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Master's Thesis

慢性疾病患者認知功能之生理指標預測

Physiological Predictors of Cognitive Functions in Patients with Chronic Diseases

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摘要

慢性疾病對全球健康構成重大挑戰，尤其在老齡化社會中更為顯著。慢性疾病可能透過多重生理機制影響認知功能，包括多重共病負擔、體液平衡失調與全身性發炎反應，而上述因素亦可能隨年齡增長而加劇認知退化。然而，現有研究多著重於單一因素的探討，缺乏整合性分析其對慢性病患認知功能的綜合影響。因此，本橫斷性研究採用了數據導向的分析框架，整合性確認影響慢性病患者認知功能的關鍵生理預測因子。本研究招募 110 位來自國立臺灣大學醫學院附設醫院家庭醫學部的慢性病患者，並分析多模態資料，涵蓋生理資料（血液與尿液檢測、身體組成）與心理行為問卷（BFI、WHO-5、CES-D、CPSQI）；認知功能評估採用蒙特婁認知評估量表（Montreal Cognitive Assessment, MoCA）。為辨識 MoCA 總分之關鍵預測因子，本研究採用具窮盡式搜尋機制的最佳子集迴歸（Best Subset Regression）；接著透過中介分析，探討年齡對認知功能的潛在因果途徑。此外，為檢驗模型穩健性，亦使用 Lasso 迴歸與結合 SHAP 解釋機制（SHapley Additive exPlanations）的類神經網路（Neural Network）。結果顯示，最佳子集迴歸解釋了 38%的 MoCA 總分變異性（Adjusted-R^2 = 0.38）；較高的總體水分（β = 1.31，p = .001）和血小板數量（β = 0.24，p = .009）是各個比較模型中最穩定的預測因子，且在年齡與認知功能間有 18%的關聯性受血小板數量的中介作用影響。此外，多重共病負擔與認知風險之間呈現潛在的劑量反應關係。儘管仍需透過縱貫性或實驗性研究驗證因果關係，本研究結果已指出具有篩檢認知風險潛力的數項生理指標。

關鍵詞：認知功能、多模態資料、身體總水量、血小板數、多重共病、最佳子集迴歸

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Abstract

Chronic diseases pose significant challenges to global health, especially in aging societies. These conditions may impair cognitive function through multiple physiological mechanisms, including multimorbidity burden, hydration imbalance, and systemic inflammation. These factors may exacerbate age-related cognitive decline. However, existing research often investigates these mechanisms in isolation, limiting understanding of their integrated effects. To bridge this gap, this cross-sectional study applied an integrative, data-driven framework to identify key physiological predictors of cognitive function in patients with chronic conditions. This study recruited 110 patients from the Family Medicine Department at National Taiwan University Hospital, leveraging a multimodal dataset comprising physiological data (blood and urine tests, body composition metrics) and psychological questionnaires (BFI, WHO-5, CES-D, CPSQI). Cognitive function was assessed using the Montreal Cognitive Assessment (MoCA). Key predictors of MoCA scores were identified using exhaustive best-subset regression; causal pathways from age to cognition were explored via mediation analysis, and model robustness was assessed using Lasso regression and a SHAP (SHapley Additive exPlanations)-explained neural network. The best-subset model explained 38% of the variance in MoCA scores (Adjusted $-R^2$= 0.38); higher total body water (β = 1.31, p

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= .001) and platelet count (β = 0.24, p = .009) emerged as the most salient predictors, with platelet count mediating 18% of the age–cognition association. Additionally, a potential dose-response relationship was observed between multimorbidity burden and cognitive risk. While causal relationships require confirmation through longitudinal or experimental studies, this study identified several physiological indicators that may serve as potential markers for cognitive risk screening.

Keywords: Cognitive Functions, Multimodal Dataset, Total Body Water, Platelet Count, Multimorbidity, Best Subset Regression

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