Predicting food insulin index: Enhancing nutritional strategies for ageing populations

Valyn Tang Yi Tein[1,2], Sriwathi Angeline Hendricks[3], Suhash Mahendira Rajan[1,2], Miram Albasal[1,2], Tee Xin Yi[1,3], Lau Siew Ping[1,3], Wong Jing Wen[1,3], Steffi Tan Shih May[1,2], Nashuha Omar[4], Asnida Abdul Wahab[5,6], Ashvaany Egambaram[7,8], Bhuwaneswaran Vijayam[1,2]

[1]Newcastle University Medicine Malaysia (NUMed), 79200 Iskandar Puteri, Johor, Malaysia, [2]Faculty of Medical Sciences, Newcastle University, Newcastle upon Tyne, NE1 7RU, United Kingdom, [3]Independent Researcher, 81300 Johor Bahru, Johor, Malaysia, [4]Cardiovascular Advancement and Research Excellence Institute (CARE Institute), Universiti Teknologi MARA, Selangor, Malaysia, [5]Department of Biomedical Engineering & Health Sciences, Faculty of Electrical Engineering, Universiti Teknologi Malaysia (UTM), 81310 Skudai, Johor, Malaysia, 6Medical Devices and Technology Centre (MEDITEC), Faculty of Engineering, Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia, [7]Department of Electrical and Electronic Engineering, Universiti Teknologi PETRONAS, 32610 Seri Iskandar, Perak, Malaysia, [8]Centre for Intelligent Signal and Imaging Research (CISIR), Universiti Teknologi PETRONAS, 32610 Seri Iskandar, Perak, Malaysia

ABSTRACT

Introduction: With the global rise in ageing populations, the prevalence of insulin resistance and type 2 diabetes mellitus (T2DM) among older adults has become a major public health concern. Dietary interventions remain a cornerstone of metabolic management, yet traditional tools such as the Glycaemic Index (GI) have shown inconsistent results in predicting insulin responses, particularly in elderly individuals with altered glucose metabolism. The Food Insulin Index (II), which quantifies the insulin response to food rather than glucose alone, offers a more direct and physiologically relevant measure. However, the cost of conducting an II study is relatively expensive when compared to GI studies. Additionally, the global II database remains limited, with fewer than 800 entries, necessitating predictive models to estimate II for untested foods. This study aimed to develop and validate predictive algorithms for estimating II using expanded datasets from Malaysia, with a focus on improving dietary planning for older adults. **Materials and Methods:** GI, II and macronutrient data including carbohydrate, protein, fat, sugar, and fibre were extracted and updated from original manuscripts and a recent II compilation. The integrity of the dataset was checked by the research team prior to analysis. Three established II prediction algorithms were evaluated: Bell's, Bjork's, and Wolever's. The II predicted values were evaluated for performance using Lin's Concordance Correlation Coefficient (CCC), precision, accuracy, Root Mean Square Error (RMSE), and Bland-Altman analysis for bias and limit of agreement (LOA). **Results:** A dataset of over 700 food items was compiled and analysed. Bell's model uses multiple regression equations based on available macronutrient inputs, while Bjork's and Bell's model applies linear transformation and quadratic equations respectively. Bell's algorithm demonstrated the highest predictive accuracy, with a CCC of 0.592, RMSE of 16.619, and Bland-Altman mean bias of -5.297 and a upper LOA of 25.5 and a lower LOA of -36.3. Bjork's and Wolever's models showed lower concordance (CCC < 0.35) and higher RMSE (>28), indicating reduced reliability. These findings suggest that Bell's model is currently the most suitable for estimating II, especially for foods lacking direct measurements. In the context of ageing, accurate prediction of insulin responses is critical especially in Malaysia where the II entries are lesser than 10 foods. Older adults often exhibit reduced insulin sensitivity and altered hormonal regulation, increasing their susceptibility to postprandial hyperinsulinemia and its complications. Predictive II models can support clinicians, caregivers, and food manufacturers in designing age-appropriate diets that minimize insulin spikes and promote metabolic stability. Moreover, such models can be integrated into digital health platforms and wearable technologies to enable personalized nutrition for elderly individuals. This can serve as a temporary bridge until an extensive global and Malaysian II database is updated. **Conclusion:** This study highlights the importance of expanding II databases, developing or refining current predictive algorithms to accommodate the unique metabolic profiles of older adults. Future research should explore machine learning approaches and incorporate age-specific physiological parameters to enhance model precision. By improving the accuracy of II prediction, we can better support dietary interventions that reduce the burden of insulin-related disorders.

Keywords: Insulin index, glycaemic index, insulin response, personalized nutrition, insulin prediction