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TO STUDY THE RISK ASSESSMENT OF DIABETES AMONG THE HOUSEWIVES OF HYDERABAD USING THE INDIAN DIABETES RISK SCORE {IDRS}

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ABSTRACT

Introduction: Diabetes is chronic metabolic disorder which has taken a turn into epidemic for India especially Hyderabad. It is characterized by increase blood glucose levels i.e., Hyperglycemia. When the blood glucose levels are > 100 mg/dL, it is considered diabetic. There is no cure for Type 2 Diabetes Mellitus though prevention in the form of proper dietary habits and following exercise regime can help reduce the incidence of developing diabetes in those individuals who have genetic predisposition to it. To reduce the incidence of diabetes amongst the population, IDRS is a score test used to identify individuals who have high risk of developing diabetes. The main objective of this study is to check whether there are changes in the IDRS scores of high-risk individuals post nutrition intervention and inclusion of physical activity.

Methods: It is a community based cross-sectional study consisting of 201 participants out of which n=24 were identified as high risk (having IDRS >80). It is a randomized controlled trial with two study groups. All the n=201 participants filled the IDRS and the individuals identified as high risk received nutritional intervention in the form of customized nutrition plan to maintain their weights. Two follow ups were conducted for the high-risk individuals – their height, weight, BMI, waist circumference and IDRS scores were recorded. This data was then analyzed using SPSS and MS Excel.

Results – In the baseline study the IDRS Scores for No exercise individuals were 79.55 ±4.82. After both follow up 1 and 2 it was 79.55 ±4.82. For moderate Exercise individuals, the IDRS score during baseline was 80.00±0.000. After follow up 1 and 2 it was 64.44±12.360 and 62.22±13.07 respectively. There were no participants who performed heavy exercise. Participants (n=11) were performing heavy exercise after follow up 1 and 2. Their IDRS scores were recorded as 70.91±8.312 during the first follow up and after the next follow up it was 64.44±23.66. The p = >0.005, it was deemed statistically insignificant though comparatively changes were seen.

Conclusion- From this study it is concluded that participants (n=4) who did not perform any exercise, there was no change in their IDRS score before and after follow ups. In the participant (n=9) who followed moderate exercise, there was 2.22±0.71 change in there IDRS scores. And for the participants who performed heavy exercise (n=11), there was the highest change in their IDRS scores being 6.5±15.34. Therefore, participants performing heavy exercise with addition to following proper nutrition, can be prevented from developing diabetes, provided they continue to follow the same.

Keywords - Indian Diabetes Risk Score, Diabetes, IDRS.

INTRODUCTION

Diabetes Mellitus {DM} is defined as a group of metabolic disorders characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. (American Diabetes Association). Diabetes is a metabolic disorder which is associated with deficiencies in insulin action or insulin secretion which leads to the body's inability in converting glucose to energy. This in turn results in elevated levels of blood glucose levels i.e., Hyperglycemia. Pancreas is an important organ associated with the causation of Diabetes. It is composed of various types of cells. The β-cells of the pancreas produce the hormone insulin. The carbohydrates we consume are converted into glucose which is used as a source of energy, under the influence of the hormone insulin. Individuals with diabetes, this function is impaired either due to the inability to secrete insulin or when the pancreas fails to produce sufficient quantities of it. Diabetes is characterized by symptoms such as polyuria [frequent urination], polyphagia [increased hunger], polydipsia [increased thirst], fatigue, blurred vision, headache, delayed healing of cuts etc. If these symptoms are overlooked and left untreated it may result in the development of certain chronic complications. (Gupta and Gupta, New concise Medical Dictionary, fourth Edition distributors, 2006)[1].

Types of Diabetes

There are mainly three types of diabetes – Type 1 also known as Insulin Dependent Diabetes- Mellitus [NIDDM] and Type 2 which is also known as non-Insulin dependent Diabetes Mellitus [NIDDM]. Type 1 is also referred as "Juvenile Diabetes". Type 1 diabetes is characterized by insufficient production of insulin by the pancreas caused due the destruction of β-cells, the cells that

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produce insulin. Type 1 is seen in adolescents. It results in taking insulin from the outside source. Type 2 diabetes is the most common form of diabetes in which the pancreas produces insulin but it is not effectively utilized. And the third main form is gestational diabetes, which occurs in pregnant women without a previous history of diabetes.[2]

It is suggested that people with diabetes should take the utmost care of their blood glucose levels so that there are no sudden peaks in the levels. The main goal of diabetes management is to keep the blood glucose levels from rising and maintaining it to a normal. Diabetic individuals should take care of their day-to-day activities which includes regular monitoring of the blood glucose levels, lifestyle modification, dietary management, inclusion of some type of physical activity.[3]

Management of diabetes

Management of diabetes is multifactorial involving medical nutrition management, physical activity as well as lifestyle modifications. Dietary management is an integral part which helps in managing diabetes. The main goals of dietary management are to –

- Attain and maintain normal blood glucose levels throughout the day.
- Treat and prevent the complications associated with diabetes.
- Modify nutrient intake and make lifestyle changes to improve the condition.
- Improve the overall health by making healthier food choices.
- And for individuals who are at risk for diabetes, to decrease this risk by encouraging physical activity and promoting food choices that facilitate moderate weight loss or at least prevent weight gain. (Sharad Pendsey, Practical Management of Diabetes: Jaypee brothers Medical Publishers, 1997)

Epidemiology of Diabetes

According to WHO, about 422 million in the world are affected with diabetes. Out of which the majority of the individuals belong to low-and middle-income countries, and around 1.6 million deaths are directly attributed to diabetes each year. Both the number of cases and the prevalence of diabetes have been steadily increasing over the past few decades. Diabetes is now considered the leading cause of death all over the world. Diabetes is a lifestyle disorder which is supposedly increasing at an alarming rate. The International Diabetes Federation (IDF) has estimated that currently there are about 100 million people living with diabetes worldwide out of which 6% represents the adults. (Rajendra, Pradeepa et al 2002)[4]

The incidence of diabetes in three leading countries with diabetes populations i.e., China, India, and United States of America will increase from an approximate estimate of 90, 61.3 and 23.7 million people with diabetes in 2011 to 129.7, 101.2 and 29.6 million people respectively by 2030 with more than 60% of the world's diabetic population in Asia in 2030 (International Diabetes Federation, 2012).[5]

Currently India is recognized as the capital of diabetes in the world with 62 million diabetic individuals residing in India. According to Wild et al, the prevalence of diabetes is predicted to double globally from 171 million in 2000 to 366 million in 2030.[6] This increase in prevalence is predicted with a maximum increase in India. It is predicted that by 2030 diabetes mellitus may afflict up to 79.4 million individuals in India. India currently is facing a potential burden with the rise of diabetic individuals in the country, with southern regions seeing a peak. In India, Hyderabad, Telangana, is recognized to be the hub of rapidly increasing numbers of diabetic individuals. Environmental and lifestyle changes and migration to urban environments from rural areas may be the reason to a large extent, for this epidemic of Type 2 diabetes seen in India. There are a number of predisposing factors that lead to rise in the prevalence rates. These factors may be geographic migration, genetics, increased insulin resistance, aging and lifestyle changes like sedentary lifestyle etc. The explosion of diabetes in India increases the propensity for developing a broad spectrum of irreversible complications.

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Risk Assessment using the Indian Diabetes Risk Score {IDRS}

Apart from these individuals, there are others who are at risk of developing diabetes soon. The chances of developing diabetes depend on multiple factors. There are certain modifiable factors such as weight gain, physical activity and certain non-modifiable factors such as family history, genetics, gender etc. By changing the modifiable factors, the risk of developing diabetes can be reduced. These will include making dietary changes, including some amount of physical activity etc. By taking certain steps, the risk of developing diabetes can be reduced. It involves being aware of the lifestyle choices which are chosen. Diabetes is a chronic disorder which can be prevented if certain changes in the lifestyle are made early on. There is an urgent need for certain strategies and tools that will help in risk assessment of diabetes and slowing down the emerging epidemic. Identifying individuals at risk is essential in planning preventive measures. One such tool is **Indian Diabetes Risk Score {IDRS}** developed by the Madras Diabetes Research Foundation. The IDRS consists of four basic parameters derived from the risk factors for diabetes. The four simple parameters are namely, age, abdominal obesity, family history and physical activity. Out of these four parameters, two parameters are modifiable risk factors which includes waist circumference and physical inactivity. The other two are the non-modifiable risk factors which are the age and family history of diabetes. A maximum score of 100 is given for these parameters. Individuals are categorized into low, moderate and high risk on the basis of the scores. Subjects with an IDRS of <30 were categorized as low risk, 30-50 as medium risk and those with > 60 as high risk for diabetes. Higher IDRS is also associated with higher risk of metabolic syndrome and CVD risk even among people without prediabetes or diabetes. Individuals with score >60 are considered to be at risk of developing diabetes. There have been numerous studies undertaken to check the validity of the IDRS. It has been proven to be a highly cost ineffective tool for testing diabetes in India.

With proper interventions in the form of dietary and lifestyle modifications and physical activity, the modifiable risk factors can be improved significantly to help prevent people who are at high risk from developing Type 2 diabetes. Early screening of diabetes with the help of IDRS, will help in identifying the high-risk population and help in the possible delay of the occurrence of Type 2 diabetes.

COVID -19 and Diabetes

Coronaviruses are enveloped, positive single-stranded RNA viruses widely distributed in humans and animals worldwide. In December 2019, clusters of pneumonia cases of unknown etiology emerged in Wuhan, Hubei Province, China. Deep sequencing analysis from lower respiratory tract samples indicated a novel coronavirus as the causative agent, which was named severe acute respiratory syndrome-Coronavirus-2 (SARS-CoV-2), and the disease it causes called COVID-19.

Although the pathophysiological mechanisms are still not understood, it has been observed that most severe and fatal cases with COVID-19 have occurred in the elderly or in patients with underlying comorbidities, particularly CVDs, diabetes mellitus, chronic lung and renal disease, hypertension, and cancer. Individuals withdiabetes mellitus (DM), hypertension, and severe obesity (BMI $\geq$ 40 kg/m^2) are more likely to be infected and are at a higher risk for complications and death from COVID-19. Diabetes is one of the leading causes of morbidity and mortality throughout the world. It is the leading cause of end-stage renal disease, adult-onset blindness, and non-traumatic lower extremity amputations. Diabetic complications cause more disability, and at the extreme, life-threatening disorders. The condition is associated with several macro vascular and micro vascular complications, which ultimately impact the overall patient's survival. A relationship between diabetes and infection has long been clinically recognized. Infections, particularly influenza and pneumonia, are often common and more serious in older people with type 2 diabetes mellitus (T2DM). Diabetes and uncontrolled glycaemia were reported as significant predictors of severity and deaths in patients infected with different viruses, including the 2009 pandemic influenza A (H1N1), SARS-CoV and MERS-CoV. In the current SARS-CoV-2 pandemic, some studies did not find a clear association between diabetes and severe disease. However, other reports from China and Italy showed that older patients with chronic diseases, including diabetes, were at higher risk for severe COVID-19 and mortality. (Akhtar Hussain, Volume 162,)[7]

Agarwal et al. report a study of 1,126 people with diabetes who were hospitalized for COVID-19. In this large cohort, age, male sex, and BMI were confirmed as risk factors. Considering the high prevalence of cardiovascular disease (CVD), obesity, and hypertension in patients with DM, it is unknown whether DM independently contributes to the increased risk. However, plasma glucose levels and DM are independent predictors for mortality and morbidity in patients with COVID-19. Potential mechanisms that may increase the susceptibility for COVID-19 in patients with DM include: 1) higher affinity cellular binding and efficient virus

[7] (Akhtar Hussain, Volume 162,)

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entry, 2) decreased viral clearance, 3) diminished T cell function, 4) increased susceptibility to hyperinflammation and cytokine storm syndrome, and 5) presence of CVD.

AIMS AND OBJECTIVES

Aim- To identify housewives who fall under high risk of developing diabetes and provide nutrition intervention to bring them under the low-risk category.

Objectives

- To assess the prevalence of housewives at high risk for developing diabetes.
- To estimate the usefulness of the Indian diabetes risk score {IDRS} for detecting high risk cases for diabetes.
- To assess the impact of nutrition education, lifestyle modification on the scores of the subjects.
- To describe a correlation between using IDRS as a tool for preventing diabetes

REVIEW OF LITERATURE

Mohan V et al 2005 conducted a study on **a simplified Indian Diabetes Risk Score for screening for undiagnosed diabetic subjects.** The aim of the study was to develop and validate a simplified Indian Diabetes Risk Score for detecting undiagnosed diabetes in India. The risk score was derived from the Chennai Urban Rural Epidemiology Study (CURES), an ongoing epidemiological study on a representative population of Chennai. Phase 1 of CURES recruited 26,001 individuals and as a result The Indian Diabetes Risk Score [IDRS] was developed based on results of multiple logistic regression analysis. Internal validation was performed on the same data. It was concluded from this study that simplified Indian Diabetes Risk Score is useful for identifying undiagnosed diabetic subjects in India and could make screening programs more cost effective.

A Ramachandran et al 2005 conducted a study on **Derivation and validation of diabetes risk score for urban Asian Indians.** This study was undertaken to develop and validate a simple diabetes risk score in an urban Asian Indian population with a high prevalence of diabetes. We also tested whether this score was applicable to South Asian migrants living in a different cultural context. A population-based Cohort of 10,003 participants aged >or=20 years was divided into two equal halves (Cohorts 1 and 2), after excluding people with known diabetes. Cohort 1 (n=4993) was used to derive the risk score. **The study concluded that** a diabetes risk score involving simple non-biochemical measurements was developed and validated in a native Asian Indian population. This easily applicable simple score could play an important role as the first step in the process of identifying individuals with an increased likelihood of having prevalent but undiagnosed diabetes.

A study conducted by Prabha Adhikari et al 2010 on **Validation of the MDRF-Indian Diabetes Risk Score (IDRS) in another south Indian population through the Boloor Diabetes Study (BDS).** The objective of the study was to validate the MDRF – Indian Diabetes Risk Score (IDRS) in a south Indian population in coastal Karnataka. The study was conducted at Boloor locality in Mangalore on adults aged 20 years or more. The study group comprised 551 participants. The results found that 71 of the study individuals were known diabetic subjects (KD) while 45 subjects were diagnosed to have newly diagnosed diabetes (NDD). An IDRS score of ≥ 60 had the best sensitivity (62.2%) and specificity of (73.7%) for detecting undiagnosed diabetes in this community. The study confirms and validates the MDRF – IDRS as being a valid simple and reliable screening tool to identify undiagnosed diabetes in the community. The MDRF – IDRS score ≥ 60 had the highest sensitivity and specificity to identify undiagnosed diabetes.

A study conducted by Divyang Patel et al 2012 on **Validity of Indian Diabetes Risk Score (MRDF) For Screening of Diabetes Mellitus Among High-Risk Group (Policemen) Of Bhavnagar city.** The main objective of the study was to validate the Indian Diabetes Risk Score as screening test for diagnosing of diabetes mellitus. The study was conducted among policemen of the Bhavnagar city, total 260 policemen of 30 or more years of age enrolled for the study. The MDRF- Indian diabetes risk score as a screening test and the sensitivity and specificity of IDRS was calculated. The study concluded that MDRF-IDRS score of ≥ 60 had the best sensitivity (92.5%) and Specificity (62.27%) for detecting diabetes in the study population. The MDRF-Indian diabetes risk score is the highly sensitive and specific, easy to perform and cost-effective tool for diagnosis of diabetes.

Ajeet Singh Bhadoria et al 2015 conducted a study on **Validation of Indian diabetic risk score in diagnosing type 2 diabetes mellitus against high fasting blood sugar levels among adult population of central India.** This study was conducted among 911 adults of Jabalpur District to validate the IDRS score against increased fasting blood sugar levels in diagnosing T2DM. The findings of this study indicate that IDRS has excellent predictive value for detecting undiagnosed diabetes in the community and IDRS is also a much stronger risk indicator than examining individual risk factors like age, family history, obesity, or physical activity.

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A study was conducted by Kanica Kaushal et al (Nov-Dec 2017) on **The Validity of Validity of Madras Diabetes Research Foundation: Indian Diabetes Risk Score for Screening of Diabetes Mellitus among Adult Population of Urban Field Practice Area, Indira Gandhi Medical College, Shimla, Himachal Pradesh, India.** The aim of the present study was to validate MDRF-IDRS for screening of diabetes mellitus among adult population of urban field practice area, IGMC, Shimla, Himachal Pradesh, India. It was a community based cross sectional study conducted among 417 adults. The study concluded that MDRF IDRS is user friendly screening tool but the criteria of including the parameter of physical activity for the calculation of the risk score needs to be clearly defined.

Meena Rajput et al 2017 conducted a study on **Validation of simplified Indian Diabetes Risk Score for screening undiagnosed diabetes in an urban setting of Haryana.** The objectives of the study were the Identification of at-risk individuals using simple screening tools like Indian Diabetes Risk Score (IDRS) and appropriate life style interventions could greatly help in preventing or delaying the onset of diabetes and thus reducing the burden of disease. 450 individuals >20years who consented to participate were selected randomly from three anganwadis of urban area of Rohtak city. Demographic characteristics and anthropometric measurements such as weight, height and waist circumference were taken and BMI was calculated. The results showed that 54% of individuals were categorized as high risk followed by 37.6% as moderate risk as per IDRS risk score. Prevalence of diabetes was more in ≥50years age group (28.6%) as compared to 35-49 years (14.2%) and 20-35 years age group (6.0%). Therefore, it was concluded that early screening and appropriate interventions at the start are needed for control of disease and risk factor modifications.

Mohammed Mustafa Khan et al 2017 conducted a study on **Validity of Indian Diabetes Risk Score and its association with body mass index and glycosylated hemoglobin for screening of diabetes in and around areas of Lucknow.** The study aimed to assess the validity of Indian Diabetes Risk Score (IDRS) and its association with body mass index (BMI) and glycosylated hemoglobin (HbA1c) for screening of diabetes and obesity. A cross-sectional study was designed, and samples were randomly enrolled from Lucknow and its adjoining areas. 405 subjects were included in the study. Diabetes risk factors (age, waist circumference, physical activity, and family history of diabetes) for screening of diabetes and abdominal obesity (AO) and BMI for screening of general obesity were used. HbA1c was used for confirming the diabetes patients in this population. The results of the study showed that according to IDRS, 272 subjects (67.2%) were found at high risk of diabetes (score ≥60). Based on BMI calculation, 198 subjects were obese, of which 79.3% were found at high risk for diabetes. A significant association was found between subjects with higher risk score and BMI. This study fully supports the validity of IDRS, as it can be used as a cost-effective tool for primary mass screening of diabetes. Moreover, its combination with BMI value and HbA1c can be used for strict monitoring for diabetes and obesity at primary health care centers to reduce the early development of diabetes complications and severe obesity comorbidities.

A. Assessment Of Diabetes Using IDRS With Lifestyle Interventions

Neha Singh (2013) presented a study **on Assessment of Nutritional Status and Dietary Counselling of Diabetic Patients belonging to Palampur region of Kangra District Himachal Pradesh.** The objectives of the study were to assess the prevalence of impaired fasting glucose, impaired glucose tolerance, pre diabetes (both impaired fasting glucose and impaired glucose tolerance), undiagnosed diabetes and normal glucose tolerance in Palampur region. 130 subjects with diagnosed diabetes were selected for the study, whereas 100 subjects were screened. Out of total 130 selected diabetic patients, majority were males. The nutrient intake of diabetic patients was lower than RDA. Nutrition education regarding diabetes, nutrition in diabetes and foods allowed and not allowed in diabetes was provided to the patients. The results showed that significant decrease in fasting and post prandial blood glucose levels of the patients. Impaired fasting glucose, pre diabetes and undiagnosed diabetes was more prevalent in females than in males, whereas impaired glucose tolerance was found to be more common in males than females. It was concluded from this study that the Indian Diabetes Risk Score proved useful in screening early diabetes and that proper nutrition is a cost-effective method in lowering blood glucose levels.

Reshma S Patil & Jayashree S Gothankar (2016) conducted a study on **Assessment of risk of type 2 diabetes using the Indian Diabetes Risk Score in an urban slum of Pune, Maharashtra, India.** The aim of this study was to use the Indian Diabetes Risk Score, developed by the Madras Diabetes Research Foundation (MDRF-IDRS), to assess the prevalence of people at high risk for developing diabetes, and the correlation with known risk factors. A cross-sectional study was conducted in the field practice area of the urban health training center of a private medical college in Pune, Maharashtra. A total of 425 participants aged 20 years and above were screened for risk factors, including age, waist circumference, family history of diabetes and physical activity. The results of the study showed the prevalence of people at high risk of diabetes was 36.55%. Therefore, the study concluded that as the prevalence of

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people at high risk for diabetes was high, lifestyle changes and awareness regarding risk factors is needed to take control of the diabetes in the study population.

C. Boya et al 2016 conducted a study on **Assessment of Risk of Diabetes Using Indian Diabetes Risk Score in Healthy Postgraduate Students of India.** The aim of the study was to assess the risk of the development of diabetes in healthy volunteers of India. This study also aims to assess the motivation status of the volunteers towards the exercise and physical activity. An observational study was conducted by online survey, using questionnaires of Indian diabetes risk score (IDRS) and Exercise motivation Inventory-2 (EMI-2). IDRS and EMI-2 scores were compared to assess the diabetic risk. Questionnaire consists of information about demographic details, family history of diabetes, high blood glucose, and physical activity. The results of the study showed that Male (73%) were found be higher than females and an average age was found to be 25 years. Complete baseline risk data were found in 320 subjects in which 162 (50.6%) subjects were found to have some risk of diabetes. Among subjects with some risk of diabetes, 101 (62.3%) were at moderate risk, 61(37.7%) were at high risk. Therefore, it was concluded from the study that a high risk of diabetes in healthy educated young volunteers of India. Many of them were unaware about their risk of diabetes. Additional burden of low-level motivation towards exercise in addition to sedentary lifestyle makes them to prone higher risk of diabetes and metabolic syndrome

A study was conducted by Anita Shankar Archarya et al 2017 on **Assessment of Diabetes Risk in an Adult Population Using Indian Diabetes Risk Score in an Urban Resettlement Colony of Delhi.** The objective **was** to assess the risk score of diabetes among the study subjects using IDRS. A cross sectional survey was conducted on adults >30 years (n=580) on both gender in an urban resettlement colony of Delhi during December 2013 to March 2015. A Semi-structured interview schedule consisting of Socio-demographic characteristics, risk factor profile and Indian Diabetes Risk Score was used. The results showed that out of 580 subjects, 31 (5.3%) study subjects were not at risk of having diabetes, rest 94.5% were at moderate or high risk of diabetes. Therefore, the study concluded that more than 90% of the study subjects were at risk of having diabetes, hence screening is of utmost importance so that interventions can be initiated at an early stage.

A study was conducted by M. Mahmood Asrar et al 2019 on **Assessment of Risk of Type 2 Diabetes in Healthy Volunteers Using Simplified Indian Diabetes Risk Score Tool: A Cross-Sectional Study in North India**. This study was aimed to assess the risk of diabetes in North Indian population using Indian Diabetes Risk Score (IDRS) to detect undiagnosed Type 2 diabetes. It was community-based cross-sectional study enrolled adult population aged between 20 to 55 years. The assessment of risk of diabetes was carried out in and around Chandigarh by employing IDRS tool. The study concluded that A very less proportion of the participants were at high risk for diabetes. IDRS is a simple and easy to use and cost-effective tool to assess the risk of type 2 diabetes in the community.

Shwetha, & Prasad, K N. (2019) conducted a study on **Community Based Study on Assessment of Diabetes Risk Using Indian Diabetic Risk Score.** This study was conducted to assess risk of diabetic using Indian diabetic risk score (IDRS) and also to determine association between non socio demographic factors and diabetes risk. It was a cross sectional study including 523 study subjects. The results of the study showed that more than half were at medium risk (59.3%) of diabetes and one fourth of them were at higher risk of diabetes (28.7%). Significant association of diabetes risk was found with alcohol consumption and physical activity. Therefore, it was concluded that more than 70% of study subjects were at high and medium risk of diabetes. The study showed significant association between risk factors of diabetes like alcohol intake and physical activity but number of study subjects.

A study was conducted by Aditya Oruganti et al 2019 on **Risk of developing Diabetes Mellitus among urban poor South Indian population using Indian Diabetes Risk Score.** The cross-sectional study was conducted among 400 adults aged between 30 and 60 years residing in a settled slum of Rukmini Nagar area of Belagavi city, Karnataka. Data were collected after taking written informed consent from each participant using a pretested questionnaire that included demographic information and details of the risk factors. Risk of developing diabetes was assessed by using Indian Diabetes Risk Score. The results showed that the proportion of low, moderate, and high risk of developing diabetes mellitus was 7%, 63%, and 30%, respectively. This study demonstrated that advancing age, low physical activity, family history, overweight, and obesity were the prominent factors that predicted the risk of diabetes in the near future.

Mongjam Meghachandra Singh**,** et al 2019 Department of Community Medicine, Maulana Azad Medical College and Associated Hospitals, New Delhi, India conducted research on the topic - **Risk Assessment of Diabetes Using the Indian Diabetes Risk Score: A Study on Young Medical Students from Northern India.** A cross sectional study was conducted among 290 first grade medical students to assess risk of type 2 diabetes mellitus (T2DM) using the IDRS and to study association of risk of diabetes with other factors. The study results IDRS categorization revealed 77%, 22% and 1% students in low-, moderate- and high-risk

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category, respectively. IDRS categorization revealed 77%, 22% and 1% students in low-, moderate- and high-risk category, respectively. This study findings have brought forth that large number (23%) of young medical students were in moderate-high risk category of developing T2DM and health professionals should be more vigilant in young obese males with minimal physical activity and positive family history of disease. Hence, there is a pressing need for bringing out behavior change communication among young medical students so that risk reduction strategies and lifestyle changes can be implemented in early years of their lives.

Raghuram Nagarathna et al 2020 conducted a study on **Assessment of risk of diabetes by using Indian Diabetic risk score (IDRS) in Indian population.** The aim **of the study was** to screen the Indian population for Type 2 Diabetes Mellitus (DM) based on Indian Diabetes Risk Score. The main question was; Does Indian Diabetic risk score (IDRS) effectively screen diabetic subjects in Indian population? The study was conducted on 240,000 subjects in a short period of 3 months based on IDRS. This was a stratified translational research study in randomly selected cluster populations from all zones of rural and urban India. In this study 40.9% subjects were detected to be high risk, known or newly diagnosed DM subjects in urban and rural regions. IDRS could detect 78.1% known diabetic subjects as high-risk group. The study concluded that IDRS is a good indicator of high-risk diabetic subjects

B. Effectiveness Of The IDRS

Dr. Ranadip Chowdhury et al 2012 conducted **A Study on Distribution and Determinants of Indian Diabetic Risk Score (IDRS) Among Rural Population of West Bengal.** The main objective of the study was to find out the distribution of IDRS among the study population and to determine the association of IDRS with socio-demographic & anthropometric factors. This was a community based cross sectional study carried out in the rural practice area of R.G Kar Medical College among 250 undiagnosed diabetic ≥ 20 years in August'11 by using IDRS. Out of 250, 235 (94%) responded. 133(56.6%) were females & 102 (43.4%) were males. 108 (46%) had moderate risk (IDRS 30-50); 74(31.5%) had high risk (IDRS≥60) and 53(22.6%) had low risk (IDRS<30). The concludes that it is essential to implement the simple IDRS tool in the community for mass screening so that proper intervention can be carried out to reduce the burden of diabetes.

T Thoopputra et al 2012 conducted **A Survey of diabetes risk assessment tools: concepts, structure and performance.** The objective of this study is to review the effectiveness and limitations of existing diabetes risk screening tools to assess the need for further developing of such tools. An electronic search was performed which retrieved a total of 2168 articles reporting diabetes risk assessment tools all of which are short questionnaires of 2-16 questions incorporating common variables including age, gender, waist circumference, BMI, family history of diabetes, history of hypertension or antihypertensive medications. In summary, there is a trend of increasing availability of diabetes prediction tools with the existing risk assessment tools being generally a short questionnaire aiming for ease of use in clinical practice. The overall performance of existing tools showed moderate to high accuracy in their predictive performance.

Ritesh P Kumar et al 2015 conducted a study on **Assessment of Prevalence of Diabetes among Rural Population of Pune District, India**. The objective of the study was to assess the prevalence of diabetes and associated risk factors in rural population using a simple diagnostic tool. A cross sectional survey was done in one randomly selected village of rural field practice area of a medical college in Pune district. House to house visits were paid and 255 residents of 20 and above years of age were interviewed using Indian diabetes risk score (IDRS). The results of the study showed prevalence of diabetes among the study population was 10.5%. Among the 27 newly detected cases 18 had high risk and 9 had moderate risk on IDRS. It was concluded from this study that the prevalence diabetes has started increasing in poor, illiterate and health ignorant rural population. They should be diagnosed at the earliest possible time using simple diagnostic tools like IDRS.

A study was conducted by Lt Col Puja Dudeja et al 2016 on **Performance of Indian Diabetes Risk Score (IDRS) as screening tool for diabetes in an urban slum.** The aim of this article was to study the performance of IDRS as screening tool for undiagnosed cases of Type 2 diabetes and to find the prevalence of undiagnosed Type 2 diabetes in an urban slum. The results showed that IDRS predicted the risk of diabetes mellitus with sensitivity of 95.12% and specificity of 28.95% in individuals with score >60. Therefore, it was concluded by this study that IDRS can be used as an effective tool for screening undiagnosed diabetes in the community.

Krutarth R Brahmbhatt et al 2016 conducted a study on **Assessment of risk of type 2 diabetes using simplified Indian Diabetes Risk Score – Community-based cross-sectional study.** The objective of this study was to assess the risk for type 2 diabetes among study participants using simplified version of IDRS and to estimate prevalence of abdominal obesity and physical activity among males and females. A community-based cross-sectional study was conducted in the field practice area of Urban Health Center of a medical college hospital in South India. Simple random sampling was performed to select the participants. Data collection

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tool had two parts. First part was about socio-demographic information and second part was Simplified Indian Diabetes Risk Score. Total 145 persons participated in the study. The results of this study showed that the prevalence of people at high risk of diabetes was 34% in the present study. The prevalence of abdominal obesity was 44% and 84% among males and females, respectively. Therefore, it was concluded from this study that one-third of the participants were at high risk for diabetes and IDRS is a simple and easy to use tool to assess the risk of diabetes in the community.

Praveen Gautham et al 2017 conducted **A Cross Sectional Study to Determine Prevalence of Type 2 DM In Association with IDRS & Random Blood Glucose in Women of Gwalior City.** A descriptive, interview-based study of 300 women aged 26-60 years age in 6 public places of Gwalior City for duration of one year was done. Of 300 participants, 50% were in high-risk group with IDRS≥60 of which Age group with highest risk (100%) is 56-60 years. Prevalence of prediabetic women was highest (57.14%) in 46-50years age group, 35.55% women with waist>90 cm, 33.33% doing no exercise or strenuous work. Therefore, it was concluded from this study that diabetes is a multifactorial disease which despite creating so much awareness its prevalence and risk keeps on increasing. IDRS proved to be an effective tool in assessing diabetes risk this risk of diabetes.

Bharati Taksande et al 2017 conducted a study on **External validation of Indian diabetes risk score in a rural community of central India.** The aim of the study was found whether the individuals of 45 years and more of rural area who are in higher tertile of Indian Diabetes Risk Score i.e., of IDRS of >60as compared to those who are in lower tertile i.e., of <30, have high frequency of hyperglycemia, impaired glucose tolerance, and manifest diabetes mellitus. This was cross sectional community-based study conducted 3 pre identified villages. The results of the study showed that The Indian Diabetes Risk Score (IDRS) (consisting of the factors likeage, abdominal obesity, physical inactivity and the family history) which predicted diabetes mellitus in the subject, its sensitivity was 97.50%and specificity of 87.89% when the score of >/+60 was externally validated on our rural population. The study concluded that Indian Diabetes Risk Score (IDRS) can be reliably applied as effective tool for the mass screening of diabetes in the community.

Sheikh Mohammed Saleem et al 2017 conducted a study on **Indian Diabetic Risk Score- a Tool for Predicting Risk of Undiagnosed Type 2Diabetes Mellitus.** The objective of the study was to assess the performance of the Indian Diabetic Risk Score (IDRS) questionnaire for detecting and predicting risk of Type 2 diabetes mellitus (T2DM) in patients attending a primary health center. This was cross-sectional study comprising 1530 adult participants, age (>20 yrs.) attending Out-patient department of a primary health center located at Harwan, district Srinagar without a diagnosis of Type 2 diabetes mellitus. The risk of developing Type 2 diabetes mellitus was assessed using the validated and widely used Indian diabetic risk score. The Total Risk Score of each participant was analyzed and compared. The study concluded that IDRS questionnaire designed by Madras Diabetic Research Foundation is a useful screening tool to identify unknown Type 2 diabetes mellitus. The questionnaire is a reliable, valuable and easy to use screening tool which can be used in a primary care setup and better convince people at high risk of Type 2 diabetes mellitus to take action towards healthier lifestyle habits.

S Nandeshwar et al 2017 conducted a study **Indian Diabetes Risk Score for Screening of Undiagnosed Diabetic Subjects of Bhopal City.** A cross sectional study was conducted in Bhopal city 250 individuals of the age group of >25yrs. Out of these subjects (2.80%) were in low risk, (28.40%) in moderaterisk and (68.80%) were high risk group as per the IDRS. The observation revealed that the IDRS is highly sensitive and specific for diagnosing diabetes in community.

V. Vijayakumar et al 2018 conducted a cross sectional study on **Challenges faced in diabetes risk prediction among an indigenous South Asian population in India using the Indian Diabetes Risk Score.** The study took place in a remote tribal hamlet of Machuru in South India. A door-to-door survey was conducted in the hamlet with a population of 555. The Indian Diabetes Risk Score (IDRS) questionnaire was completed by 160 individuals older than 25 years. Of 160 adults who completed the questionnaire, 37 were at high risk (23.13%) as per the IDRS, 52 at medium risk (32.5%) and 71 at low risk (44.38%). None of the respondents knew their family history of diabetes owing to the lack of awareness about the condition. It was concluded from the study that the IDRS might not be an accurate measure to understand the risk of diabetes in this particular population owing to their unique family dynamics and a lack of awareness about diabetes

Amrutha Angadi et al 2018 conducted a study on **Assessment of Risk of Type 2 Diabetes using Indian Diabetes Risk Score Community-Based Cross-Sectional Study in Urban Mysuru.** A community-based cross-sectional study was conducted in the urban areas of Mysore from March and July 2015. Direct interview method was used for the data collection. Risk level for diabetes was assessed using Indian Diabetic Risk Score (IDRS) and socio-demographic and anthropometric factors were assessed through a semi structured pretested questionnaire. The results of this study showed that total of 900 individuals participated, majority of subjects

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had moderate to low IDRS risk. On the whole, around 22% of adults had a high-risk score (score >60) for diabetes, 42.6% had moderate scores and 35.6% had low scores on IDRS. This study concludes the usefulness of simplified Indian Diabetes Risk Score for identifying high risk for diabetes in the community. It should be used routinely in community-based screening to find out high risk category of population for diabetes

Sudha Bala et al 2019 conducted a study on **Performance of Indian diabetic risk score as a screening tool of diabetes among women of industrial urban area.** The aim of this study was to assess the performance of IDRS as a screening tool to detect undiagnosed cases of type 2 Diabetes mellitus among women in Industrial urban area. A Community based cross sectional study was undertaken at medical college, Hyderabad. The results of the study showed that as per the classification of IDRS 22% were at low risk, 40% medium risk and 38% at high risk. Therefore, the study concluded that IDRS is a cost-effective tool which can be used for screening among undiagnosed cases.

Manjula & Sivaprasad Nugawela et al 2019 conducted a study on **Evaluating the Performance of the Indian Diabetes Risk Score in Different Ethnic Groups.** The aim of the study was to evaluate the performance of Madras Diabetes Research Foundation-Indian Diabetes Risk Score (MDRF-IDRS) in different ethnic groups, including Indians, Hispanic, non-Hispanic whites, non-Hispanic blacks, and other American. The study participants aged ≥20 years with and without type 2 diabetes were included. Performance of the MDRF-IDRS was assessed using sensitivity, specificity, positive predictive value, negative predictive value, and the area under the receiver operating characteristic curve (AUC) measures within each ethnic group. IDRSs' performance was then compared with existing noninvasive American diabetes risk scores. The results of the study showed that MDRF-IDRS (cutoff ≥60) performed well in Indians with an AUC, sensitivity, and specificity of 0.73, 80.2%, and 57.3%, respectively. Therefore, it was concluded from this study that the MDRF-IDRS performs well among Indians and Americans, including Hispanic, non-Hispanic white, non-Hispanic black, and other American. It can be used as a screening tool to help in early diagnosis, management, and optimal control of diabetes mainly in mass screening programs in India and America.

C. Changes in the IDRS scores post Intervention

A study on **the effect MDRF-Indian Diabetes Risk Score as a motivational tool for lifestyle change with special reference to physical activity and caloric intake among medical students** was conducted by Anand Vardhan et al 2015. The study was conducted on 150 medical students who were given their IDRS scores and laboratory values of Fasting plasma glucose and fasting lipid profile. IDRS was recalculated after 6 months. It was reported that there was a significant decline in IDRS (from 36+ 10 to 31.2+11), waist circumference (85.4+7.4 cm to 84.1+7.2), caloric intake (from 1994+154 calories to 1817+152), and physical inactivity score in IDRS (from 26+4.7 to 21 + 3.6). Therefore, it was concluded that calculating diabetes risk by using MDRF-IDRS improved physical activity, decreased caloric intake and waist circumference significantly among medical students and is a useful motivational tool for lifestyle change.

Kavumpurathu R. Thankappan et al 2018 conducted a study which aimed to **evaluate the effectiveness of a peer-support lifestyle intervention in preventing type 2 diabetes among high-risk individuals identified on the basis of a simple Indian diabetes risk score**. A total of 1,007 participants (47.2% female) were enrolled (507 in the control group and 500 in the intervention group). Participants from intervention clusters participated in a 12-month community-based peer-support program. A total of 964 (95.7%) participants were followed up at 24 months. At 24 months, compared with the control group, intervention participants had a greater reduction in IDRS score (mean difference: −1.50 points). It was concluded that a low-cost community-based peer-support lifestyle intervention resulted in a nonsignificant reduction in diabetes incidence in this high-risk population at 24 months.

MATERIAL AND METHODS

The study has been undertaken with the purpose of assessing the risk of diabetes development in housewives of Hyderabad. The main objectives of the study are listed down below-

- To assess the prevalence of housewives at high risk for developing diabetes.
- To estimate the usefulness of the Indian diabetes risk score {IDRS} for detecting high risk cases for diabetes.
- To assess the impact of nutrition education, lifestyle modification on the scores of the subjects.
- To describe a correlation between using IDRS as a tool for preventing diabetes.

The various aspects included here are represented under various subheads.

1) **Location of the study** – The study entitled "To Study the Risk Assessment of Diabetes among Housewives of Hyderabad Using Indian Diabetes Risk Score Test {IDRS} is being conducted among the homemakers of the city Hyderabad, Telangana.

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The main motive behind its selection is since Hyderabad is recognized as the diabetic capital in the country and rapid increase of the diabetics in the city.

2) **Study Design** - It is a community based cross-sectional study. It is a randomized controlled trial with two study groups. Both the two study groups filled the IDRS and the individuals identified as high risk received nutritional intervention in the form of customized nutrition plan to maintain their weights. It is an 8week long study were the data will be collected thrice, a baseline data collection after recruiting the participants, next set of data is collected 4 weeks after the start of intervention and lastly at the end of 8 weeks. All of these will be done during follow-up sessions.

Data is collected via the IDRS form and a simple questionnaire which are modified as per the requirements of the study. The questionnaire consisted questions on demographics like age, height, weight and BMIs. The main tool for the data collection is the Indian Diabetes Risk Score {IDRS} which consist of questions related to two modifiable risk factors and two non-modifiable risk factors. The study is being carried out among the housewives spread across the city.

3) **Participants**- The study is mainly focused on housewives of all age groups residing in Hyderabad. The target is to get 200 participants, out of which only the individuals with high risk were chosen for the intervention. Participants are being collected via advertisements that are circulated through social media platforms and through referrals of peoples known to the researcher and conducting health camps at locations near to the researcher.

The health camps are conducted at two colonies for the general population residing there, two schools for the teaching and non-teaching staff and one Intermediate (junior) college for the teaching and non-teaching staff. Word for these camps is propagated by putting up banner at the site of camp and posting e-posters of the camp in the colony WhatsApp groups and making prior announcements and sending WhatsApp messages to the staffs in schools and colleges.

The age of the participants ranged from 20 to 50. A total of 56 people responded for the study via online mode of which 7 people are falling under high risk of developing diabetes, to participate in the study after considering the inclusion and exclusion criteria. While a total of 149 participated in the camp of which 17 people were included to participate in the study. Therefore, N=24 participants are enrolled for this study. A simple random method is being employed in this this study.

3.1) **Inclusion criteria**- The inclusion criteria of this study is housewives with undiagnosed diabetes.

i. Aged between 20 to 50 and able to give their consent
ii. Non-Diabetics
iii. Non-Pregnant and Lactating

3.3) **Exclusion criteria** – the exclusion criteria of the study include

i. Women who are already diagnosed with diabetes.
ii. Women with other chronic illnesses like cardiovascular diseases, Hypertension, etc.
iii. Women who are unwilling to participate in the study.

4) **Description of Tools used** – The study was undertaken to study the risk assessment of developing diabetes among the housewives. There is mainly one tool which is described down below.

4.1) **Indian Diabetes Risk Score:** The study employs the Indian Diabetic Risk Score {IDRS} developed by the Madras Diabetes Research Foundation. The IDRS consists of four basic parameters derived from the risk factors for diabetes. The four simple parameters are namely, age, abdominal obesity, family history and physical activity. Out of these four parameters, two parameters are modifiable risk factors which includes waist circumference and physical inactivity. The other two are the non-modifiable risk factors which are the age and family history of diabetes. A maximum score of 100 is given for these parameters. Individuals are categorized into low, moderate and high risk on the basis of the scores. Subjects with an IDRS of <30 was categorized as low risk, 30-50 as medium risk and those with > 60 as high risk for diabetes.

4.2) **Questionnaire**: A questionnaire was developed on Google forms which includes the following-

i. Personal Information – which includes email id.
ii. Anthropometric data – includes height, weight and BMI.
iii. IDRS Parameters - The IDRS parameters are age, waist circumference, physical activity and family history of diabetes.

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5) **Nutrition Intervention** – The study is divided into two phases- pre intervention phase and post-intervention phase. The pre-intervention phase of the study consists of developing a questionnaire through which data is being collected. The post-intervention phase of the study consists of providing nutrition counselling, conducting activities for awareness regarding the risk of developing diabetes, inclusion of physical activity etc. which is being done via the online platforms.

Participants are divided into two groups of which one group is interventional and one is the control group. n=24 is included in the intervention group, n=149 were the ones falling under low and moderate risk of diabetes. Individuals with high risk were given customized weight loss diets but both the groups are also guided to follow a balanced diet which includes all the food groups in required proportions along with the intervention.

The controlled group is only prescribed with dietary approaches and physical activity to manage weight and waist circumference.

All the two groups are asked to be physically active for at least 30 minutes each day.

6) **Procedure**

For Online mode the participants are approached by advertising on various social media platforms, through common WhatsApp groups, referrals from people known to the researcher and participants. The participants registered themselves for the study via Google form which have the title of the study, recruitment details, and benefits to the participant through the study and asked for their name, age, anthropometric measurements and consent to participate in the study.

For Offline mode the participants who visited the camp were first screened for their body temperature and questioned if they have any symptoms of COVID-19. After which their Name and Anthropometric data is collected which include their height, weight and waist circumference following this a brief medical history is collected by questioning them if they are already diabetic or not and if they have any other co-morbid conditions. Then the questions of IDRS were asked and filled and a score given accordingly. Participants who meet the inclusion criteria are then informed about the study and after receiving their consent to participate in the study are interviewed further and their questionnaire is filled by the researcher. They are guided about the process of the study and their role in it.

Data collection

Data collection is done by via the questionnaires, anthropometric and blood pressure measurement.

A baseline collection is done while recruiting the participants, second set of data collection is done during the first follow up after 4 weeks and third collection of data is done during the final follow up after 8 weeks. Collection of data began from 4th week of September 2020 and is completed by 4th week of December 2020.

Description of Tools used – The study was undertaken to study the risk assessment of developing diabetes among the housewives. There is mainly one tool which is described down below.

1. **Indian Diabetes Risk Score** - The study employs the Indian Diabetic Risk Score {IDRS} developed by the Madras Diabetes Research Foundation. The IDRS consists of four basic parameters derived from the risk factors for diabetes. The four simple parameters are namely, age, abdominal obesity, family history and physical activity. Out of these four parameters, two parameters are modifiable risk factors which includes waist circumference and physical inactivity. The other two are the non-modifiable risk factors which are the age and family history of diabetes. Anthropometric measurements (height, weight, waist circumference, hip circumference and blood pressure) were measured using standard methods and noted. Risk factor profile was found out using the IDRS. Age was categorized into <35 years coded as 0 (score: 0), 35–49 years as 1 (score: 20) and ≥50 years as 2 (score: 30). Abdominal obesity was found out using waist circumference. Subjects with waist circumference <80 cm (female), <90 cm (male) were coded as 0 (score: 0); waist circumference ≥81–89 cm (female), ≥91–99 cm (male) as 1 (score: 10) and waist circumference ≥90 cm (female), ≥100 cm (male) as 2 (score: 20). Vigorous intensity activities were defined as activities that cause large amount of effort, rapid breathing and a substantial increase in heart rate for at least 10 min continuously. Moderate intensity activities were defined as activities that required moderate amount of effort and noticeably accelerated heart rate for at least 10 min continuously. For physical activity categorization, subjects performing regular vigorous exercise or strenuous (manual) activities at home/work were coded as 0 (score: 0); regular moderate exercise or moderate physical activities at home/work were coded as 1 (score: 10); regular mild exercise or mild physical activities at home/work were coded as 2 (score: 20); no exercise and/or sedentary activities at home/work were coded as 2 (score: 30). Subjects with no family history of diabetes were coded as 0 (score:

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0); with one diabetic parent as 1 (score: 10) and with both diabetic parents as 2 (score: 20). Subjects with IDRS <30 were graded as low risk, 30–50 as medium risk and ≥60 as high risk. Subjects detected with diabetes risk score of >30 were referred to tertiary care hospital for getting their blood sugar levels checked and further follow up. A maximum score of 100 is given for these parameters. Individuals are categorized into low, moderate and high risk on the basis of the scores. Subjects with an IDRS of <30 was categorized as low risk, 30-50 as medium risk and those with > 60 as high risk for diabetes.

2. **Questionnaire:** A questionnaire was developed on Google forms which includes the following-
   - Personal Information – which includes email id.
   - Anthropometric data – includes height, weight and BMI.
   - IDRS Parameters - The IDRS parameters are age, waist circumference, physical activity and family history of diabetes.

STATISTICAL ANALYSIS

Statistical Analysis was performed using SPSS- 20 using descriptive and analytical statistics. Statistical significance was set to P > 0.005. Frequency, percentage, and mean standard deviation were used to describe IDRS parameters. The main statistical tests used in the study were linear regression, Chi square, Fischer exact test, to assess difference in the parameters before after follow ups. Chi square test was used for categorical variables and ANOVA for continuous variables.

RESULTS

From August 2020 to December 2020, the data collection began with follow ups being completed by the end of December 2020. A total of 201 participants were recorded randomly from different localities in this study. After the collection of data, the participant was categorized as High risk (>80), Moderate risk (>50) and low risk (<30). Out of which n= 24 participants were falling under high risk of developing diabetes (> 80). Only the participants falling under high-risk n= 24 were selected for nutritional intervention. And the rest of the participant's data was recorded and analyzed. The parameters of the data collected was coded into ranges, for easy analysis. Table 1.1 shows the ranges.

Parameters	Ranges
Physical activity	
no exercise	1
moderate exercise	2
heavy exercise	3
History of Diabetes	
no diabetes	1
one parent	2
both parents	3

Table 1 depicting the ranges

All the n=24 participants falling under high risk (>80) received nutritional intervention in the form of customized weight reduction diets. This diet was followed by them diligently for a period of 8 weeks, wherein 2 follow ups were organized. The data from this follow ups was also recorded and statistically analyzed.

Physical Activity vs. Family history of Diabetes

The next table shows the correlation between family histories of diabetes with physical activity.

Of the total participant of n=24, n= 22 participants perform no exercise, 93.3% (n=14) have no family history of diabetes, 100% (n= 4) have 1 parent with diabetes and, 80.4% (n=4) have both the parents with diabetes. The remaining n= 2 out of n=24 participants perform moderate exercise. 6.7% (n=1) have no family history of diabetes and 20.0% (n=1) have both the parents with diabetes.

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According to the chi-square test performed between the above-mentioned parameters, there is no value with p > 0.05. Therefore, **PHYSICAL ACTIVITY AND FAMILY HISTORY OF DIABETES ARE NOT MUCH ASSOCIATED AS EXPECTED.**

		N	Height (m)		Weight (kgs)		BMI		Age	Waist Circumference			Score	
Physical Activity 1			Mean ± SD	P	Mean ± SD	P	Mean ± SD	P	Mean ± SD	P	Mean ± SD	P	Mean ± SD	P
Baseline	Intervention	22	9.01±34.8	0.541	70.32± 15.78	0.067	28.07±6.142	0.083	39.27±7.166	0.135	93.02 ±10.477	0.958	79.55±4.857	0.59
Follow up 1	Intervention	22	1.58±0.04967	0.783	68.35±11.978	0.082	27.58±5.878	0.198	37.75±7.32	0.878	94.7±9.327	0.812	62.5±5	0.029
Follow up 2	Intervention	22	1.58±0.04967	0.783	75.05±17.826	0.952	30.41±9.046	0.435	37.75±7.32	0.878	93.57± 7.038	0.316	62.5±5	0.015

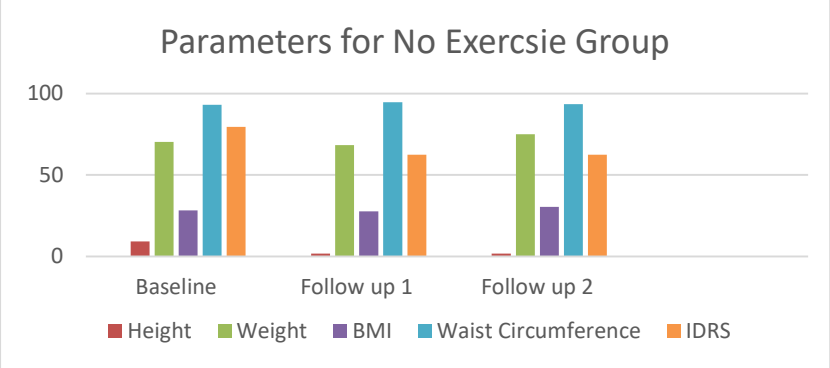
Table 2 depicting characteristics for no exercise group

Physical Activity 2		N	Height (m)		Weight (kgs)		BMI		Age		Waist Circumference		Score	
			Mean ± SD	p	Mean ± SD	P	Mean ± SD	P	Mean ± SD	P	Mean ± SD	P	Mean ± SD	P
Baseline	Intervention	4	1.52±0.000	0.541	65.0 ± 0.000	0.129	28.07±6.142	0.001	39.27 ± 7.166	0.001	93.02± 10.477	0.955	79.55 ± 4.857	0.665
Follow up 1	Intervention	9	1.5544±0.06405	0.496	76.36±19.024	0.46	30.52±8.221	0.537	38.78±6.996	0.814	94.2±10.072	0.934	64.44±12.36	0.771
Follow up 2	Intervention	11	16.4445±49.2703	0.566	72.18±12.469	0.729	27.49±5.283	0.445	42±7.899	0.366	88.65±11.459	0.44	60±23.664	0.841

Table 3 depicting characteristics for moderate exercise group

Pre-Intervention Findings

a) Height- Out of n= 24 participants who were found to be at high risk of developing diabetes, n= 22 participants did not perform any exercise at the start of this study and n= 2 participants, performed moderate exercise. The participants who did not perform any exercise were provided with customized weight loss diets and put on an exercise regime of moderate exercise, whereas those who already performed moderate exercise were shifted to heavy exercise. In the participants who do not perform any exercise the mean height of the study was analyzed to be 9.0134.8 with p = 0.541 which is greater than >0.05 in the baseline study. The n= 2 participants who performed moderate exercise had a mean height of 1.52±0.000. Therefore, the value is not statistically significant. The mean height both in follow up 1 and follow up 2 remained as 1.58±0.04967 after the intervention as height is a measure of genetics.



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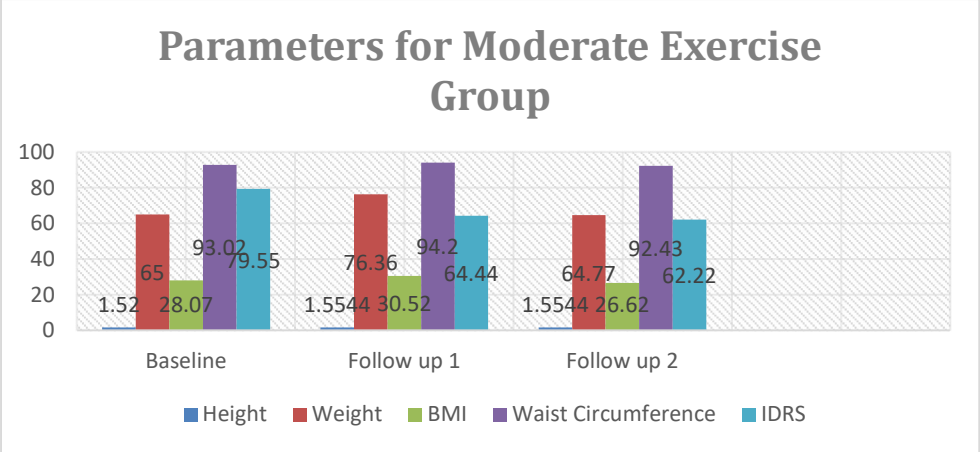
b) Weight- The mean weight in the baseline study of the n=22 participants who did not perform any exercise was 70.32± 15.78 with p = 0.067, whereas in the n=2 participants who performed moderate exercise, the mean weight was found out to be 65±0.000. After follow up 1, the mean weight dropped to 68.35±11.978 and increased to 75.05±17.826 after follow up 2.

c) BMI- The mean BMI during the baseline study was found to be 28.07±6.142 with p = 0.083 in n=22 participants who did not perform any exercise. In n=2 participant who performed moderate exercise, the mean BMI was 23.00±0.000 with p= 0.073. Both p values are statistically insignificant. In follow up 1, the mean BMI was found to be same with no difference in the participants who did not perform any exercise. However, in follow up 2, the mean BMI increased to 30.41± 9.024 in the n=4 participants who did not perform any exercise.

d) Age - In the baseline study, the mean age of the n=22 participants who did not perform any exercise was found to be 39.27±7.166 with p= 0.13. In the participants (n=2) who performed moderate exercise pre intervention (n=2) the mean age was found to be 49.00±0.1414. There was no change in the mean age after follow up 1 & 2.

e) Waist Circumference- In the baseline study, the mean waist circumference the participants (n=22) who did not perform any exercise was analyzed as 93.02 ±10.477 with p= 0.958. In the participants who performed moderate exercise (n=2) at the start of the study, the mean waist circumference was found to be 92.40± 12.445. After follows up 1, there was no significant change in the waist circumference. However, after follow up 2, the mean waist circumference was significantly lower with mean of 88.65±11.459.

f) IDRS Score - At the time of start of the study, those participants who did not perform any exercise, their mean IDRS score was 79.55±4.857 with p= 0.59. In the participants who performed moderate exercise at the start of the study (n=2), the mean IDRS score was found to be 80.00±0.000.



Post Intervention Findings

After conducting a baseline study consisting of 201 participants and choosing n=24 participants with high risk of developing diabetes, nutritional intervention was planned in terms of customized weight loss diet plans and exercise regime. The efficacy of this nutrition intervention was checked by conducting follow up visits. One follows up was conducted 1 month post the baseline study and another 2 months after. Out of n=24 participants, n= 4 participants did not follow any exercise, n= 9 participants were following moderate exercise and n= 11 participants were following heavy exercise along with their customized weight loss diets.

The findings of the follow up visits is as follows.

Physical Activity 3		N	Height (m)		Weight (kgs)		BMI		Age		Waist Circumference		Score	
			Mean ± SD	p	Mean ± SD	P	Mean ± SD	P	Mean ± SD	P	Mean ± SD	P	Mean ± SD	P
Follow up 1	Intervention	11	1.5945±0.056	0.341	72.95±15.794	0.781	27.41±10.967	0.445	42±10.967	0.366	90.46±11.11	0.44	70.91±8.312	0.841
Follow up 2	Intervention	11	16.4445±49.2703	0.214	72.18±12.469	0.542	27.49±5.283	0.298	42±7.899	0.724	88.65±11.459	0.465	60±23.664	0.067

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Table 4 Comparison of characteristics for heavy exercise group post intervention

Follow Up 1

During follow up 1 which was done in November 2020, the participants have been following their diet plans and performing regular exercise.

a) **Height** - during follow up 1, the mean height of the participants who did not perform any exercise n=4, their average mean of height was found to be 1.58±0.04967 and n=9 participants who followed moderate exercise had mean of height was 1.55±.06405 and n= 11 participants who performed heavy exercise had a mean of 1.5945±0.05698. The total mean of height of follow up 1 was found out to be 1.57±0.59 with p = 0.341. This value was found to be statistically significant.

b) **Weight** – The mean weight of participants n=4 was found to be 68.35±11.97, for n= 9 the mean weight was 72.95±15.79, and for n= 11 participants it is 72.95±15.7. Therefore, the total mean of weight after follows up 1 was found to be 73.46±16.5. with. The total mean of weight of follow up 1 was found out to be 73.46±16.55 with p = 0.781. This value is >0.005 therefore statistically insignificant.

c) **BMI**- The mean BMI after follow up 1 in n= 4 participants was found to be 27.58±5.78, for n=9 participants the mean BMI was found to be 30.52± 8.22 and for n= 11 it was found to be 27.41±10.96. The total mean for BMI after follows up 1 was found to be 28.60±9.08 with p= 0.00. This value is < 0.005 therefore statistically significant.

d) **Age** – The mean age for n=4 participants was found to be 37.75±7.32, for n= 9 the mean age was found to be 38.78±6.99, and for n= 11 the mean age was found to be 42.00±7.89. The total mean age after follows up 1 was found to be 40.08±7.38 with p= 0.001. This value is <0.005 therefore statistically significant.

e) **Waist Circumference-** the mean waist circumference for n=4 participants were found to be 94.70±9.32, for n= 9 the mean waist circumference was found to be 94.20±10.07, and for n= 11 the mean age was found to be 90.46±11.11. The total mean waist circumference after follows up 1 was found to be 92.57±10.21 with p=0.955. This value is >0.005 therefore statistically insignificant.

f) **IDRS Score** - the mean IDRS score for n=4 participants were found to be 62.50±5.00, for n= 9 the mean IDRS score was found to be 64.44±12.36, and for n= 11 the mean age was found to be 70.91±8.32. The total mean IDRS score after follow up 1 was found to be 67.08±9.99 with p=0.66. This value is >0.005 therefore statistically insignificant.

Follow up 2

During follow up 1 which was done in December 2020, the participants have been following their diet plans and performing regular exercise.

a) **Height**- during follow up 2, the mean height of the participants who did not perform any exercise n=4, their average mean of height was found to be 1.58±0.04967 and n=9 participants who followed moderate exercise had mean of height was 1.55±.06405 and n= 11 participants who performed heavy exercise had a mean of 1.5945±0.05698. The total mean of height of follow up 1 was found out to be 1.57±0.59 with p = 0.341. This value was found to be statistically significant. These values were same as that of follow up 1 with no change.

b) **Weight** – The mean weight of participants n=4 was found to be 75.05±0.04, for n= 9 the mean weight was 64.77±17.23, and for n= 11 participants it is 72.18±12.47. Therefore, the total mean of weight after follows up 1 was found to be 73.46±16.5. with. The total mean of weight of follow up 1 was found out to be 69.88±15.155 with p = 0.214. This value is >0.005 therefore statistically significant.

c) **BMI**- The mean BMI of participants n=4 was found to be 30.41±9.04, for n= 9 the mean weight was 26.62±5.82, and for n= 11 participants it is 27.49±5.28. Therefore, the total mean of weight after follows up 2 was found to be 27.65±0.64. p = 0.298. This value is <0.005 therefore statistically significant.

d) **Age**- The mean age for n=4 participants was found to be 37.75±7.32, for n= 9 the mean age was found to be 38.78±6.99, and for n= 11 the mean age was found to be 42.00±7.89. The total mean age after follows up 1 was found to be 40.08±7.38 with p= 0.001. This value is <0.005 therefore statistically significant.

e) **Waist Circumference-** the mean waist circumference for n=4 participants were found to be 93.57±7.03, for n= 9 the mean waist circumference was found to be 92.42±109.76, and for n= 11 the mean age was found to be 88.65±11.45. The

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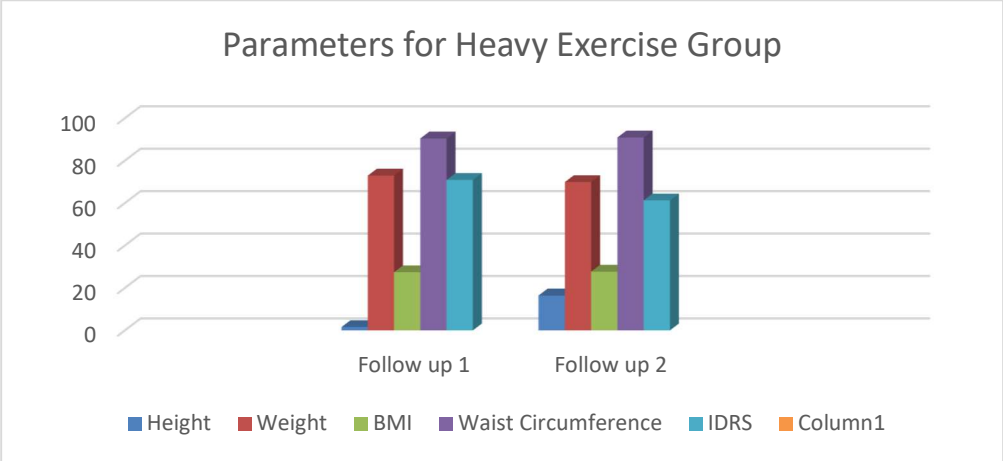
total mean waist circumference after follows up 1 was found to be 90.897±10.64 with p=0.465. This value is <0.005 therefore statistically significant.

f) **IDRS Score** - the mean IDRS score for n=4 participants were found to be 62.50±5.00, for n= 9 the mean IDRS score was found to be 62.22±13.01, and for n= 11 the mean age was found to be 60.00±23.66. The total mean IDRS score after follow up 2 was found to be 61.25±17.523 with p=0.06. This value is >0.005 therefore statistically insignificant.



Final Findings

The main objective of this study was to check the IDRS scores of the participants and identify the ones with high risk of developing diabetes. In this study, n=24 participants were identified as high-risk candidates. Out of these n= 4 did not perform any exercise but followed customized weight loss diet, n= 9 performed moderate exercise along with following their customized diet plans, and the remaining n=11 participants followed heavy exercise along with their customized diet plans over the course of this study.

The other major objective of this study was, to check changes in the IDRS scores of the high-risk participants over the course of the study. There were two modifiable factors- waist circumference and exercise and two non-modifiable factors – age and family history that determined the IDRS Scores. The changes in the modifiable factors are enumerated below.

In the baseline study, the average weight of the participants was 69.88±15.154. After follow up 1 and 2 the average weight of these participants was found to be 73.46±16.15 and 69.88±15.15 respectively. The average weight increased to 3.5±1 in the first follow up but came back to its original number in the next follow up. Therefore, no significant change was found in the weights of the participants. The average mean of BMI in the baseline study was 27.65±6.04. After follow up 1, the BMI increased to 28.26±9.08 and returned back to 27.65±6.04 after follow up 2. Since BMI is a measure of height and weight, no significant changes were found.
The mean waist circumference at the time of baseline study was 92.97±10.3. At the time of follow up 1, the mean waist circumference changed to 92.57±10.2 and during follow up 2, it was 90.89±10.06. Therefore, during the first follow up, there was slight change of 0.4±0.1 and 1.68±0.4 change during the next follow up. Therefore, it is concluded that not much difference in the waist circumference was analyzed post intervention in the study.

The mean IDRS score during the baseline study was recorded as 79.58±4.46. At the time of follow up 1 the IDRS score decreased to 67.08±9.99 and after follow up 2, it further reduced to 61.25±17.52. Therefore, after the first follow up, there was a difference was 12.5±5.53 and a difference of 18.33±13.06 after the commencing of follow up 2. Therefore, it was concluded that although only minor changes were recorded in the weight, BMI and waist circumferences there was a significant change in the IDRS score of the participants post intervention.

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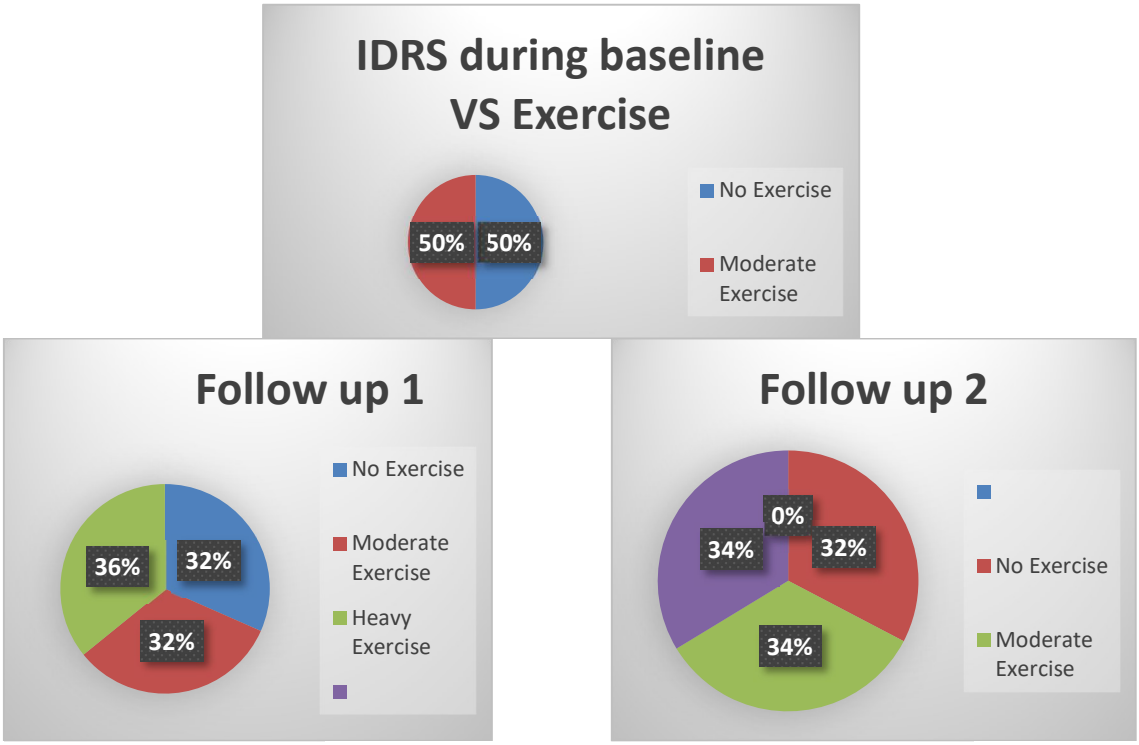

DISCUSSION

Type 2 diabetes mellitus (DM) is a chronic metabolic disorder in which prevalence has been increasing steadily all over the world. As a result of this trend, it is fast becoming an epidemic in some countries of the world with the number of people affected expected to double in the next decade due to increase in ageing population, thereby adding to the already existing burden for healthcare providers, especially in poorly developed countries.[8].Type 2 DM results from interaction between genetic, environmental and behavioral risk factors. People living with type 2 DM are more vulnerable to various forms of both short- and long-term complications, which often lead to their premature death. This tendency of increased morbidity and mortality is seen in patients with type 2 DM because of the commonness of this type of DM, its insidious onset and late. [9]

There are several factors that predisposes an individual in developing diabetes. These may include lifestyle, environment and genetic factors. Lifestyle factors like obesity, dietary patterns, physical activity determines the development of diabetes. Environment factors like civilization, migration from rural to urban hubs and genetic factors like diabetic genes, role of adiposity etc. also play their roles in diabetes. (Hu FB & 11556298.)[10] Diabetes risk scores have been developed on the basis of data from the San Antonio Heart Study, the Fin risk Studies, the Japanese American Community Diabetes Study and the Indian Diabetes risk Score. There is an urgent need for mass screening programs. However, it is difficult and expensive to screen everyone [universal screening]; hence selective screening is necessary to make screening cost-effective. Therefore, there is a need for having an Indian Diabetes Risk Score. Women especially housewives with poor dietary habits and sedentary lifestyle become easy targets for developing diabetes in the long run. Therefore, awareness and certain programs with housewives as beneficiaries should be put in place if diabetics are to be reduced in the city. Simple tools like IDRS helped in efficiently identifying those women who were standing at the curb of developing diabetes in their near futures.

The main objective of this study was to check whether changes in the IDRS scores can be seen with nutrition intervention and following of proper exercise regime. As the number of diabetics in India especially Hyderabad are increasing every day, the IDRS tool proved to be significantly helpful in identifying those falling under high risk. If these individuals can be identified early on,

[8] (Olokoba)
[9] (Olokoba)
[10] (Hu FB & 11556298.)

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the incidences of diabetics can be significantly reduced. Although the number of high-risk individuals identified were only n=24 in this study, it proved to be statistically insignificant to prove the efficacy of the IDRS and its correlation with height, weight and BMI of the individuals. Even with this drawback, the results of this study shows that with correct nutrition and proper exercise regime, a change can be brought in the incidences of developing diabetes in housewives, provided they follow the same diligently.

STRENGHTS AND LIMITATIONS

This study proves that simple tools like IDRS can also be helpful in curbing the incidences of diabetes provided that proper care is taken during its usage and minimizing the loop holes regarding the same. The strength of this study are the participants who with a personal goal worked hard to improve their own lifestyle for their betterment.

The limitation of this study was the small size of 201 participants and out of which only n=24 was identified as high risk of developing diabetes. The results of this study however small, were statistically insignificant. If the results are to be proven statistically significant, a large number of high-risk individuals are to be identified with proper nutrition intervention and mass screening is the right way to go about this study.

CONCLUSION

It was alarming to note that out of 201 participants, there were 68 (23%) of participants falling under moderate risk (≤60) and 24 participants (12%) were falling under high risk (>80). These participants were identified as individuals with risk of developing T2DM. To summarize, this study is statistically insignificant as p >0.005 in the baseline as well as follow ups 1 and 2. The reason behind its insignificance is that only n=24 participants were identified as high risk. However, in the participants who followed their customized weight loss diets and exercise regime as suggested diligently, changes in the score were reported from 79.58±4.46 in the baseline study to 61.25±17.52 after commencement of the follow ups. We notice that however small the changes are in the weight, BMI and waist circumference, a significant change is seen in the IDRS score putting the high risk (>80) individuals in moderate risk (<60).

Current study findings highlight the importance and need to focus and strengthen health promotion and Information Education and Communication activities in young population so as to reduce the future burden of disease. There is an urgent requirement of early identification of our at-risk population of individuals and to increase awareness among our future healthcare professionals, so that interventions viz. behavior change, communication and lifestyle modifications can be instituted at the earliest to prevent/delay onset of diabetes mellitus and its complications in later life.

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