TITLE: MLCs for Advanced Glaucoma Diagnosis: A Study within the Ghanaian Healthcare Context

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Abstract

Purpose: This study aimed to evaluate the diagnostic ability of OCT, VFT, clinical, and demographic parameters in glaucoma detection and to develop a machine learning model to automate diagnosis and classify disease severity.

Methods: A retrospective, cross-sectional study was conducted using hospital data from patients diagnosed by expert clinicians. The diagnostic capabilities of OCT, VFT, clinical, and demographic parameters were analyzed. Data from 605 eyes (361 glaucoma and 244 healthy) were used to train ten traditional machine learning algorithms and a deep neural network (DNN) algorithm, using cross-validation, both with and without feature selection. Performance metrics, including AUC, sensitivity, and specificity, were used to assess the models.

Results: The predictive model for glaucoma detection and disease classification was built using OCT, VFT, demographic, and clinical parameters. The deep neural network algorithm was implemented in a web application to automate disease detection and severity classification. The GCC parameters showed the highest accuracy for detecting early-stage glaucoma, while RNFL parameters were better suited for tracking disease progression. Combining clinical, demographic, OCT, and VFT data significantly improved glaucoma detection.

Conclusion: In this study of the African population, GCC parameters demonstrated the highest diagnostic accuracy for early glaucoma detection. Machine learning models, particularly the DNN, exhibited high sensitivity in diagnosing glaucoma. The developed web application provides an automated, fast, reproducible, and objective tool for diagnosing glaucoma and staging disease severity. This proof-of-concept study highlights the potential for machine learning to enhance clinical glaucoma diagnosis and management.