

PREDICTION OF BLOOD GLUCOSE LEVEL
BASED ON LIPID PROFILE AND BLOOD
PRESSURE USING MULTIPLE LINEAR
REGRESSION MODEL

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We hereby declare that we have checked this thesis and, in our opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Science.



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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

A handwritten signature in black ink, appearing to read 'Qurratu Aini', is written above a horizontal line.

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ABSTRACT

Type 2 diabetes mellitus (T2DM) refers to the inability to produce or respond to insulin, resulting in an elevated blood glucose level in the human body. Due to concerns over current diabetes screening and diagnostic procedures that require fasting, oral glucose consumption, and invasive nature (finger prick), the number of undiagnosed T2DM increases yearly. The increase is due to the hesitation of individuals to undergo screening tests as their routine check-up. As T2DM is closely related to blood glucose levels, a predictive model is developed to predict blood glucose levels, which can be used as an alternative for screening T2DM. Thus, the present study proposed a multiple linear regression equation for predicting the fasting blood glucose level based on independent parameters of lipid profile and blood pressure. It is widely known that high blood cholesterol and high blood pressure are the risk factors of T2DM. In this study, a set of 302 data was collected from UMP's retrospective data via the data directory of the University Health Centre from 2017 to 2018. The present study used 211 (70%) data to fit the predictive model, whereas another 91 (30%) of the data were used for self-validation of the model. Moreover, the overall model performance was observed by refitting the whole data set ($n = 302$, 100%) into the predictive model equation. The main outcome of the study showed that 46.8% (adjusted $R^2 = 0.468$, p -value < 0.05) of the fasting blood glucose level could be predicted using multiple linear regression based on high-density lipoprotein cholesterol, triglycerides, and systolic blood pressure levels without the standard fasting procedure. The prediction made by this model is acceptable with moderate accuracy (MAPE = 9.46%). This predictive model is easily adaptable to data changes (the difference of error metric values between the training data and testing data: MAE = 0.1836 mmol/L, RMSE = 0.1040 mmol/L, and MAPE = 3.93%). Thus, in order to increase the accuracy of the model, future research should consider a bigger and broader cohort from different comorbidities, which can be an alternative method in screening T2DM.

ABSTRAK

Penyakit kencing manis jenis 2 merujuk kepada ketidakupayaan untuk menghasilkan atau bertindak balas terhadap hormon insulin yang mengakibatkan peningkatan paras gula dalam darah dalam tubuh manusia. Oleh kerana ketakutan dan kerisauan terhadap kaedah untuk menyaring dan mengenal pasti penyakit kencing manis jenis 2 sedia ada yang memerlukan puasa, minum air gula serta penggunaan jarum, bilangan pesakit kencing manis jenis 2 yang tidak didiagnosis terus meningkat setiap tahun. Hal ini disebabkan oleh keraguan individu untuk menjadikan ujian saringan ini sebagai rutin mereka. Oleh kerana penyakit kencing manis jenis 2 berkait rapat dengan paras gula dalam darah, model ramalan untuk meramal paras gula dalam darah boleh dijadikan sebagai salah satu alternatif untuk menyaring penyakit kencing manis jenis 2. Oleh itu, kajian ini mengusulkan persamaan regresi linear berganda untuk meramal paras gula dalam darah ketika berpuasa berdasarkan parameter bebas iaitu paras kolesterol dalam darah dan tekanan darah. Paras kolesterol tinggi dalam darah dan tekanan darah tinggi adalah faktor risiko kepada penyakit kencing manis. Dalam kajian ini, satu set 302 data dikumpulkan daripada data retrospektif UMP melalui direktori data dari Pusat Kesihatan Universiti bagi tahun 2017 sehingga tahun 2018. Kajian ini menggunakan 211 (70%) data untuk dimasukkan ke dalam model ramalan sementara 91 (30%) data lain digunakan untuk pengesahan diri model. Prestasi keseluruhan model diperhatikan dengan memasukkan kembali keseluruhan kumpulan data ($n = 302$, 100%). Hasil utama kajian menunjukkan bahawa 46.8% (nilai R^2 yang diubah = 0.468, nilai- $p < 0.05$) tahap gula dalam darah puasa dapat diramalkan menggunakan regresi linear berganda berdasarkan paras kolesterol lipoprotein berketumpatan tinggi, trigliserida, dan tekanan darah sistolik, tanpa prosedur standard puasa. Ramalan yang dihasilkan oleh model ini boleh diterima dengan ketepatan sederhana (MAPE = 9.46%). Model ramalan ini mudah disesuaikan dengan perubahan data (perbezaan nilai metrik ralat antara data latihan dan data ujian: MAE = 0.1836 mmol/L, RMSE = 0.1040 mmol/L, dan MAPE = 3.93%). Oleh itu, untuk meningkatkan ketepatan model, penyelidikan pada masa hadapan perlu mempertimbangkan kohort yang lebih besar dan luas daripada latar belakang komorbiditi yang berbeza yang dapat menjadi kaedah alternatif dalam menyaring penyakit kencing manis jenis 2.

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