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Prevention and Management Strategies of Pre-Diabetes

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Abstract

Pre-diabetes is a metabolic condition that is visible before the development of diabetes mellitus (DM). It is characterized by elevated blood glucose levels greater than normal, but is not too high to the diagnostic criteria for diabetes. It is developed when the pancreatic β-cells are no longer able to supply sufficient insulin for the maintaining normoglycemia. It is highly prevalent, especially in older age groups and obese individuals. It is diagnosed through the impaired fasting glucose (IFG), which is between 100-125mg/dl (5.6 to 6.1mmol/l), impaired glucose tolerance (IGT), which is between 140-199mg/dl (7.8 to 11.0mmol/l), and elevated glycosylated hemoglobin (HbA1c), which is between 5.7-6.4%. Healthy lifestyle, sustainable dietary approaches, physical activity, briskly regular aerobic exercise, weight loss, and psychological support with pharmacotherapy can manage the pre-diabetes. In this study an attempt has been taken to discuss aspects of pre-diabetes with prevention and management strategies.

Keywords: pre-diabetes, risk factors, management, healthy diet, physical exercise

1. Introduction

At present diabetes mellitus (DM) has become a serious health problem worldwide. DM patients may face macro-vascular diseases, such as blindness, kidney failure, lower-limb amputation, heart disease, stroke and peripheral vascular disease; and micro-vascular diseases, such as retinopathy, neuropathy and nephropathy (Reyden et al., 2007; van Dieren et al., 2012). Pre-diabetes is a condition that comes before diabetes, in which blood sugar levels remain greater than "normal", but is not high enough to be called diabetes (American Diabetes Association, 2019; Mohajan & Mohajan 2023c). Sometimes it is considered as impaired glucose tolerance (IGT). It is an asymptomatic intermediate state of hyperglycemia with a major risk of developing T2D. It is increasing at an alarming rate due to industrialization, urbanization, physical inactivity, series of excess consumption of fast foods, and overeating of carbohydrate, sugar-rich foods and fat-rich foods (Rariden, 2019).

Pre-diabetes is a national and worldwide health concern, and early identification and intervention have been successful in delaying and/or preventing the progression to type 2 diabetes (T2D) (American Diabetes Association, 2019). It is considered as a preventable disease. If a person of pre-diabetes is remained untreated for a long-time, s/he is at relatively high risk for the development of type 2 diabetes and cardiovascular disease (CVD). It is estimated that each year 5-10% of individuals with pre-diabetes will develop to T2D (Hordern et al., 2012).

Since 1980, the global prevalence of diabetes has almost doubled. International Diabetes Federation (IDF) shows that in 2019, diabetes caused 4.2 million deaths, and 463 million adults aged between 20 and 79 years old are living with diabetes that costs $720 billion per year. It is expected that diabetes patients may rise up to 552 million by 2030 and 700 million by 2045, respectively (Galicia-Garcia et al., 2020). It is estimated that one-third of all adults have pre-diabetes in developed countries, such as in the USA and the UK; about 90% of them are

unaware that they are in a dangerous situation of DM (Tabák et al., 2012; Li, 2013).

Common diagnose of DM are; i) fasting plasma glucose (FPG) level ≥126mg/dl (7.1mmol/l), a person has not eaten overnight or for the last 8 hour, ii) plasma glucose (PG)≥200mg/dl two hours after a 75g oral glucose load (OGL), and iii) random plasma glucose (RPG)≥200mg/dl (11.1mmol/l) with unequivocal signs of hyperglycemia (IDF, 2017; García, 2017).

2. Literature Review

Literature review is an introductory section where research works of previous researchers are highlighted to make familiar with the new researchers in the research world (Polit & Hungler, 2013). It also helps the researchers to understand the core concept of the subject, and it serves as an indicator of the subject that has been carried out previously (Creswell, 2007). Agung Pranoto has provided a guideline to improve the skills of healthcare professionals in recognizing pre-diabetes condition. He has observed that most people are at high risk for diabetes and an appropriate disease management is necessary so that the incidence and complication of DM can be reduced (Pranoto, 2014).

Christina Rariden has observed that to reduce the prevalence of T2D, identifying and managing of pre-diabetes is necessary. She has realized that early identification and intervention have been successful in delaying and/or preventing the progression to T2D (Rariden, 2019). Kirstine Bell and her coauthors have tried to recommend on a multidisciplinary approach that implements healthy lifestyle changes through education, nutrition and physical activity. They have wanted to show that early detection of pre-diabetes prevent the development of T2D and cardiovascular disease (Bell et al., 2020).

Abdullah Alomari and Saad Al Hisnah have aimed to detect the prevalence rate of pre-diabetes among the adult population and to assess the association of the risk factors to pre-diabetes in both the men and women through the fasting plasma glucose (FBG) and hemoglobin A1c (HbA1C). They have obtained that highly prevalent of pre-diabetes among adults attending (20%) that is associated with obesity, hypertension, and a family history of DM (Alomari & Hisnah, 2022). Joline W. Beulens and her coauthors describe the pre-diabetes, progression from pre-diabetes to T2D or other vascular complications, risk factors associated with progressions and the management of progression to T2D. They have observed that lifestyle modification and metformin use are the effective tools in preventing the development of pre-diabetes (Beulens et al., 2019).

Justin B. Echouffo-Tcheugui and Elizabeth Selvin have used five different definitions of pre-diabetes, which are based on different cut points of HbA1c, fasting glucose, and 2-hour after a 75g oral glucose load. They have shown risks of major complications in persons with pre-diabetes are T2D, cardiovascular disease, kidney disease, and death, and these also vary depending on the pre-diabetes definition used (Echouffo-Tcheugui & Selvin, 2021).

3. Research Methodology of the Study

Research is an essential part for academicians to develop their academic area (Pandey & Pandey, 2015). Methodology is a guideline to prepare a good research (Kothari, 2008). Therefore in brief, a research methodology is the collection of a set of principles for planning, designing, organizing, and conducting a good research (Legesse, 2014).

In this study we have started our main section with the risk factors of pre-diabetes. Then we have briefly discussed management techniques of pre-diabetes. To prepare this article we have dependent on the secondary data sources related to pre-diabetes. We have consulted books of famous authors, national and international journals, e-journals, handbooks, theses, etc.

4. Objective of the Study

The core objective of this study is to discuss prevention and management strategies of pre-diabetes. Other minor objectives of the study are as follows:

- to show the risk factor of pre-diabetes, and
- to created awareness about the pre-diabetes,

5. Pre-Diabetes and Risk Factors

Pre-diabetes is a major public health issue globally. When the fasting blood glucose level, i.e., impaired fasting glucose (IFG) is 100 to 125 mg/dl (5.6 to 6.1mmol/l) or when the 2-hour postprandial blood glucose level, i.e., impaired glucose tolerance (IGT) is 140 to 199 mg/dl (7.8 to 11.0mmol/l), then the individual is considered as pre-diabetes patient (Aroda & Ratner, 2008). The metabolic syndrome, obesity (especially abdominal or visceral obesity), physical inactivity, hypertension, dyslipidemia (the high-triglyceride and/or low HDL type), blood pressure, smoking, hyperglycemia, and family history of diabetes are major risk factors of DM (Pranoto, 2014). The most common test of pre-diabetes is the HbA1c or A1c (glycosylated hemoglobin) that is used to diagnose

and monitor diabetes, which measures average blood sugar level for the past two to three months. From the diagnosis A1c 5.7 to 6.4% (39 to 47mmol/mol) indicates pre-diabetes (WHO, 2002).

Both T2D and pre-diabetes provide similar nature in diagnosis and treatment; also risk factors of both are similar. Overweight and obesity are strong predictors for the development of pre-diabetes. There is a strong correlation between obesity and pre-diabetes. Also unhealthy eating habit and physical inactivity are main causes of development of pre-diabetes. Some other non-modifiable risk factors are; genetic factors, age, sex, high total caloric intake, etc. (Albright & Gregg, 2013). The people whose age are >45 years, overweighed (25≤BMI ≤30), and obese (BMI≥30), and having a higher waist circumference are in the high risk of pre-diabetes. If a parent and/or sibling are with diabetes may infected with pre-diabetes (Hordern et al., 2012; Mohajan & Mohajan, 2023b). There is no clear evidence of influence of genetic factors for the development of pre-diabetes. But people of different ethnic groups, such as African, African American, Asian American, Native American, Arab, Latino, Hispanic, Asian, Indigenous, South Asian, and Pacific Islander; have a chance of infected with pre-diabetes earlier (Uusitupa et al., 2011).

Long-time consumption of low fiber diet, high caloric food intake, high glycemic load, and low ratio of polyunsaturated fatty acid are risk factors for the development of pre-diabetes (Bansal, 2015). The women, who are infected by gestational diabetes or with polycystic ovary syndrome, are at high risk of developing pre-diabetes in the future (Tarvonen et al., 2021). On the other hand, women with pre-diabetes before pregnancy have a higher risk of developing gestational diabetes (Bell et al., 2020).

6. Pre-Diabetes Management

The management of pre-diabetes can be performed through the lifestyle modification, psychological support, and application of pharmacotherapy appropriately. Early detection of pre-diabetes is essential to facilitate optimal management to prevent the development of conditions, such as type 2 diabetes and cardiovascular disease (Mainous et al., 2016; Bell et al., 2020).

6.1 Lifestyle Modification

Lifestyle modification is a fundamental approach to effectively prevent or delay the progression of pre-diabetes to diabetes. It can reduce all risk factors of pre-diabetes and its related diseases (Pranoto, 2014). It is an integral part of pre-diabetes management, and the addition of pharmacotherapy is appropriate in high-risk patients. For example, weight reduction, healthy eating, regular physical activity reduce stress, improve sleep; and smoking cessation will be benefited for the prevention of pre-diabetes (Rariden, 2019).

6.2 Healthy Diet

Dietary recommendations include monitoring of calories, reduced carbohydrate intake, and high fiber consumption. High fiber and low-fat foods emphasize for the consumption of whole grains, fruits, vegetables, lean proteins, low-dairy products, and eight glass of water per day (Forouhi et al., 2018). Reduction of consumption of various fast-foods, such as cakes, biscuits, confectionery, fried snacks, etc. is beneficial of delay of pre-diabetes. Avoid of excess salt, alcohol, and caffeine, such as coffee, tea, diet pop, etc. are also essential for the prevention of pre-diabetes (Lindström et al., 2013). High sugar foods, such as desserts, honey, jam, regular pop, juice, sweetened beverages, ice cream, syrups; high fat foods, such as French fries, chips, and pastries are accelerated the pre-diabetes (Tonstad et al., 2013).

6.3 Physical Activity and Weight Loss

Main goal of pre-diabetes treatment is weight loss which is beneficial for healthy life. Diabetes Prevention Program (DPP) observes that obese people can take attempts to reduce 5% to 10% weight to delay or prevent the pre-diabetes. Therefore, about 5-10% loss of body weight if the individual is overweighed can lead a health life, and increased exercise can prevent or delay the development of pre-diabetes (Johnston et al., 2014). Also, an individual can reduce fat mass, decreased blood pressure, glucose, low density lipoprotein (LDL) cholesterol, and triglycerides levels through the weight loss strategy (Alberti et al., 2007; Mohajan & Mohajan, 2023a). A program of regular moderate to vigorous physical activity or aerobic exercise for 30 to 60 minutes daily, at least 4 days weekly or minimal 150 minutes/week can provide a healthy life to an individual (Goodpaster, 2010). Reduction of daily fat intake to less than 30%, reduction of daily saturated fat intake to less than 10%, and a minimum daily fiber consumption of 15g per 1,000 kcal can reduce the risk of developing pre-diabetes. Metformin use of routine wise is effective to reduce the risk of development of pre-diabetes (Tuomilehto et al., 2001).

7. Conclusions

From this study we have observed that the prevalence of pre-diabetes is high in the worldwide. People with pre-diabetes are at the increased risk to develop T2D. Pre-diabetes is a leading cause of both morbidity and mortality. There are various risk factors that are related to pre-diabetes, such as physical activity, waist

circumference, family history of diabetes, hypertension, sex, age group, BMI, smoking, and family history of diabetes and cardiovascular diseases (CVDs). We have observed that lifestyle modification and medication are both effective in preventing the development of pre-diabetes. Regular physical activity and moderate to vigorous intensity aerobic exercise should be done for the maintaining of normal body weight and for the reduction of blood glucose.

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