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Identification of Parameters Impacting Diabetes Risk Score

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Abstract: Objective of this research study is to identify the parameters of a person related to health, life style, personal and family history, eating habit and work nature which may have certain impact on person's diabetes risk for type-2 diabetes. Despite the very high prevalence of diabetes in India, there are very few nationwide studies conducted on it. Ironically, the diabetic profile of India and western countries are very different. So the risk score developed based on the studies conducted in European and Western countries are of very little use in Indian context. The outcome of this study is a comprehensive questionnaire that systematically captures the complete profile of a diabetic person, which is easy to understand and answer. It can be used to build Diabetic Risk Score (DRS) Tool to assess a person's risk of getting type-2 diabetes. It can also be helpful in building type-2 diabetes prediction model using machine learning techniques.

Keywords: Type-2 Diabetes, Diabetic Risk Score Tool, Diabetic Profiling, Machine Learning

1. INTRODUCTION

Number of patients having diabetes is increasing at a very alarming rate in the world and India has become its capital [1], [2]. Type-2 diabetes is a life style disease. And unlike other diseases, it can't be cured, so prevention should be given high importance, which needs life style changes [3], [4]. Several strategies have been proposed by experts to reduce the risk of diabetes [5]. These guidelines are effective only when high diabetes risk persons get identified early. Data mining techniques are used in predicting and developing diabetes decision support system [6], [7], [8]. Lots of research work is being carried out for accurate prediction. When personalized dataset is used for building prediction model, accuracy of the prediction is reported high [9]. Selection of appropriate machine learning technique and algorithm also plays an important role in prediction accuracy [10]. Diabetes Risk Score (DRS) is a mathematical tool used to detect individuals with high risk for developing type 2 diabetes. It's a simple and noninvasive yet very reliable and popular tool used for mass screening for type 2 diabetes. There are several Diabetes Risk Score (DRS) tools available. These risk scores use a set of parameters like age, BMI, personal and family history etc. [11]. Basically, these risk scores uses a questionnaire to collect the data from the population. These data are used to build a mathematical model, which will predict the risk of a person's getting diabetes in near future. Accuracy of the Diabetic Risk Score Tool depends on the parameters used to calculate it [12].

2. LITERATURE SURVEY AND RESEARCH GAPE

There are several Diabetes Risk Score tools [13], [14], [15], [16], [17], [18], [19], [20], [21], [22], [23], [24]. Different parameters have been used in different Diabetes Risk Score tools. Researchers observed several issues, which need to be addressed, as follows.

1. Proper selection of parameters is very important.
2. Very limited parameters have been taken into consideration for calculating Diabetes Risk Score. In the 12 Diabetes Risk Scores, selected for this study, the minimum, maximum and average no parameters used for calculation is 5, 11 and 8.75 respectively. Table 1, shows the Diabetes Risk Score and no. of parameters.
3. The risk scores are based on the current information of the person. Person's historical data are not given any importance. For example if weight of two persons are as follows, assuming that height of both persons are 5.5 feet.
4. Person 1 was overweight before 5 years, but person 2 has maintained his ideal weight for last 15 years. All the 12 Diabetes Risk Scores, mentioned above, will consider both persons similar, while person 1 should be given good rank over person 2.
5. Some of the parameter of Diabetic Risk Score like life quality, stress, diet etc. are heavily depends on person's perspective. There should be a mechanism to standardize it.
6. Diabetes profile of India is significantly different from those of European and Western countries. Researchers found only two Diabetic Risk Score for Indian population and both of them used the parameters which are identified by the research conducted in European and Western countries.
7. Despite the very high prevalence of diabetes in India, no nationwide studies conducted on it.

Table 1
Diabetes Risk Score and no. of parameters

<i>No.</i>	<i>Diabetes Risk Score Tool</i>	<i>No. of Parameter</i>
1.	American Diabetic Association	6
2.	Type 2 Diabetes Risk Assessment	10
3.	Uk Diabetes Association Drs	8
4.	Dia Care-2003-Lindstrom	9
5.	Australia Gov	10
6.	University Of Leicester Drs	9
7.	The Canadian Drs	11
8.	Queensland Australia Assess Your Risk	10
9.	A Simplified Indian Diabetes Risk Score For Screening India	5
10.	Indian Diabetes Risk Score	10
11.	Dia Care-2008-Heikes-1040-5	8
12.	Danish Drs dia Care-2004-Glumer-727-33	9

Table 2
Historical Data

	<i>Weight (KG)</i>		
	<i>At the time of risk calculation</i>	<i>5 years back</i>	<i>10 years back</i>
Person 1	65	78	80
Person 2	65	67	65

3. A COMPREHENSIVE QUESTIONNAIRE FOR DIABETES RISK SCORE CALCULATION

Researchers developed a comprehensive questionnaire, shown in annexure 1, which is specifically for designed for Indian population by including India specific parameters.

Following are the salient features of the questionnaire.

1. To capture the complete profile of a diabetes person, a very comprehensive questionnaire was prepared, which contains 106 parameters. The maximum no of parameters used in the 12 Diabetes Risk Score questionnaire is 11. Researchers are of opinion that let the parameters be an exhaustive list, so no significant data get slipped. And once the data gets collected, let the data analysis techniques decide, which are the important parameters for capturing a complete profile of a diabetes person?
2. There is no proven cure in the modern system of medicine for diabetes, but it can be avoided or delayed by some life style changes, if it is possible to predict diabetes or pre-diabetes patient very early. Researchers are of the opinion, that if a diabetes patient's comprehensive profile is created from the date of it's diagnosis to 15 years back, then it is possible to build a model to predict a pre-diabetes or diabetes person very early. None of the 12 Diabetes Risk Score tools, researchers studied, capture any past data of the person. In the present questionnaire, researchers capture the last 15 years data for following parameters;
 - A. Pathological Investigations like blood pressure, cholesterol, hospitalization frequency
 - B. Physical attributes like height, weight, waist measurement
 - C. Diet habits like balanced diet, rice based diet, addiction
 - D. Life styles like stress, nature of work, physical activity
 - E. Quality of life
3. Diabetes is very closely related with some other diseases like high triglyceride. None of the Diabetes Risk Score tools, we studied, considered it for the prediction.
4. Family history of diabetes is strongly associated with the diabetes risk of a person. And most of the Diabetes Risk Score considered it. Closeness in blood relation, higher the risk. Impact of parent's diabetic status is more on a person's diabetic risk, than their siblings or grandparents. So closeness of the blood relation should be captured and given appropriate weight. The proposed questionnaire captures the relationship, parents, siblings and grandparents separately along with their diabetic history.
5. As discussed in the above paragraph, not only the diabetic history, but family's blood pressure and cardiac disease history, is separately recorded in the questionnaire proposed here. No other Diabetes Risk Score tools found in literature that captures it so.
6. Looking to the diabetes map of India, the states where rice is dominating food, prevalence of diabetes is high. So rice based diet might be a contributing factor in diabetes and it is being captured in the questionnaire proposed here. No Diabetes Risk Score found in the literature considered it.
7. In this comprehensive questionnaire, different terms and their rankings are clearly defined, like life quality, balanced diet, nature of work, physical activity, stress etc.

IV. CONCLUSION

In this research study, researchers identified potential parameters for type-2 diabetes risk and presented a comprehensive questionnaire that will help to capture the complete profile of a type-2 diabetes person. This

questionnaire is used to build Indian Weighted Diabetes Risk Score (IWDRS) [12], which is a cost effective mass screening tool for diagnosis of type-2 diabetes and pre-diabetes patients.

ANNEXURE 1: A COMPREHENSIVE QUESTIONNAIRE FOR DIABETES RISK SCORE CALCULATION

1. Personal Information (This information will be kept confidential. However you may choose not to fill it.)

Identification No & Date [Office use only]	DIABETES YES NO	Name:	Surname	First Name	Father's Name
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2. Demographic Information

Gender: Male Female	Age: Years	Education: None School Graduate
Gestational Diabetes (For female only): Yes No [Diagnosed with diabetes during the pregnancy]		
Caste:	Religion: Hindu Muslim Parsi Sikh Christian Others	
City:	City Category: Rural Urban	
Race:	<input type="radio"/> South Asian (East Indian, Pakistani, Sri Lankan, etc.) and East Asian (Chinese, Vietnamese, Filipino, Korean, etc.) <input type="radio"/> Aborigina, Black (Afro-Caribbean), Other non-white (Latin American, Arab, West Asian) <input type="radio"/> White (Caucasian)	

3. Family History

	Tick if present.
Mother:	Diabetes Blood Pressure Cholesterol Gestational Diabetes
Father:	Diabetes Blood Pressure Cholesterol
Brother:	Diabetes Blood Pressure Cholesterol
Sister:	Diabetes Blood Pressure Cholesterol Gestational Diabetes
Grand Mother/Father:	Diabetes Blood Pressure Cholesterol Gestational Diabetes

4. Pathological Investigations

Attribute	Today	5 Years Back	10 Years Back
Blood Pressure:	Yes No	Yes No	Yes No
Cholesterol:	Yes No	Yes No	Yes No
Hospitalization Frequency:	/5 years	/5 years	/5 years
[Other than pregnancy and accidental cases]			

5. Physical Attributes

Attribute	Today	5 Years Back	10 Years Back
Obesity	Yes No	Yes No	Yes No

BMI:	[If you don't know your exact weight & height before 5 and 10 years, then just response whether you were obsessed during that period.]					
Weight:	Kg.		Kg.		Kg.	
Height:	Feet	Inch	Feet	Inch	Feet	Inch
Waist:	Inch		Inch		Inch	

6. Diet Habit

Attribute	Today	5 Years Back	10 Years Back
UNBALANCED DIET – 1 (Junk food, no fruits & vegetables, more oil, unhealthy diet frequently) POOR – 1(Junk food, no fruits & vegetables, more oil, unhealthy diet) MODERATE –3 GOOD – 4 BALANCED DIET –5 (Equal proportion of grains, pulses, vegetables, fruits with normal oil consumption)			
Balanced Diet:	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Rice Based Diet:	Yes No	Yes No	Yes No
Addiction	Yes No	Yes No	Yes No
[Smoking, Tobacco, Alcohol or any other drug]			

7. Life Style:

Attribute	Today	5 Years Back	10 Years Back
	NO OR MILD – 1 MODERATE – 2 HIGH – 3 VERY HIGH – 4 UNBEARABLE -- 5		
Work Stress:	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Financial Stress:	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Family Stress:	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Health Stress:	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Social Stress:	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Over all Stress:	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Nature of Work:	Office Field Work	Office Field Work	Office Field Work
	Hours/Day	Hours/Day	Hours/Day
Physical Activity:	Physical activity like exercise, walking, cycling, out-doors sports, working in home/form/factory or other labor intensive work. Do not count routine work.		

8. Quality of Life:

	Today	5 Years Back	10 Years Back
Life Quality:	[How you rate yourself for Happiness, Love, Hope, Satisfaction, Confidence, Emotional, Physical and Spiritual well-being]		
	LOW – 1 MILD – 2 MODERATE – 3 GOOD – 4 VERY GOOD – 5		
	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

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Identification of Parameters Impacting Diabetes Risk Score

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