Research Paper

A Strategy for Prevention of Type 2 Diabetes Mellitus in Guyana: The Guyana Diabetes Risk Score

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ABSTRACT

Background: Type 2 Diabetes Mellitus (T2DM) imposes an enormous and mounting burden on global public health systems, especially in developing countries such as Guyana. However, primary prevention of type 2 diabetes can be achieved through organized lifestyle intervention programs for weight loss, increased physical activity and dietary restrictions. Therefore, there is a need to develop local risk stratification tools tailored to the local population to identify high-risk individuals who may benefit from these interventions.

Objectives: This study proposes implementing a program for the primary prevention of T2DM in high-risk adults (18-55 years) in Guyana. The main objective is to identify adults at high-risk for developing type 2 diabetes mellitus using a Diabetic Risk Score and to enroll the participants in a lifestyle intervention program.

Methods: The health belief model is a theoretical framework that guides health promotion programs by predicting health behaviours. A health promotion campaign will target high-risk adults at local healthcare facilities and across Guyana through television, radio and social media adverts. The health promotion adverts will inform and educate the target population to complete the Guyana Diabetic Risk Score questionnaire. If the score on the Guyana Diabetic Risk Score questionnaire exceeds 50, the participants will be enrolled in a lifestyle intervention program, 'Healthy Me'.

Results and Discussion: Minor changes in lifestyle, such as a healthy diet, increased physical activity, and healthy body weight, can reduce diabetes in high-risk adults by over 50%.

Conclusions: The Guyana Diabetes Risk Score is a low-cost, non-invasive, practical tool to identify individuals at high risk for T2DM in Guyana.

Keywords: Type 2 Diabetes Mellitus, T2DM, Guyana Diabetes Risk Score

INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disease characterized by high blood glucose levels due to insufficient insulin production or diminished cellular sensitivity to insulin levels.[1,2] T2DM results from a complex interaction of biological factors (genetics, ethnicity, age, and family history) combined with environmental and behavioural influences such as a sedentary lifestyle and obesity.[3]

According to the World Health Organization's *Global Diabetes Report*,' the incidence and prevalence of T2DM have steadily increased and quadrupled since 1980. Alarmingly, the prevalence of diabetes and the morbidity and mortality associated with T2DM are significantly higher in low- and middle-income countries than in developed countries. [4]

The World Health Organisation recommend effective methods for preventing T2DM, its complications, and premature death. These include policies and practices applicable to entire populations and specific settings such as schools, homes, and workplaces. Early in life, when eating and physical activity habits are formed, and the long-term regulation of energy balance may be conditioned,

intervention is crucial to mitigate the risk of T2DM later in life. The prevention of T2DM advocates for a governmental and societal approach in which all sectors consider the health impact of trade, agriculture, finance, transportation, education, and urban planning, recognizing that these policies will improve or impede health.[4]

Diabetes prevention studies from Japan, Europe and India show that healthy behavioural changes in diet or physical activity can reduce the incidence of T2DM by approximately 60% in 4 years. Physical activity improves glucose tolerance and leads to weight loss. Any physical activity can be incorporated into a healthy lifestyle; Lindstrom et al. advocate that walking for more than 150 minutes per week reduces the risk of DM by over 60%.[5] Wu et al. suggest that keeping a daily step is an effective self-regulatory strategy to promote increased physical activity.[6]

Dietary composition is essential in the prevention of T2DM. The Finnish Diabetes Prevention Study advocated decreasing total and saturated fat intake and increasing fibre density in the diet and reinforced that excessive amounts of refined grains, sugar-sweetened beverages, red and processed meat, and alcohol markedly increased the risk of T2DM. [5,7] obesity is the most crucial risk factor for T2DM, and weight reduction can prevent or delay the incidence of T2DM. Lindström et al. advise that each kilogram of weight loss is correlated with a 16% reduction in the development of T2DM.[5] However, it is healthier and more sustainable for people to gradually change their diet or physical activity levels since the paucity of habitual and consistent behaviour is one of the barriers to achieving weight loss.[6]

Walker et al. recommend that any approach to prevent diabetes should address the social inequalities within the local population. Social determinants of health such as profession, education, income, access to housing and healthy food are decisive factors which increase the prevalence of DM. People with lower income and less education are more likely to develop T2DM. [8,9] Local communities also contribute to individual health status through access to healthcare and healthy foods; and by providing designated areas for physical activity.[10]

T2DM has imposed an enormous and mounting burden on public health systems in Guyana and globally.[11] However, there is robust evidence for the primary prevention of T2DM from several randomized controlled trials. Lindstrom et al., Ramachandran et al., and Kosaka et al. have conducted large trials in Europe, India and Japan, proving that lifestyle interventions can prevent the onset of type 2 diabetes mellitus in high-risk individuals. These trials show that a few years of delayed diabetes progression will reduce diabetes-related complications. [12-14] The key to prevention is lifestyle changes such as weight loss (if participants are overweight), increased physical activity, and dietary modifications to reduce fat intake. The more of these goals the participants achieved, the lower their risk of developing DM. [12-14] Thus, the need for developing risk stratification tools to identify high-risk individuals who may benefit from these interventions promptly.[15]

According to Gillies et al., approximately 20-30% of people with T2DM were undiagnosed before developing diabetes-related complications, mainly due to ineffective screening for DM. [16] Therefore, an alternate screening method is essential for earlier diagnosis or prevention of T2DM. There are various risk assessment tools based on self-assessment and biochemical and genetic markers for the prediction of T2DM; however, laboratory-based diagnostic methods are expensive. The International Diabetes Federation suggested using simple risk-scoring questionnaires to identify individuals at high risk for developing T2DM. [17] Furthermore, non-invasive prediction models are more cost-effective and more practical for screening large populations. Risk score

questionnaires have shown good sensitivity and specificity for identifying the prevalence and incidence of impaired glucose regulation. They measure non-invasive data about age, sex, height, waist circumference, BMI, ethnicity, history of hypertension and diabetes, physical activity, and diet composition.[18] The FINDRISC (Finnish Diabetes Risk Score) questionnaire is used extensively in Europe and adapted in other countries to self-assess the risk of T2DM. This questionnaire is designed on seven questions and has proven validity in predicting future diabetes onset over 10 years.[12] In South America, trials by Gomez-Arbelaez et al. in Columbia and Bernabe-Ortiz et al. in Peru used the FINDRISC questionnaire as a screening tool to successfully identify undiagnosed T2DM and to predict the incidence of T2DM among high-risk individuals. [17,19]

Demographics
Guyana is a developing country located on the north-eastern coast of South America. It has a population of 747,884 residents, with an average life expectancy for males at 63.5 years and 68.7 years for females.[20] However, the risk of premature death (between the ages 30 – 60 years) from non-communicable diseases is 31% in Guyana, mainly due to smoking, alcohol abuse, physical inactivity and unhealthy diet leading to hypertension and diabetes.[11] In addition, the Ministry of Public Health in Guyana estimates that 14% of the adult population is plagued by diabetes. This is the highest prevalence in South America and is expected to rise to 17.9% by 2030.[21]

Aim and Objectives of a DM Prevention Program for High-Risk Adults
This strategy aims to prevent or delay T2DM in high-risk adults (aged 18 – 55 years) in Guyana.

Objectives
1. Identify adults at high-risk for developing T2DM by implementing the Guyana Diabetic Risk Score over three months.

The Guyana Diabetic Risk Score (GDRS) will be a simple questionnaire to estimate a person's risk of being diagnosed with DM in the next 10 years.
The questionnaire will include age, abdominal obesity, physical activity, family history of diabetes and body mass index (BMI). The GDRS will be used for screening at healthcare facilities, places of employment, and schools and in a nationwide screening campaign through interactive social media platforms such as Facebook and Instagram.

2. Promote lifestyle changes to aid in weight loss > 5 % and increase physical activity levels to 150 mins weekly over six months.

A lifestyle programme called 'Healthy Me' will be designed to increase physical activity to more than 150 minutes weekly, divided into three or more sessions. Weight loss will be aided by dietary modification with a dietician at the local healthcare facilities and through meal planning and online healthy cooking demonstrations. The use of five fruits/vegetables per day, a food diary and the plate model are well-documented methods.[12] Media campaigns to promote healthy nutrition will include radio, television and Facebook advertisements.

3. Decrease sedentary and obesogenic behaviours through community participation and public health policies by 2025.

Community participation will be essential to achieve an effective and sustainable program to prevent diabetes in high-risk adults.[2] Meetings and discussions will be held with stakeholders to inform the need to create a healthier environment. Stakeholders will include corporate and small business employers, proprietors of supermarkets, bars, cafes and restaurants, school directors and local education officials. Local and national public health authorities will also be invited.

Methodology to Implement a DM Prevention Programme

This health promotion strategy aims to teach healthy behaviour (increased physical activity, healthy nutrition and weight loss) through lifestyle changes in adults at high risk for developing diabetes.

Lifestyle changes can prevent diabetes in high-risk adults through behaviour modification.[12-14] The health belief model is a theoretical framework used to guide health promotion programs by predicting health behaviours at an individual level. It emphasizes the use of various health education methods to change a person's perception of their risk of acquiring a disease leading to the adaptation of new behaviours.[22,23]

The health belief model is an individual-only theory and does not apply to social and environmental concerns. In comparison, the nudge theory argues that a person's behaviour can be changed by making small changes to their environment. The focus is on modifying the surrounding environment rather than changing how people think.[22,24]

The 'Healthy Me' program will be implemented through individual and population strategies. The individual strategy will target the prevention of diabetes in high-risk adults through interventions at designated local healthcare facilities countrywide. Local awareness campaigns at primary and secondary healthcare facilities, places of employment and universities will be conducted through meetings, lectures and seminars. Each participating healthcare facility will use planned activities for the implementation of prevention of diabetes programs using existing and supporting resources to provide the participants with support for lifestyle changes.

The population strategy will focus on increasing awareness of diabetes and its risk factors in the general population through an online interactive platform for activities aimed at behaviour modification. A nationwide media campaign involving television, radio, newspapers and social media will inform and educate the target population (adults aged 18 – 55 years) of the possibility of high- risk of developing diabetes. They will be urged to complete the Guyana Diabetic Risk Score (see Fig. 1) and, if the score is above 50, to enrol in a 'Healthy Me' online programme.

The evaluation of this program will report the outcome in six months and one year.

This 'Healthy Me' program is a locally designed module adapted from the IMAGE Toolkit used in Europe for preventing T2DM.[12] Educational videos will be designed to highlight the risk factors of diabetes and how minor changes in lifestyle can prevent diabetes, its comorbidities and life-threatening complications. Since the prevalence and morbidity of diabetes are high among Guyanese, adults can be convinced of their risk of developing the disease due to experiences with diabetic family members and colleagues. Risk perception is essential in developing healthy behaviours.[23] To achieve the perceived benefits construct of the framework, education classes focused on risk factor reduction and the benefits of simple lifestyle changes will be enforced. The idea that diabetes is a condition that can be prevented by minor lifestyle modification will be emphasized.[24] Participants will be encouraged to read food labels, make homemade meals, and eat smaller portions using a plate model.[12] This will be done through online cooking demonstrations and meal planning.

Societal involvement will help mitigate barriers and sustain healthy behaviour, especially early in the program when patient uncertainty may allow financial and social limitations to outweigh the potential benefits.[23,24] Initiatives will be pursued to allow participants discounted healthy food at supermarkets and provide discounted access to neighbourhood fitness facilities.

Self-efficacy or confidence in one's ability to perform an activity is a precursor to maintaining behaviour change.[25,26] Thus, one of the objectives of this health promotion activity will be to recognize

small success in weight loss, augmented physical activity and healthier nutrition. Television programs, radio, and Facebook ads will expose participants to various physical activities such as yoga, dancing, running and weight drills to facilitate finding a form of physical activity that would be fun and easy to practice long-term. Individuals are expected to maintain behaviours they like, transforming into sustainable behaviour change.[26]

Health Promotion Message of the T2DM Prevention Programme

The campaign to prevent type 2 diabetes mellitus in high-risk adults in Guyana will instil the following messages.

- Type 2 diabetes mellitus can be prevented or delayed in high-risk adults by implementing simple lifestyle changes such as weight reduction, increased physical activity and healthy nutrition.[14,15]

- Being overweight or obese is the main contributing modifiable risk factor for diabetes.[2]

- Type 2 diabetes mellitus can have a prolonged pre-diabetic phase, often lasting from 5 to 10 years, during which it is often undiagnosed. This can lead to cardiovascular disease, even before the diagnosis of diabetes.[27,28]

- The local community can aid in lifestyle changes. Numerous studies have linked diabetes, obesity and a sedentary lifestyle to a lack of resources for physical activity and the amplified presence of unhealthy food venues.[2,27]

Guyana Diabetic Risk Score	
Particulars	Score
Age	
< 35 years old	0
35-50 years old	10
>50 years old	20
Abdominal Obesity	
Waist <80cm (female);90 cm (male)	0
80-89 cm (female); 90-99cm (male)	10
>90cm(female); 100cm(male)	20
Physical Activity	
Vigorous regular exercise or strenuous activity at home or work	0
Mild to Moderate exercise or mild to moderate activity at home or work	10
No exercise or sedentary at work	20
Family History	
No Family History	0
Either parent diabetic	10
Both parents' diabetic	20
Body Mass Index (BMI)	
Between 18.5- 25	0
Between 25-30	10
Above 30	20
TOTAL SCORE	

*Any score above 50 requires Diabetic Screening with Oral Glucose Tolerance Test (OGTT) and enrolment to Health and Fitness program.

Fig. 1: Guyana Diabetic Risk Score

Evaluation of the DM Prevention Programme

Evaluation is essential to a diabetic prevention program. The results of this program will be evaluated to determine the success of the 'Healthy Me' approach and to justify that the resources allocated to this programme were used effectively. Measurements will be standardized to the metric system, and the methods used will be validated by published research.[13, 27]

Optimal standards will be necessary for organized evaluation and reporting at a state level.

The 'Healthy Me' campaign will be evaluated using the Guyana Diabetic Risk Score Toolkit (see Fig. 1). This evaluation tool is adapted from the IMAGE toolkit used in Europe.[12]

High-risk adults scoring more than 50 points in the Guyana Diabetic Risk Score will be enrolled in the 'Healthy Me' programme. All

the participants enrolled in the 'Healthy Me' programme will have their data recorded at the local health facility or will be contacted via telephone if they use the online platform. All participants will have an oral glucose tolerance test (OGTT) at baseline, after six months and one year.

In the local healthcare facilities, the Guyana Diabetic Risk Score Evaluation Toolkit will be completed by the participants and verified by a healthcare professional designated for this task. The following parameters will be measured, standardized, and filed into the evaluation toolkit.[29]

- Height will be measured to the nearest centimetre.
- Weight will be measured to the nearest 0.1 kg with the participant in light clothing.
- Waist circumference will be measured midway between the lowest rib and the iliac crest to the nearest centimetre.
- BMI will be calculated as weight in kilograms divided by the square of height in meters.
- An OGTT with a glucose load of 75 g and fasting and 2-hour plasma samples. The test will be done in the morning after overnight fasting using venous plasma samples.

Equivalent examinations will be performed at baseline, six months and one year. OGTT has shown superiority as a screening tool over HbA1c levels.[30]

- Participants with fasting glucose levels ≥7.0 mmol/l or 2-hour glucose ≥11.1 mmol/l will be diagnosed with type 2 diabetes and referred to a chronic disease clinic. Therefore, they will not be enrolled in the 'Healthy Me' programme.
- Participants with 2-h venous plasma glucose ≥7.8 and <11.1 mmol/l and fasting plasma glucose <7.0 mmol/l were classified as having impaired glucose tolerance (IGT) and enrolled in the programme.
- Impaired fasting glucose (IFG) is defined as fasting plasma glucose ≥6.1 but <7.0 mmol/l and 2-hour glucose <7.8 mmol/l. These individuals will also be enrolled in the 'Healthy Me' Programme.

Intervention visits at the healthcare facility will be done through individual and group counselling sessions. Group sessions will include lectures and practical sessions on diabetes, lifestyle changes, weight loss and exercise.[12,28] Intervention group meetings will be held monthly.

Diabetic Risk Assessment Questionnaire
Follow-up:
- 6months
- 1 year

Details	Points	Score
Age		
< 35 years old	1	
ears old	2	
> 50 years old	3	
Body Mass Index		
Between 18.5-25	1	
Between 25-30	2	
Above 30	3	
Weight Loss		
<2.5%	1	
2.5%-3%	2	
>3%	3	
Abdominal Weight Loss(cm)		
<1cm	1	
1-3cm	2	
>3cm	3	
TOTAL		
Oral Glucose Tolerance Test (OGTT): results greater than reference		
Fasting: 60 to100mg/dl		
1 hour:< 200mg/dl		
2 hours:<140mg/dl		
Diabetic Risk Score		

Fig. 2: Diabetic Risk Assessment Questionnaire

Data Analysis and Application

Analysis of the data gathered from evaluating the 'Healthy Me' programme will provide valuable information for community leaders, national health policymakers and the Ministry of Public Health.

Public health stakeholders can use this information to create an environment that facilitates healthy living. For example, policies can be explored to enforce menu labelling in restaurants and cafeterias and incorporate nutrition and physical education into schools' curriculums. Other stakeholders, such as corporate employers, can also be encouraged to provide healthy food and snacks for their employees at subsidized costs.[2]

Local government authorities can invest in public gyms and parks with recreation centres to provide equal access to physical activity facilities for all social classes.[28]

The objectives and targets of future intervention programmes for other chronic diseases can be modelled from this successful venture. Furthermore, analysis of the results of this prevention activity can lead to a more judicious allocation of resources.[27]

It will also be essential to communicate the evaluation results of the 'Healthy Me' programme to the doctors and nurses of local healthcare facilities, physical activity trainers, dieticians, nurses and other specialized staff involved in the programme. This will help to renew their enthusiasm and lend continued support for future projects.

Applications

Using a simple and easy-to-use questionnaire, such as the Guyana Diabetic Risk Score, as a primary screening method for T2DM, followed by more invasive and accurate diagnostic testing, constitutes a cost-effective and practical method with a potentially high impact on public health.

CONCLUSION

The Diabetes Risk Score is a low-cost, non-invasive and reliable tool to identify persons at high-risk for type 2 diabetes in the general population.[12-15]

The onset of diabetes can be prevented or delayed in high-risk adults (individuals with obesity, a sedentary lifestyle and impaired glucose regulation). Minor changes in lifestyle, such as a healthy diet, increased physical activity, and healthy body weight, can reduce diabetes by over 50%.[14,15]

A practical and sustainable approach to diabetes prevention should combine individual and population-based primary prevention. Therefore, collaboration is needed across diverse sectors such as the food industry, the media, education workers, non-governmental organizations, metropolitan designers and legislators.[15]

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