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Review Article

Insights of Cardiovascular Pharmacology Research

A Predictive Equation for Assessing the Risk of Kidney Failure: Integrating the Relative and Temporal Impact of Health Factors

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Abstract

This study aims to develop a predictive model based on an integrated mathematical equation that includes both health and temporal factors to assess the risk of kidney failure. The equation incorporates values derived from various clinical tests, the relative impact of each factor, and a temporal impact coefficient representing how risk accumulates over time. This equation provides a quantitative tool to support clinicians in evaluating kidney failure risk and forming appropriate preventive strategies.

Keywords: Kidney Failure, Prediction, Mathematical Equation, Time Factor, Clinical Tests, Health Factors

1. Introduction

hronic kidney failure is among the most complex global health challenges, particularly with the increasing prevalence of conditions such as diabetes, hypertension, and obesity [1,2]. Diagnosis and risk assessment are often based on individual clinical indicators, which may limit the accuracy of predicting disease progression. This research introduces a novel mathematical equation that accounts not only for clinical values but also for the relative contribution and time-dependent impact of each factor on kidney failure risk [3,4].

2. Methodology

A mathematical equation was developed to calculate the total kidney failure risk as follows:

$$GD = \Sigma(Fi \times Ri \times Ti)$$

Where:

- Fi: The clinical test result representing the health factor.
- Ri: The relative impact coefficient of the factor on kidney failure risk.
- Ti: The temporal impact coefficient representing risk increase over time.

The reference values (Fi), impact factors (Ri), and temporal coefficients (Ti) were defined based on clinical guidelines and published studies [5,6]. The overall risk (GD) is interpreted as:

- GD < 8: Low risk
- GD between 8 and 15: Moderate risk
- GD > 15: High risk

2.1 Justification for Selected Health Factors

Clinical Risk Factors	Diagnostic Tests	Reference Range (Normal)	Fi (Normalized Value)	Ri (Impact Factor)	Ti (Temporal Impact)
Diabetes	Fasting Blood Sugar, HbA1c	FBS: 70–99 mg/dL, HbA1c: <5.7%	FBS/100, HbA1c/6.5	1.3	1.2
Hypertension	Systolic/Diastolic BP	<120/80 mmHg	SBP/120, DBP/80	1.2	1.1
Proteinuria	Urine Protein Test	Negative	1 (if positive)	1.4	1.3
Anemia	Hemoglobin Test	M: 13–17 g/dL, F: 12–16 g/dL	Hb/13	1.1	1.05
Hyperlipidemia	LDL Test	<100 mg/dL	LDL/100	1.1	1.1
Obesity	Body Mass Index (BMI)	18.5–24.9 kg/m²	BMI/24.9	1.1	1.05
Impaired Renal Filtration	BUN/Creatinine Ratio	10:1–20:1	Ratio/20	1.2	1.1
Family History	Family History	Negative	1 (if positive)	1.5	1.0

2.2 Theoretical Justification of the Equation

The equation GD = Σ(Fi × Ri × Ti) is based on three components for each health factor:

1. Fi (Clinical Value): Standardized test results allow for integration across diverse diagnostics [7].
2. Ri (Relative Impact): Reflects the epidemiological and clinical evidence for each factor's contribution to kidney failure [8].
3. Ti (Temporal Impact): Quantifies how risk evolves with time under the influence of chronic exposure [9].

Mathematical structure enables flexible expansion by adding new health indicators and facilitates accurate individual risk comparisons [10,11].

3. Results and Theoretical Analysis

The mathematical structure of the equation indicates a direct correlation between the intensity of health factors, their relative influence, and their cumulative exposure over time. The higher the Fi, Ri, and Ti values, the greater the total risk (GD), logically reflecting the progression of chronic kidney disease [12].

Moreover, the additive nature of the equation emphasizes the compounding effect of multiple coexisting risk factors, aligning with clinical understanding of CKD progression [13,14].

4. Conclusion

The proposed equation demonstrates a high potential for predicting kidney failure risk through a precise integration of clinical and temporal data. It lays the groundwork for developing intelligent decision-support tools to enhance early diagnosis and personalized prevention strategies [15].

Declaration

1. Data Analysis, Availability, and Sharing: The study relied on the analysis of pre-existing, anonymized medical records from patients who underwent dialysis sessions in 2022. The dataset included various laboratory test results, such as Complete Blood Count (CBC), creatinine levels, bilirubin, and hemolysis indicators. Statistical analysis was conducted using advanced tools and the Python programming language to construct the predictive mathematical model. All relevant data are transparently documented in the body and tables of the manuscript to fully support the findings and conclusions. Regarding data sharing, the dataset is available from the corresponding author upon reasonable request for legitimate research purposes, provided appropriate approvals are obtained and ethical standards for data confidentiality are maintained.
2. Was ethical approval obtained from a research ethics committee? Yes, the study was conducted under the supervision of the Research and Studies Committee of the Dialysis Center and the Al-Thawra General Hospital Authority in Al-Hodeidah, and was formally approved by the relevant local authorities, as indicated in the study's title and content.
3. Was informed consent obtained from participants? This study did not involve the direct collection of data from individuals, nor did it involve clinical trials or surveys. It was based exclusively on anonymized, pre-existing medical data. Therefore, individual informed consent was not required.
4. Were interviews conducted? If yes, please upload the interview questions. No interviews were conducted as part of this study. The work was limited to the analysis of existing medical data and the computational validation of the model using statistical software. As such, no interview questions or related documents exist.
5. Did the authors follow the ethical principles outlined in the Declaration of Helsinki? Yes, the study adhered fully to the ethical principles of the Declaration of Helsinki, including the protection of patient privacy, data confidentiality, and the use of information strictly for scientific research purposes.

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Conflict of interest: None declared

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