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FINDRISC or PRESS Scores for the Prediction of Prediabetes Risk: Assessing and Comparing Their Performance Among the Lebanese University Workers

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Abstract

Objective: Compare and Assess the performance of two screening tools: FINDRISC and PRESS in the prediction of prediabetes risk among the Lebanese university workers.

Material and methods: This cross-sectional study involves 508 individuals working at the Lebanese university. Participants were subjected to fasting blood glucose and 2-h oral glucose tolerance test. Logistic regression is fitted for 2 models that predict prediabetes: FINDRISC and PRESS; the area under the curve (AUC) was calculated for both to assess their diagnostic accuracy.

Results: In our sample, the prevalence of prediabetes is 23.8%. After fitting the logistic regression for FINDRISC model, only age, history of high blood sugar and BMI predictors were statistically significant, and for the PRESS model, only waist to height ratio with age (numerical) were statistically significant. The AUC were 0.67 and 0.587 respectively for FINDRISC and PRESS.

Conclusion: FINDRISC score can be used for the prediction of prediabetes among the Lebanese university worker community, having a similar performance compared with communities. While PRESS score did not have a good performance in our study population.

Keywords: Prediabetes; FINDRISC Score; PRESS Score; Screening Test

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Introduction

Type II diabetes mellitus is a major public health concern in the whole world. According to the International Diabetes Federation, 463 million people in the world suffer from diabetes, and out of these 463 million, 55 million are from the MENA region until February 2020. Being part of the MENA region, Lebanon's prevalence of diabetes is on the rise and accounts for 12.9% in those aged between 20 and 79 years till February 2020 [1].

Type II diabetes is a chronic disease characterized by insulin resistance that results in an unregulated blood glucose level following food consumption mainly carbohydrates. Persistently elevated blood glucose could lead to serious life-threatening complications: macro-vascular complications, such as coronary heart disease, peripheral arterial disease, and strokes, and micro-vascular ones, such as neuropathy, retinopathy, and diabetic nephropathy [2]. The diagnosis of diabetes is usually done by measuring fasting or random blood glucose, A1C level, or an oral glucose tolerance test (OGTT).

Prediabetes is a condition in which plasma glucose values are higher than normal but still lower than the levels used to diagnose diabetes. According to the American diabetic association ADA, prediabetes is defined as impaired fasting glucose IFG when fasting plasma glucose levels range from 100 mg/dl to 125 mg/dl and impaired glucose tolerance when following a glucose tolerance test, 2h plasma glucose levels range from 140 mg/dl to 199 mg/dl [3]. In Lebanon, the prevalence of individuals, aged between 20 and 79 years, with impaired glucose tolerance reached 8.4% in 2019 [2].

The International Diabetes Federation estimated that the health care costs of individuals with diabetes are two times higher than those of an individual without diabetes [4]. Tools such as the Atherosclerosis Risk in Communities score (ARIC) and the Framingham Offspring score [5] are considered invasive tools to predict diabetes since they need an expensive and invasive blood test to perform them. The non-invasive screening tools are inexpensive, simple, and fast to administer.

The Finnish Diabetes Risk Score (FINDRISC) is one of the most used and efficient screening tools for newly diagnosed type II diabetes mellitus (T2DM). To predict T2DM, FINDRISC includes

anthropometric measurements (BMI, waist circumference), metabolic and lifestyle factors (age, presence of hypertension, history of high blood sugar, fruits and vegetables consumption, physical activity), and family history of diabetes. FINDRISC is originally created to predict the risk of diabetes within 10 years then, it was validated to predict the outcome: metabolic syndrome [6] and later on, it was used to predict prediabetes [7]. But only a few studies investigated the ability of FINDRISC to detect prediabetic individuals (impaired fasting glucose and/or impaired glucose tolerance), diabetes mellitus has always been the main investigated outcome.

Few screening tools are commonly used to detect prediabetes; like ADA (The American diabetic association) and CDC (Centers for Disease and Control and prevention) scores. A new score "PRESS" is also a Prediabetes Risk Evaluation Scoring System elaborated recently in a study done by Rajput R, et al. (2019) [8], it was created and applied on an adult population in Haryana, India, easy to apply and includes four simply assessed parameters with minimum time and effort needed. PRESS includes: age (3 categories: less than 30, between 30 and 60, and more than 60 years), family history, raised waist to height ratio (>0.5), and raised diastolic blood pressure (>90 mmHg) [8].

This study aims to investigate the ability of both FINDRISC and PRESS in detecting prediabetes and compare both scores performance on the working community of the Lebanese University.

Materials and Methods

Our sample's data is secondary data already collected between January 2018 and May 2019 [9]. Participants are workers within the faculties of the Lebanese University from different regions in Lebanon. Those aged above 30 with no serious medical condition, not already diagnosed as diabetic or prediabetic, and non-pregnant women, were included in the study. A questionnaire was completed by the participants after signing informed consent. The questionnaire included all FINDRISC components along with socio-demographic information. Anthropometric measurements were collected by master's nutrition students including weight and waist circumference. The height of the participants was self-reported. The values waist and height collected were used to compute waist to height ratio also BMI (Body Mass Index) was calculated for each participant. Blood pressure (systolic and diastolic) and heart rate were measured for each participant after being seated for 5 minutes with no distractions [9].

Blood samples for laboratory examination were collected after 12 hours of fasting and each participant was instructed to abstain from vigorous exercise the night before and morning before the laboratory visit. Biochemical measurements included: 75g OGTT test, fasting blood glucose, and 2-hours plasma glucose level.

Individuals were classified as prediabetic according to the American diabetic association's criteria (ADA, 2018): FBG ranges between 100 and 125 mg/dl, and 2-hours plasma glucose after OGTT ranges between 140 and 199 mg/dl.

This data allows us to evaluate and compare both FINDRISC and PRESS scores for the prediction of prediabetes.

Statistical Analysis

SPSS version 23 (IBM Corp, SPSS Statistics) was used to conduct statistical analysis. One-way ANOVA test was used to compare the difference between the means of age, BMI, WC, and WHT ratio between men and women and prediabetes status. Chi-square test was used to compare the percentages between the different categories of different variables (age, BMI, WC, and WHT ratio). A p-value of less than 0.05 was considered significant. Binary logistic regression was used for both FINDRISC and PRESS to look for significant variables in both scores in predicting prediabetes. The goodness of fit was assessed using the Hosmer-Lemeshow test. The area under the ROC curve (AUC) was evaluated to compare the performance of each score in predicting prediabetes with both sensitivity and 1-specificity used to plot the ROC curves (FINDRISC and PRESS).

Results

In our sample, 222 (43.7%) are men and 286 (56.3%) are women, 121(23.8%) were found to be prediabetic. Out of the 508 participants, 31 individuals were found to have undiagnosed diabetes and were excluded from the sample since our main focus is on "prediabetes", making the sample's total number of 477 individuals. The highest percentage of prediabetic was found among men 58.9% compared with 41.1% among women (Table 1). There is a significant difference between gender in BMI, waist circumference, weight, and waist to height ratio with a p-value<0.05. The mean BMI for men was higher than women 28.13±4.1 and 25.95±4.5 respectively. The mean waist to height ratio for men was 0.58±0.06 higher than women which was 0.54±0.08 (Table 1).

FINDRISC variables were included as categorical variables in binary logistic regression. After performing logistic regression, we obtained three main categories as significant variables in independently predicting prediabetes which are age category, BMI category, and history of high blood glucose with a p-value<0.05 (Table 2). The ODD's ratio for the variable age as categorical increased with the increase in the age category; an ODD's ratio of 1.935 for those aged between 45 and 54 years compared with 41.101 for those who fall into the age category that is older than 64. A similar increase in ODD's ratio is noticed for BMI with the increasing BMI category (3.564 for a BMI between 25 and 30 kg/m^2 vs 4.723 for a BMI higher than 30 kg/m^2) (Table 2). Also, there was a significant difference in age, BMI, weight, waist circumference, and waist to height ratio between prediabetic and non-prediabetic individuals (p-value<0.05) (Table 3). The mean age of prediabetic individuals is 51.9±9.4 higher than non-prediabetic which is 46.99±9.08. Also, the mean BMI for prediabetic is 28.85±3.8 kg/m^2 higher than 26.25±4.4 kg/m^2 in non-prediabetic individuals (Table 3).

For PRESS score we removed the first age category (<30 years) because in our sample all participants are above 30. When we performed logistic regression for PRESS variables, out of the four variables age and waist to height ratio were significant, with a p-value <0.05 (Table 4). There was a significant difference in the waist to height ratio value between prediabetic and non-prediabetic participants with prediabetic participants having a higher mean waist to height ratio than non-prediabetic, 0.59±0.06 and 0.55±0.07 respectively (Table 3). The Hosmer-Lemeshow test for both FINDRISC score and PRESS showed

Table 1: Distribution of some predictors within gender.

	Gender		*p-value*
	Men (n=199)	**Women (n=278)**	
Prediabetic (count)	66	46	**0.000**
Age (mean±SD)	48.48±9.7	47.6±8.9	0.151
BMI (mean±SD)	28.13±4.1	25.95±4.5	**0.000**
Waist circumference (mean±SD)	101.88±11.5	89.03±13.1	**0.000**
Weight (mean±SD)	86.36±13.5	68.92±12.8	**0.000**
Wasit to height ratio (mean±SD)	0.58±0.06	0.54±0.08	**0.000**

Table 2: Logistic regression for the FINDRISC model.

Variables	Prediabetes				
	Beta- coefficient	OR	95% CI for OR		p-value
			Lower	Upper	
FINDRISC					
Age category					**.001**
45-54 years	.660	1.935	1.075	3.485	**.028**
55-64 years	.848	2.334	1.213	4.493	**.011**
>64 years	3.716	41.109	5.784	292.180	**.000**
Waist category					.282
94-102 cm men	-.010	.990	.439	2.232	.980
80-88 cm women					
More than 102 cm men	.433	1.541	.678	3.502	.302
More than 88 cm women					
BMI category					**.001**
25-30 kg/m²	1.271	3.564	1.729	7.347	**.001**
>30 kg/m²	1.552	4.723	2.051	10.873	**.000**
Family History category					.340
First degree	.153	1.166	.690	1.970	.567
Second/third degree	.496	1.642	.847	3.181	.142
PA ≥ 30 mins/day	-.359	.699	.372	1.312	.265
Daily fruits and vegetables	.008	1.008	.623	1.631	.973
Medication for HTN	-.462	.630	.325	1.220	.171
High blood glucose	.874	2.396	1.136	5.054	**.022**
Hosmer-Lemeshow	0.334				

Table 3: Distribution of some variables within the prediabetic status.

	Prediabetes status		*p-value*
	Normal (n=365)	Prediabetic (n=112)	
Age (mean±SD)	46.99±9.08	51.9±9.4	**0.000**
BMI (mean±SD)	26.25±4.4	28.85±3.8	**0.000**
Waist circumference (mean±SD)	92.45±14.1	100.7±11.3	**0.000**
Weight (mean±SD)	74.41±15.5	82.02±14.6	**0.000**
Waist to height ratio (mean±SD)	0.55±0.07	0.59±0.06	**0.000**

good calibration 0.334 and 0.643 respectively (higher than 0.05) (Table 2 and Table 4). The area under the ROC (AUC) for FINDRISC is 0.670 better than 0.587 which is the AUC for PRESS in our general study population (Figure 1). After splitting our data according to gender, the AUC values for men and women, using FINDRISC, were 0.687 and 0.669 respectively. As for PRESS, AUC values for men and women were 0.587 and 0.602 respectively.

Optimal Cut-off Values to Detect Prediabetes Using FINDRISC

For the whole sample and for a cut-off of 9.5, the sensitivity and the specificity were 76.8% and 48.9%. These values became 67% and 56.9% for a cut-off of 10.5.

For men, the sensitivity and specificity values were 78.8% and 54.9% respectively for a cut-off equal to 9.5, while for a cut-off equal to 10.5, these values became 68.2% and 62.4% respectively.

For women, the sensitivity and specificity values were 73.9% and 45.5% respectively for a cut-off equal to 9.5, while for a cut-off equal to 10.5, these values became 65.2% and 53.7% respectively.

Optimal Cut-off Values to Detect Prediabetes Using PRESS

For the whole sample and for a cut-off of 67.5, the sensitivity and

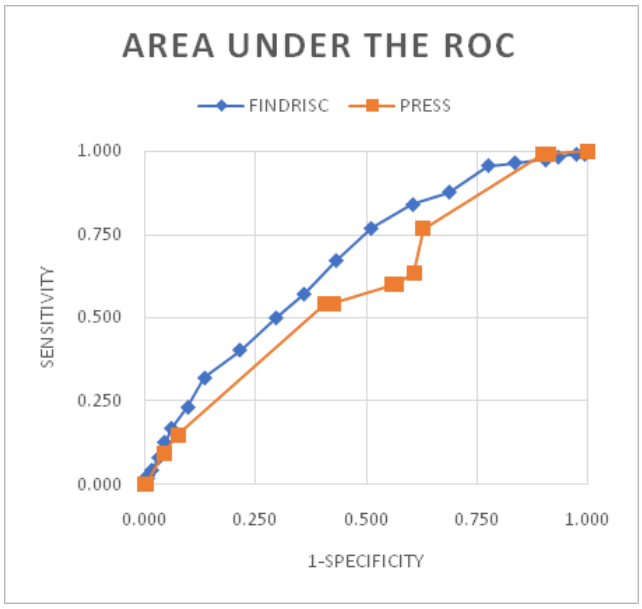

Figure 1: ROC curves for FINDRISC and PRESS scores as the outcome is Prediabetes.

Table 4: Logistic regression for PRESS score model.

Variables	Beta- coefficient	OR	95% CI for OR		p-value
			Lower	Upper	
Age	0.996	2.707	1.412	5.191	0.00
Family history for diabetes	0.290	1.337	0.845	2.115	0.22
Waist to height ratio	1.481	4.398	1.956	9.890	0.00
Diastolic blood pressure	0.129	1.138	0.582	2.224	0.71
Hosmer-lemeshow	0.643				

the specificity were 59.8% and 43.8%. These values became 54.2% and 57.3% for a cut-off of 72.5.

For men, the sensitivity and specificity values were 52.3% and 51.2% respectively for a cut-off equal to 62.5, while for a cut-off equal to 67.5, these values became 52.3% and 53.6% respectively.

For women, the sensitivity and specificity values were 59.1% and 56.8 % respectively for a cut-off equal to 72.5, while for a cut-off equal to 77.5, these values became 59.1% and 57.2% respectively.

Discussion

In this study, we have compared the FINDRISC score and the PRESS score performance in the prediction of prediabetes in the Lebanese university worker community.

A study was done by Rajput R, et al. (2019) [8], aimed to develop a simple risk score to detect undiagnosed prediabetes PRESS (prediabetes risk evaluation scoring system). PRESS included: age, family history, waist to height ratio, and diastolic blood pressure as variables for predicting prediabetes. After fitting logistic regression for prediabetes outcome, all these predictors were statistically significant (p-value<0.05) except diastolic blood pressure (p-value = 0.55) [8]. Our results show that age and the waist to height ratio variable are significant in our study population. The waist to height ratio was used in PRESS instead of BMI, used in FINDRISC because it is considered a better predictor of visceral obesity and is independent of the gender of an individual [8]. In another study done by Rajput R, et al. (2014) [10], that aimed to compare waist circumference, waist to hip ratio, BMI and waist to height ratio, waist to height ratio, irrespective of gender

and place of residence in India, can be used as a universal screening tool to look for individuals at high risk of a metabolic problem [10]. The area under the ROC for PRESS was 0.785 at an optimal score of 45 the sensitivity and the specificity were 84.37% and 58.47% respectively in the Indian population of Haryana [8]. In our study PRESS did not perform as good as it did in the Indian population having an AUC of 0.587 and the sensitivity and specificity were 59.8% and 43.8% respectively at an optimal score of 67.5.

A study done by Zhang L, et al. (2014) [7], validated FINDRISC for prediabetes, it was one of the very few studies to look for the outcome "prediabetes" and not only "diabetes" among US adults. Results showed that the prevalence of undiagnosed prediabetes were 35.55%, using the optimal cutoff point of 9 for men the sensitivity and specificity were 60.94% and 62.43% respectively with the area under the ROC curve equal to 0.66. As for women, using an optimal cutoff point of 10, the sensitivity and the specificity were 68.72% and 60.89% respectively, with the area under the ROC curve equal to 0.70; when compared to our results the sensitivity and specificity was 78.8% and 54.9% respectively at cutoff equal to 9.5 for men and 65.2%, 53.7% respectively at cutoff equal to 10.5 for women. The AUC among the US population was 0.67, which is similar to our results with an AUC of 0.67.

Another study done in Venezuela aimed to compare Latin American FINDRISC and original FINDRISC in predicting both diabetes mellitus and prediabetes (IGT and/or IFG), the original FINDRISC having an AUC of 0.587 for men and 0.627 for women. While our results show that FINDRISC had an AUC= 0.687 for men and 0.669 for women [11]. Which means that the O-FINDRISC performs better in the Lebanese university worker than Venezuela's population.

These differences between our results and the other studies can be due to factors like ethnicity. The PRESS score shows a good performance among the Indian population and bad performance among the Lebanese university worker community maybe due to difference in the ethnicity between these two populations. This hypothesis can be supported by a study done by Bennet L, et al. (2014) [12], which shows a different performance of FINDRISC in the prediction of diabetes among native swedes and Iraqis immigrants in Sweden.

Conclusion

Based on our results, FINDRISC is the score to choose to predict prediabetes in our study population. It had a good performance in the Lebanese university worker community, which is similar to its performance in the US population and not so different from its performance in Venezuela. In our study population, the PRESS score did not perform as good as it did in the Indian population.

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Author's Contribution

Maher Abdallah and Mohamad Hneino conceived and designed the study, Maher Abdallah, Jajieh Assil and Ghemrawi Ihab analyzed the data, Jajieh Assil and Ghemrawi Ihab wrote the paper, Maher Abdallah reviewed the article, all authors read and approved the final manuscript.

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Availability of Data and Materials

Not applicable.

Ethics Approval and Consent to Participate

Since the data used is secondary, there was no need for consent in this study.

Consent for Publication

Not applicable.

Conflict of Interest

No conflict of interest.

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