ORIGINAL RESEARCH

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Analysis and Comparison for Prediction of Diabetic among Pregnant Women using Innovative K-Nearest Neighbor Algorithm over Logistic Regression with Improved Accuracy

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ABSTRACT

Aim: In comparison to the K-Nearest Neighbor (KNN) algorithm, Logistic Regression (LR) was used in machine learning algorithms for the prediction of diabetes among pregnant women to get better accuracy, PEARCEsensitivity, and precision. **Materials and methods:** To verify the usefulness of the technique, researchers collected data sets from free available data sets such as the Pima Indian dataset from the UCI website to examine diabetes among pregnant women. There are two groups in this study: K-Nearest Neighbor (N=20) and Logistic Regression (N=20), each having a sample size of 40. A pre-test power of 80%, a threshold of 0.05, and a confidence interval of 95% are used in the sample size calculation. **Results:** The accuracy, sensitivity, and precision of algorithms are used to evaluate their performance. K-Nearest Neighbor (KNN) accuracy rate is 72.44 percent, but Linear Regression (LR) accuracy is 76.67%. The sensitivity rate for K-Nearest Neighbor is 74.42 percent, while the sensitivity rate for Linear Regression (LR) is 76.16 percent. The precision rate for K-Nearest Neighbor (KNN) is 73.75percent, whereas the precision rate for Linear Regression (LR) is 81.87 percent. The accuracy rate is significantly different P=0.366 (P>0.05). **Conclusion:** When compared to the Innovative K-Nearest Neighbor algorithm, the Logistic Regression algorithm predicts better classification in discovering the accuracy, sensitivity, and precision for accessing the rate for prediction of diabetes among pregnant women.

Keywords

Diabetes prediction, Innovative K-Nearest Neighbor algorithm, Logistic Regression algorithm, Artificial Intelligent, Accuracy.

Imprint

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INTRODUCTION

Diabetes is a group of metabolic disorders characterized by hyperglycemia caused by flaws in insulin production, insulin action, or both. Diabetes-related chronic hyperglycemia is linked to long-term damage, malfunction, and failure of a variety of organs, including the eyes, kidneys, nerves, heart, and blood vessels (Khanam and Foo 2021). Diabetes is the most chronic condition, putting a strain on the public health system. According to the World Health Organization, diabetes-related deaths will increase by 55% in the next decade (Patikar et al. 2020). When the pancreas does not generate enough insulin or the insulin that is produced is not utilized properly in the body, diabetes develops. According to the World Health Organization and the American Diabetes Association, there are four kinds of diabetes: Type I, Type II, Gestational diabetes (GDM), and rare specific diabetes are all types of diabetes (Abedini, Bijari, and Banirostam 2020). Obesity and type 2 diabetes, often known as diabetes, are likely to be the biggest epidemic in human history. If the whole number of diabetes in the world were gathered in one country, it would be the world's third-largest (Grinenko, n.d.). The primary goal of this study is to evaluate the accuracy, sensitivity, and precision of the K-nearest neighbor and logistic regression methods in terms of diabetes prediction (I et al., n.d.). T2DM diagnosis is so critical in avoiding a variety of severe and even life-threatening consequences in people at risk of cardiovascular disease (Barakat, Youssef, and Al-Lawati 2010). According to recent diabetes patient statistics, diabetes among adults (over 18 years old) increased from 4.7 percent to 8.5 percent between 1980 and 2014 and is increasing in other regions of the world as well. (Polce et al. 2021) According to data, more than 451 million individuals globally have diabetes in 2017, with that number expected to rise to 693 million in 20 years. Application of prediction of Breast cancer in study revealed how common diabetes is, with rates predicted to rise to 25% and 51% in

2030 and 2045, respectively (Abedini, Bijari, and Banirostam 2020). Our team has extensive knowledge and research experience that has translate into high quality publications (Chellapa et al. 2020; Lavanya, Kannan, and Arivalagan 2021; Raj R, D, and S 2020; Shilpa-Jain et al. 2021; S, R, and P 2021; Ramadoss, Padmanaban, and Subramanian 2022; Wu et al. 2020; Kalidoss, Umapathy, and Rani Thirunavukkarasu 2021; Kaja et al. 2020; Antink et al. 2020; Paul et al. 2020; Malaikolundhan et al. 2020)

Several machine learning algorithms to predict diabetes have been done in recent years. Google Scholar yielded 1200 results, while ScienceDirect yielded 30 research papers. The objective of this study is to develop a model that can properly predict a person's risk of developing diabetes (Rohan et al. 2015). These investigations use machine learning classification methods including KNN, Decision Tree, SVM, Logistic Regression, and PCA to detect diabetes at an early stage. In these studies, the Pima Indian diabetes database (PIDD), which is provided by the UCI machine learning respiratory, is used. The algorithm's performance is measured in terms of accuracy, sensitivity, and precision (Soni, n.d.). Because there are so many risk factors linked with diabetes, it is critical to anticipate diabetes at an early stage (Ugwu and Ene, n.d.). We utilized K-Nearest Neighbor to predict diabetes in this article, A supervised machine learning algorithm is the KNN algorithm. When fresh data is input into the KNN machine learning algorithm, it compares it to previously stored data to see if there are any similarities (Hojjatoleslami 1996). By constructing multiple classifications and ensemble models from gathered datasets, various machine learning techniques give efficient results for collecting knowledge (Alanazi and Mezher 2020). Machine learning has been a huge help in predicting the behavior of a certain system through training. Machine learning has emerged as a developing, dependent, and supportive technology in the medical sector in recent years (Asfaw 2019). Medical analysis improves diagnosis accuracy, lowers costs, and saves human resources thanks to recent breakthroughs in machine learning (I et al., n.d.). Machine learning is a technique for directly training computers or machines.

The primary challenge that has inspired me to undertake this study on enhancing the accuracy of machine learning and the prediction of diabetes among pregnant women in the early stages is inefficient early identification of diabetes and human mistakes in the detection of diabetes by traditional techniques. The primary issue with current research is that diabetes prediction systems are inaccurate. The authors compared machine learning algorithms since they were specialists in machine learning algorithms and deep learning technology. The major goal is to evaluate and assess diabetes deduction approaches utilizing cutting-edge machine learning algorithms such as the Decision Tree algorithm and Logistic Regression algorithm.

MATERIALS AND METHODS

The study was carried out at the University simulation lab, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Chennai. In this paper, the sample size was determined using clinical.com, using an alpha error-threshold of 0.05, enrollment ratio of 0:1, 95 percent confidence interval, and power of 80 percent, based on earlier study findings (Sufriyana et al. 2020). A K-Nearest Neighbor algorithm (N=20) and Logistic Regression (N=20) were in Group 1. This research includes a total of 40 samples.

The UCI respiratory website provided the data samples utilized in this investigation. To acquire the absolute data necessary, the data set is subjected to data reduction procedures. To execute classification learning techniques, the data should be fed into Matlab 2021a. To train, input data should be loaded into categorization learning systems. The imported data is trained twice, once for the K-Nearest Neighbor ranging from 5 to 24, and once for the Logistic Regression with validations ranging from5 to 24. The confusion matrix should be obtained for each validation after data validation for an algorithm, which includes the TP (true positive), TN (true negative), FP (false positive), and false negative. These variables are used to calculate accuracy, sensitivity, and precision.

STATISTICAL ANALYSIS

IBN SPSS 26.0.1 is the statistical software package that was used in this study. The mean, standard deviation, and standard error mean statistical significance between the groups were determined using the independent sample T-Test, and then a comparison of the two groups using SPSS software yielded accurate values for the two different algorithms that will be used with the highest level of accuracy (81.87%), mean

(0.8187), and standard deviation value (0.02627). The image size is an independent variable, whereas the image accuracy is a dependent variable.

RESULTS

Table 2 shows how to predict diabetes in pregnant women using K-Nearest Neighbor (KNN) and Logistic Regression (LR) methods. When comparing the accuracy, sensitivity, and precision of the K-Nearest Neighbor (KNN) with the Logistic Regression (LR), the LR method outperforms the KNN technique. Table-2 shows the accuracy of the Logistic Regression (LR) and K-Nearest neighbor (KNN) methods. The accuracy, sensitivity, and precision rate of a Logistic Regression (LR) are higher than those of a K-Nearest Neighbor (KNN) as shown in Table 1a and Table 1b. The accuracy, sensitivity, and precision of K-Nearest Neighbor (KNN) findings are 72.44 percent, 774.42 percent, and 73.75 percent, respectively, whereas the accuracy, sensitivity, and precision of Logistic Regression (LR) results are 76.67 percent, 76.16 percent, 81.87 percent respectively. Logistic Regression (LR) has a lower error rate than the K-Nearest Neighbor (KNN), as seen in Table 2.

Table 1a

Diabetes prediction samples using K-Nearest Neighbor Algorithm

Samples	Accuracy	Sensitivity	Precision
1	0.74	0.74	0.79
2	0.71	0.71	0.77
3	0.73	0.7	0.7
4	0.74	0.77	0.72
5	0.71	0.7	0.7
6	0.71	0.72	0.72
7	0.71	0.72	0.72
8	0.71	0.7	0.7
9	0.71	0.73	0.70
10	0.72	0.75	0.70
11	0.72	0.74	0.72
12	0.72	0.74	0.72
13	0.72	0.74	0.72
14	0.74	0.77	0.72
15	0.74	0.75	0.77
16	0.72	0.74	0.72
17	0.72	0.73	0.7
18	0.72	0.7	0.70
19	0.73	0.76	0.72
20	0.73	0.76	0.72
21	0.74	0.75	0.71
22	0.72	0.72	0.75

Table 1b

Diabetes prediction samples using Logistic Regression

Samples	Accuracy	Sensitivity	Precision
1	0.77	0.76	0.83
2	0.77	0.7	0.8
3	0.77	0.76	0.83
4	0.77	0.76	0.83
5	0.8	0.77	0.8
6	0.78	0.77	0.85
7	0.73	0.7	0.77
8	0.76	0.76	0.8
9	0.76	0.76	0.8
10	0.74	0.75	0.77
11	0.75	0.7	0.8
12	0.78	0.77	0.85
13	0.75	0.7	0.8
14	0.76	0.76	0.8
15	0.77	0.76	0.83
16	0.74	0.73	0.8
17	0.74	0.73	0.8
18	0.77	0.76	0.83
19	0.75	0.7	0.79
20	0.75	0.7	0.79
21	0.76	0.74	0.81
22	0.78	0.75	0.82

Table 2

Comparison of mean accuracy, sensitivity, and precision using Principal Component Analysis and Support Vector Machine algorithms.

GROUP STATISTICS					
PARAMETERS	GROUP	N	MEAN	STD. DEVIATION	STD. ERROR MEAN
ACCURACY	K-NEAREST NEIGHBOR	20	0.7244	0.01280	0.00286
	LOGISTIC REGRESSION	20	0.7667	0.01766	0.00395
SENSITIVITY	K-NEAREST NEIGHBOR	20	0.7442	0.01766	0.00395
	LOGISTIC REGRESSION	20	0.7616	0.01321	0.00295
PRECISION	K-NEAREST NEIGHBOR	20	0.7375	0.02180	0.00487
	LOGISTIC REGRESSION	20	0.8187	0.02627	0.00587

Table 3 shows that using the independent sample T-test, there appears to be a statistically negligible difference in both approaches (P=0.156, for accuracy, P=0.419, for sensitivity, P=0.390, for precision, P=<0.001) (P=0.156, for accuracy, P=0.419

Table 3

Independent sample T-test in predicting the accuracy, sensitivity, and precision of diabetes using the K-Nearest Neighbor and Logistic Regression. There appears to be an insignificant difference in both methods p>0.05 for Accuracy and precision

Param-eter	Equal Vari-ances	Levene's Test for Equality of Variances		T-test for Equality of Means					
Accuracy	Assumed	F	Sig	t	df	Significance (one-Sided p)	Mean Dif-ference	95% Confi-dence interval (Lower)	95% Confi-dence interval (Upper)
		2.095	0.156	-8.65	38	<.001	-.04222	-.05209	-.03235
	Not assumed			-8.65	34.63	<.001	-.04222	-.05213	-.03232
Sensitivity	Assumed	0.667	0.419	-3.52	38	<.001	-.01737	-.02735	-.00739
	Not assumed			-3.52	35.19	<.001	-.01737	-.02738	-.00736
Precision	Assumed	0.390	0.536	-10.64	38	<.001	-.08125	-.09670	.06580
	Not assumed			-10.64	36.75	<.001	-.08125	-.09672	-.06578

with p>0.05, for sensitivity, P=0.390 for precision. P<=0.001with p>0.05). According to these data, the Logistic Regression techniques beat the K-Nearest Neighbor in predicting Diabetes disease. Figure 1 shows a bar chart depicting the comparison of K-Nearest Neighbor (KNN) and Logistic Regression (LR) mean accuracy, sensitivity, and precision values.

Figures 2a and 2b represent the true positive, true negative, false positive, and false negative values are utilized to derive the accuracy, sensitivity, and precision values from the confusion matrix of the K-Nearest Neighbor and Logistic Regression.

DISCUSSION

In this research paper, Logistic Regression (LR) performed better than K-Nearest Neighbor (KNN) accuracy (76.67%), sensitivity (76.16%), and precision (81.87%) for predicting diabetes among pregnant women, with accuracy (72.44%), sensitivity (74.42%), and precision (73.75%). Although it is not statistically significant, the difference appears to have expanded. Machine learning techniques are widely used in the early detection of diabetes.

Many researchers (Joshi and Dhakal 2021) have proposed a model based on ensemble methods using machine learning algorithms, with the object of assessing

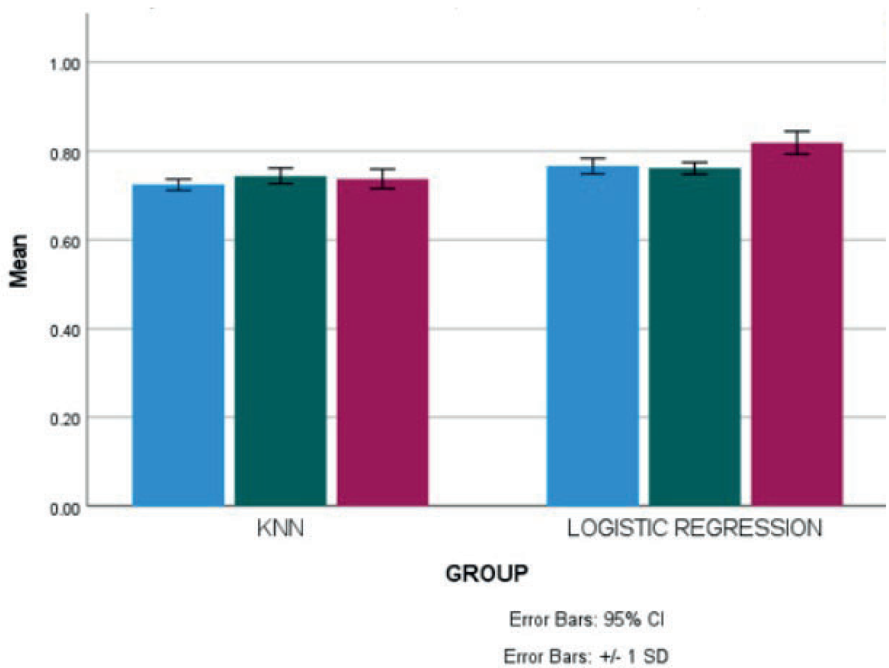

Fig. 1. Bar graph representing the comparison of mean accuracy, sensitivity, and precision of Diabetes prediction with the K-Nearest Neighbor algorithm and the Logistic Regression algorithm. Both the techniques appear to produce the same variable results with accuracy ranging from 72% to 77%. X-axis: K-Nearest Neighbor vs Logistic Regression. Y-axis: mean accuracy, sensitivity, and precision detection ± 1 SD.

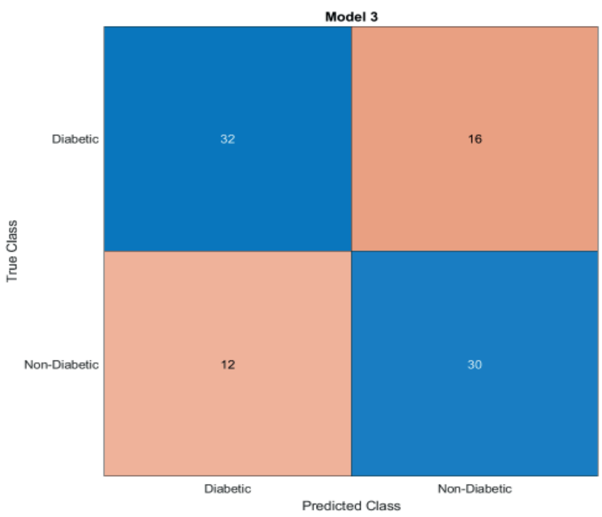

Fig. 2a. Confusion matrix for K-Nearest Neighbor algorithm K=5. True Positive is found to be 44% and false positive is found to be 4%, true negative is found to be 26% and false negative is found to be 16%.

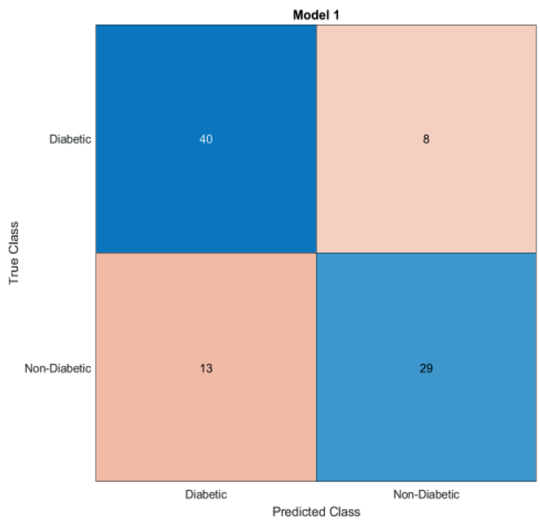

Fig. 2b. Confusion matrix for Logistic Regression algorithm K=5. True Positive is found to be 44% and false positive is found to be 4%, true negative is found to be 26% and false negative is found to be 16%.

the model's accuracy, sensitivity, and precision. With a precision of 70% and an accuracy of 80%, the findings were attained. (Tigga and Garg 2021) performed another investigation and developed a computer-aided identification technique based on the classifiers Support Vector Machine and Random Forest. (Edlitz and Segal, n.d.) name used feature selection and a KNN model to accurately detect diabetes with an accuracy of 78%. False-positive and False-negative selections can be reduced using data mining approaches author name. The author performed a comparative analysis of different classifiers and discovered that KNN-SVM has the highest accuracy of 82% over a clinical diabetes data set (Ismail and Materwala 2021).

Shortly, the proposed technique, in combination with the suggested Machine Learning classification algorithms, might be beneficial in the prediction or diagnosis of new illnesses. For diabetes prediction analysis, this research work, as well as a few other machine learning approaches, may be upgraded and improved. Metaheuristic algorithms will be utilized to learn the missing data completely in future studies. Furthermore, the study may be broadened to predict diabetes by accumulating data from many areas across the world and developing a more precise and common, discriminating framework. The approach might be improved and adjusted to make diabetes analysis more automatic.

CONCLUSION

In this diabetes prediction study, Matlab-based Logistic Regression (76.67 percent) generated superior results than K-Nearest Neighbor (72.44 percent). Furthermore, unlike prior techniques, the algorithm's performance improved with the increasing data volume. This model is extremely efficient and has a lot of promise for predicting and assessing diabetes, thus it may be used in hospitals and testing facilities.

DECLARATION

Conflicts of Interest

No conflict of interest in this manuscript

Author Contributions

Author VSKP was involved in data collection, data analysis & manuscript writing. The author guide NSK was involved in conceptualization, data validation, and critical review of manuscripts.

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