolic control. The risk of developing microvascular problems is reduced when HbA1c is a target, and it may help protect against CVD, especially in newly diagnosed patients⁸¹. Intake of carbohydrates is the main macronutrient to worry about in glycemic control since it directly affects postprandial glucose levels in persons with diabetes⁸².

Additionally, a person's dietary decisions and energy balance directly affect their body weight, blood pressure, and cholesterol levels. By individualised nutrition interventions and ongoing support for improvements, healthcare providers can assist their patients in achieving health goals through collaborative efforts⁸³⁻⁸⁵. According to a study, eating a diet high in virgin olive oil in the Mediterranean region may slow the course of T2DM retinopathy⁸⁶. Dietary habits are crucial components of a person's metabolic and cardiovascular risk⁸⁷.

Over the past few decades, a variety of health advantages have been linked to the Mediterranean diet, which includes a high intake of fruits and vegetables. Utilizing fish and olive oil has been shown to have positive effects on glucose metabolism and reduce the incidence of T2DM, obesity, and CVD⁸⁸.

CONCLUSION:

According to a review of several studies, T2DM patients need to have their DM education, including dietary management, reinforced by stakeholders (healthcare providers, health facilities, etc.), in order to help them better understand how to manage their condition, provide for themselves appropriately, and have a higher quality of life. The overall goal of T2DM treatment is to protect patients from early end-organ problems, which can be accomplished with careful dietary management. Health practitioners must be knowledgeable with the cultural values, perspectives, families, and social networks of the patients in order for nutritional management to be

successful.

Due to the fact that diabetes is a chronic condition, healthcare professionals should use the appropriate therapeutic techniques, with a focus on nutrition, to manage the condition, lessen symptoms, and avert complications. The health care professionals must advise the patients to make modifications to their eating habits and food preparations in order for the patients to have good knowledge of the disease and diet. Dietary education that is proactive and effective may delay the onset of diabetes and its problems.

REFERENCES:

1. Frank LL. Diabetes mellitus in the texts of old Hindu medicine (Charaka, Susruta, Vagbhata). *Am J Gastroenterol* 1957;27:76-95.
2. Ahmed AM. History of diabetes mellitus. *Saudi Med J* 2002;23:373-8.
3. Reece EA, Homko CJ. Diabetes mellitus in pregnancy. What are the best treatment options? *Drug Saf* 1998;18:209-20.
4. Alberti K, Davidson MB, DeFronzo RA, Drash A, Genuth S, Harris MI, *etal*. Report of the expert committee on the diagnosis and classification of diabetes mellitus. *Diabetes Care* 1998;21:S5.
5. Narayan KV, Zhang P, Kanaya AM, Williams DE, Engelgau MM, Imperatore G, *etal*. *Diabetes: The Pandemic and Potential Solutions*. Washington, DC: World Bank; 2006.
6. Jamison DT, Breman JG, Measham AR, Alleyne G, Claeson M, Evans DB, *etal*. *Diabetes: The Pandemic and Potential Solutions*. Washington, DC: World Bank; 2006.
7. Whiting DR, Guariguata L, Weil C, Shaw J. IDF diabetes atlas: Global estimates of the prevalence of diabetes for 2011 and 2030. *Diabetes Res Clin Pract* 2011;94:311-21.
8. Organization WH. *Obesity: Preventing and Managing the Global Epidemic*. Geneva, Switzerland: World Health Organization; 2000.
9. Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes Res Clin Pract* 2010;87:4-14.
10. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. *Diabetes Care* 2004;27:1047-53.
11. Rizkalla SW. Glycemic index: Is it a predictor of metabolic and vascular disorders? *Curr Opin Clin Nutr Metab Care* 2014;17:373-8.
12. Weinstein MC, Toy EL, Sandberg EA, Neumann PJ, Evans JS, Kuntz KM, *etal*. Modeling for health care and other policy decisions: Uses, roles, and validity. *Value Health* 2001;4:348-61.
13. Davies R, Roderick P, Raftery J. The evaluation of disease prevention and treatment using simulation models. *Eur J Oper Res* 2003;150:53-66.
14. Charokopou M, Sabater F, Townsend R, Roudaut M, McEwan P, Verheggen B. Methods applied in cost-effectiveness models for treatment strategies in Type 2 diabetes mellitus and their use in health technology assessments: A systematic review of the literature from 2008 to 2013. *Curr Med Res Opin* 2015;32:1-12.
15. Tucker DM, Palmer AJ. The cost-effectiveness of interventions in diabetes: A review of published economic evaluations in the UK setting, with an eye on the future. *Prim Care Diabetes* 2011;5:9-17.
16. Cole G, Leonard B, Hammond S, Fridinger F. Using stages of behavioral change constructs to measure the short-term effects of a worksite-based intervention to increase moderate physical activity. *Psychol Rep* 1998;82:615-8.
17. Danaei G, Finucane MM, Lu Y, Singh GM, Cowan MJ, Paciorek CJ, *etal*. National, regional, and global trends in fasting plasma glucose and diabetes prevalence since 1980: Systematic analysis of health examination surveys and epidemiological studies with 370 country-years and 2.7 million participants. *Lancet* 2011;378:31-40.
18. Bassuk SS, Manson JE. Epidemiological evidence for the role of physical activity in reducing risk of Type 2 diabetes and cardiovascular disease. *J Appl Physiol* 2005;99:1193-204.
19. Jakicic JM, Otto AD. Physical activity considerations for the treatment and prevention of obesity. *Am J Clin Nutr* 2005;82 1 Suppl:226S-9.
20. Kriska AM, Saremi A, Hanson RL, Bennett PH, Kobes S, Williams DE, *etal*. Physical activity, obesity, and the incidence of Type 2 diabetes in a high-risk population. *Am J Epidemiol* 2003;158:669-75.
21. Mohammadi S, Karim NA, Talib RA, Amani R. Knowledge, attitude and practices on diabetes among Type 2 diabetic patients in Iran: A cross-sectional study. *Science* 2015;3:520-4.
22. Magurová D, Majerníková E, Hloch S, Tozan H, Goztepe K. Knowledge of diabetes in patients with Type 2 diabetes on insulin therapy from Eastern Slovakia. *Diabetol Croat* 2012;41:95-102.
23. Parimalakrishnan S, Dussa K, Sahay R.

- Assessment of diabetes knowledge using diabetes knowledge questionnaire among people with Type 2 diabetes mellitus. *Asian J Pharm Clin Res* 2015;8(2): 254-6.
24. Shah VN, Kamdar PK, Shah N. Assessing the knowledge, attitudes and practice of Type 2 diabetes among patients of Saurashtra region, Gujarat. *Int J Diabetes Dev Ctries* 2009;29:118-22.
 25. Bani IA. Prevalence, knowledge, attitude and practices of diabetes mellitus among Jazan population, Kingdom of Saudi Arabia (KSA). *Int J Diabetes Mellitus* 2015;5:115.
 26. Kheir N, Greer W, Yousif A, Al Geed H, Al Okkah R. Knowledge, attitude and practices of Qatari patients with Type 2 diabetes mellitus. *Int J Pharm Pract* 2011;19:185-91.
 27. Khan LA, Khan SA. Level of knowledge and self-care in diabetics in a community hospital in Najran. *Ann Saudi Med* 2000;20:300-1.
 28. Abahussain NA, El-Zubier AG. Diabetes knowledge among self reported diabetic female teachers: Al-khobar, Saudi Arabia. *J Family Community Med* 2005;12:43-8.
 29. Weinstein MC, O'Brien B, Hornberger J, Jackson J, Johannesson M, McCabe C, *etal*. Principles of good practice for decision analytic modeling in health-care evaluation: Report of the ISPOR task force on good research practices--modeling studies. *Value Health* 2003;6:9-17.
 30. Seidell JC. Dietary fat and obesity: An epidemiologic perspective. *Am J Clin Nutr* 1998;67 3 Suppl:546S-50.
 31. Lumey LH, Van Poppel FW. The Dutch famine of 1944-45: Mortality and morbidity in past and present generations. *Soc Hist Med* 1994;7:229-46.
 32. Khatib O. Noncommunicable diseases: Risk factors and regional strategies for prevention and care. *East Mediterr Health J* 2004;10:778-88.
 33. Ludwig DS, Peterson KE, Gortmaker SL. Relation between consumption of sugar-sweetened drinks and childhood obesity: A prospective, observational analysis. *Lancet* 2001;357:505-8.
 34. Peterson DB, Lambert J, Gerring S, Darling P, Carter RD, Jelfs R, *etal*. Sucrose in the diet of diabetic patients--just another carbohydrate? *Diabetologia* 1986;29:216-20.
 35. Lundgren H, Bengtsson C, Blohmé G, Isaksson B, Lapidus L, Lenner RA, *etal*. Dietary habits and incidence of noninsulin-dependent diabetes mellitus in a population study of women in Gothenburg, Sweden. *Am J Clin Nutr* 1989;49:708-12.
 36. Marshall JA, Hamman RF, Baxter J. High-fat, low-carbohydrate diet and the etiology of non-insulin-dependent diabetes mellitus: The San Luis valley diabetes study. *Am J Epidemiol* 1991;134:590-603.
 37. Colditz GA, Manson JE, Stampfer MJ, Rosner B, Willett WC, Speizer FE. Diet and risk of clinical diabetes in women. *Am J Clin Nutr* 1992;55:1018-23.
 38. Nseir W, Nassar F, Assy N. Soft drinks consumption and nonalcoholic fatty liver disease. *World J Gastroenterol* 2010;16:2579-88.
 39. Assy N, Nasser G, Kamayse I, Nseir W, Beniashvili Z, Djibre A, *etal*. Soft drink consumption linked with fatty liver in the absence of traditional risk factors. *Can J Gastroenterol* 2008;22:811-6.
 40. Amin TT, Al-Sultan AI, Ali A. Overweight and obesity and their association with dietary habits, and sociodemographic characteristics among male primary school children in Al-Hassa, Kingdom of Saudi Arabia. *Indian J Community Med* 2008;33:172-81.
 41. Panagiotakos DB, Tzima N, Pitsavos C, Chrysohoou C, Papakonstantinou E, Zampelas A, *etal*. The relationship between dietary habits, blood glucose and insulin levels among people without cardiovascular disease and Type 2 diabetes; the ATTICA study. *Rev Diabet Stud* 2005;2:208-15.
 42. Villegas R, Shu XO, Gao YT, Yang G, Elasy T, Li H, *etal*. Vegetable but not fruit consumption reduces the risk of Type 2 diabetes in Chinese women. *J Nutr* 2008;138:574-80.
 43. Nanri A, Mizoue T, Noda M, Takahashi Y, Kato M, Inoue M, *etal*. Rice intake and Type 2 diabetes in Japanese men and women: The Japan public health center-based prospective study. *Am J Clin Nutr* 2010;92:1468-77.
 44. Mohieldein AH, Alzohairy M, Hasan M. Risk estimation of Type 2 diabetes and dietary habits among adult Saudi Non-diabetics in Central Saudi Arabia. *Glob J Health Sci* 2011;3:123.
 45. Badran M, Laher I. Obesity in arabic-speaking countries. *J Obes* 2011;2011:686430.
 46. Backman DR, Haddad EH, Lee JW, Johnston PK, Hodgkin GE. Psychosocial predictors of healthful dietary behavior in adolescents. *J Nutr Educ Behav* 2002;34:184-92.
 47. Savoca M, Miller C. Food selection and eating patterns: Themes found among people with Type 2 diabetes mellitus. *J Nutr Educ* 2001;33:224-33.
 48. Primanda Y, Kritpracha C, Thaniwattananon P. Dietary behaviors among patients with Type 2 diabetes mellitus in Yogyakarta, Indonesia.

- Nurse Media J Nurs 2011;1:211-23.
49. Drury TF, Powell AL. Statistics NCFH. Prevalence of known diabetes among black Americans. USA: US Department of Health and Human Services, Public Health Service, National Center for Health Statistics; 1987.
 50. Shai I, Schwarzfuchs D, Henkin Y, Shahar DR, Witkow S, Greenberg I, *et al*. Weight loss with a low-carbohydrate, Mediterranean, or low-fat diet. *N Engl J Med* 2008;359:229-41.
 51. Islam SM, Niessen LW, Seissler J, Ferrari U, Biswas T, Islam A, *et al*. Diabetes knowledge and glycemic control among patients with Type 2 diabetes in Bangladesh. *Springerplus* 2015;4:284.
 52. El-Khawaga G, Abdel-Wahab F. Knowledge, attitudes, practice and compliance of diabetic patients in Dakahlia, Egypt. *Eur J Res Med Sci* 2015;3:40-53.
 53. Carr-Hill RA, Chalmers-Dixon P, Lin J. The Public Health Observatory Handbook of Health Inequalities Measurement. Oxford: South East Public Health Observatory; 2005.
 54. Al-Hamdan N, Kutbi A, Choudhry A, Nooh R, Shoukri M, Mujib S. WHO stepwise approach to NCD surveillance country-specific standard report Saudi Arabia. World Health Organization. 2005.
 55. Berkman ND. Center RI-UoNCE-bP. Management of Eating Disorders. Rockville, MD: Agency for Healthcare Research and Quality; 2006.
 56. Gaede P, Lund-Andersen H, Parving HH, Pedersen O. Effect of a multifactorial intervention on mortality in Type 2 diabetes. *N Engl J Med* 2008;358:580-91.
 57. Midhet FM, Al-Mohaimed AA, Sharaf FK. Lifestyle related risk factors of Type 2 diabetes mellitus in Saudi Arabia. *Saudi Med J* 2010;31:768-74.
 58. Chan YM, Molassiotis A. The relationship between diabetes knowledge and compliance among Chinese with non-insulin dependent diabetes mellitus in Hong Kong. *J Adv Nurs* 1999;30:431-8.
 59. Persell SD, Keating NL, Landrum MB, Landon BE, Ayanian JZ, Borbas C, *et al*. Relationship of diabetes-specific knowledge to self-management activities, ambulatory preventive care, and metabolic outcomes. *Prev Med* 2004;39:746-52.
 60. Hogan P, Dall T, Nikolov P; American Diabetes Association. Economic costs of diabetes in the US in 2002. *Diabetes Care* 2003;26:917-32.
 61. Siega-Riz AM, Popkin BM, Carson T. Trends in breakfast consumption for children in the United States from 1965-1991. *Am J Clin Nutr* 1998;67:748S-56.
 62. Haines PS, Guilkey DK, Popkin BM. Trends in breakfast consumption of US adults between 1965 and 1991. *J Am Diet Assoc* 1996;96:464-70.
 63. Timlin MT, Pereira MA. Breakfast frequency and quality in the etiology of adult obesity and chronic diseases. *Nutr Rev* 2007;65:268-81.
 64. McCrory MA, Campbell WW. Effects of eating frequency, snacking, and breakfast skipping on energy regulation: Symposium overview. *J Nutr* 2011;141:144-7.
 65. Rimm EB, Giovannucci EL, Stampfer MJ, Colditz GA, Litin LB, Willett WC. Reproducibility and validity of an expanded self-administered semiquantitative food frequency questionnaire among male health professionals. *Am J Epidemiol* 1992;135:1114-26.
 66. Feskanich D, Rimm EB, Giovannucci EL, Colditz GA, Stampfer MJ, Litin LB, *et al*. Reproducibility and validity of food intake measurements from a semiquantitative food frequency questionnaire. *J Am Diet Assoc* 1993;93:790-6.
 67. van Dam RM, Rimm EB, Willett WC, Stampfer MJ, Hu FB. Dietary patterns and risk for Type 2 diabetes mellitus in U.S. men. *Ann Intern Med* 2002;136:201-9.
 68. Joosten MM, Chiuve SE, Mukamal KJ, Hu FB, Hendriks HF, Rimm EB. Changes in alcohol consumption and subsequent risk of Type 2 diabetes in men. *Diabetes* 2011;60:74-9.
 69. de Munter JS, Hu FB, Spiegelman D, Franz M, van Dam RM. Whole grain, bran, and germ intake and risk of Type 2 diabetes: A prospective cohort study and systematic review. *PLoS Med* 2007;4:e261.
 70. Joosten MM, Chiuve SE, Mukamal KJ, Hu FB, Hendriks HF, Rimm EB. Changes in alcohol consumption and subsequent risk of Type 2 diabetes in men. *Diabetes* 2011;60:74-9.
 71. Farrah M. The impact of peer feedback on improving the writing skills among hebron university students. *An-Najah Univ J Res* 2012;26:179-210.
 72. Boucher BJ. Vitamin D insufficiency and diabetes risks. *Curr Drug Targets* 2011;12:61-87.
 73. Rotimi C, Daniel H, Zhou J, Obisesan A, Chen G, Chen Y, *et al*. Prevalence and determinants of diabetic retinopathy and cataracts in West African Type 2 diabetes patients. *Ethn Dis* 2003;13 2 Suppl 2:S110-7.
 74. Rodriguez-Poncelas A, Miravet-Jiménez S, Casellas A, Barrot-De La Puente JF, Franch-

- Nadal J, López-Simarro F, *etal*. Prevalence of diabetic retinopathy in individuals with Type 2 diabetes who had recorded diabetic retinopathy from retinal photographs in Catalonia (Spain). *Br J Ophthalmol* 2015;99:1628-33.
75. Khan AR, Wiseberg JA, Lateef ZA, Khan SA. Prevalence and determinants of diabetic retinopathy in Al hasa region of Saudi Arabia: Primary health care centre based cross-sectional survey, 2007-2009. *Middle East Afr J Ophthalmol* 2010;17:257-63.
76. Raman R, Rani PK, Kulothungan V, Sharma T. Diagonal ear lobe crease in diabetic South Indian population: Is it associated with diabetic retinopathy? Sankara Nethralaya diabetic retinopathy epidemiology and molecular-genetics study (SN-DREAMS, Report no. 3). *BMC Ophthalmol* 2009;9:11.
77. Zheng Y, He M, Congdon N. The worldwide epidemic of diabetic retinopathy. *Indian J Ophthalmol* 2012;60:428-31.
78. Krawagh AM, Alzahrani AM, Naser TA. Diabetes complications and their relation to glycemic control among patients attending diabetic clinic at King Khalid National Guard Hospital in Jeddah, Saudi Arabia. *Saudi J Int Med* 2012;1:29-33.
79. Rudel LL, Parks JS, Sawyer JK. Compared with dietary monounsaturated and saturated fat, polyunsaturated fat protects African green monkeys from coronary artery atherosclerosis. *Arterioscler Thromb Vasc Biol* 1995;15:2101-10.
80. Bantle JP, Wylie-Rosett J, Albright AL, Apovian CM, Clark NG, Franz MJ, *etal*. Nutrition recommendations and interventions for diabetes-2006: A position statement of the American Diabetes Association. *Diabetes Care* 2006;29:2140-57.
81. Franz MJ, Powers MA, Leontos C, Holzmeister LA, Kulkarni K, Monk A, *etal*. The evidence for medical nutrition therapy for Type 1 and Type 2 diabetes in adults. *J Am Diet Assoc* 2010;110:1852-89.
82. Holman RR, Paul SK, Bethel MA, Matthews DR, Neil HA. 10-year follow-up of intensive glucose control in Type 2 diabetes. *N Engl J Med* 2008;359:1577-89.
83. Control Group, Turnbull FM, Abraira C, Anderson RJ, Byington RP, Chalmers JP, *etal*. Intensive glucose control and macrovascular outcomes in Type 2 diabetes. *Diabetologia* 2009;52:2288-98.
84. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, *etal*. Seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure. *Hypertension* 2003;42:1206-52.
85. Cholesterol Treatment Trialists' (CTT) Collaborators, Kearney PM, Blackwell L, Collins R, Keech A, Simes J, *etal*. Efficacy of cholesterol-lowering therapy in 18,686 people with diabetes in 14 randomised trials of statins: A meta-analysis. *Lancet* 2008;371:117-25.
86. Al-Sinani M, Min Y, Ghebremeskel K, Qazaq HS. Effectiveness of and adherence to dietary and lifestyle counselling: Effect on metabolic control in Type 2 diabetic Omani patients. *Sultan Qaboos Univ Med J* 2010;10:341-9.
87. Elmazar HM, Essa AB, Ojurongbe O, Oyesiji K, Ojo J, Odewale G, *etal*. Environmental and dietary factors affecting the progression of Type 2 diabetic retinopathy in Aljabal Algharby, Libya. *Int Res J Med Med Sci* 2014;2:1-5.
88. Buscemi S, Nicolucci A, Mattina A, Rosafio G, Massenti FM, Lucisano G, *etal*. Association of dietary patterns with insulin resistance and clinically silent carotid atherosclerosis in apparently healthy people. *Eur J Clin Nutr* 2013;67:1284-90.