



REVIEWER'S REPORT

Manuscript No.: IJAR-55140

Title: HYBRID BOGA OPTIMIZATION OF XGBOOST FOR CALIBRATED AND ROBUST HYPERTENSION PREDICTION: A MULTI-COHORT VALIDATION STUDY.

Recommendation:

- Accept as it is
- Accept after minor revision.....
- Accept after major revision
- Do not accept (*Reasons below*)

Rating	Excel.	Good	Fair	Poor
Originality	✓			
Techn. Quality	✓			
Clarity		✓		
Significance	✓			

Reviewer Name: Mr. Bilal Mir

Reviewer's Comment for Publication.

The manuscript presents an advanced and well-structured methodological framework—BO–GA–XGBoost—for hypertension prediction across multiple cohorts. The integration of **Bayesian Optimization + NSGA-II**, combined with constraints on calibration, discrimination, and clinical applicability, represents a strong contribution to predictive modeling in healthcare.

The authors provide extensive technical detail, strong statistical rigor, and large-scale validation across NHANES, Framingham, and Kaggle cohorts ($n = 117,376$). The model demonstrates excellent performance ($AUC = 0.962$; $ECE = 0.021$), significantly outperforming baseline and partially optimized approaches.

Strengths

1. High Methodological Novelty:

- The hybrid BO–GA framework with multi-objective optimization is innovative and addresses limitations of conventional grid/random search.
- Simultaneous optimization of AUC, F1, Brier Score, ECE, and cross-cohort variance is rarely seen in hypertension prediction studies.

2. Clinical Relevance:

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- Calibration and robustness—often neglected in ML healthcare studies—are rigorously evaluated and constrained.
 - External validation across heterogeneous cohorts strengthens translational potential.
3. **Strong Statistical Validation:**
- Use of DeLong tests, 1,000× bootstrap confidence intervals, TOST equivalence tests, and fixed hyperparameters for external evaluation demonstrates exceptional methodological discipline.
4. **Explainability:**
- Multi-layer SHAP analysis with 94% concordance with ESC/ESH guidelines is a major strength for clinical integration.
5. **Fairness Assessment:**
- Subgroup AUC differences ≤ 0.007 indicate stable performance across demographic categories.

Areas Requiring Minor Revision

Although the manuscript is of high quality, some refinements will further improve clarity and publication readiness:

1. Language and Editing

- The manuscript is highly technical but contains multiple long, complex sentences.
- Some sections (particularly the introduction) would benefit from clearer wording and reduced redundancy.

2. Formatting Issues

- Figures (e.g., Fig. 1, Fig. 2, Fig. 3, Fig. 4) appear as placeholders without actual images.
- Some tables lack labels or have split formatting.
- Ensure consistent numbering and alignment of sections/subsections.

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3. Literature Review Density

- The introduction reviews many studies sequentially; summarizing with a table of comparisons may improve readability.
- Some references appear clustered or overly cited for minor points.

4. Minor Method Clarifications

- Provide explicit values for hyperparameters selected by the final BO–GA process.
- Clarify if isotonic regression calibration was applied before or after threshold optimization.

5. Discussion Section

- The discussion could be expanded to address:
 - Limitations (e.g., reliance on structured clinical data, dataset-specific biases).
 - Potential integration into clinical workflows.

6. Ethical and Data Governance Notes

- Add a sentence confirming ethical approvals or use of publicly available datasets.
- Briefly discuss privacy or reproducibility considerations.

Overall Evaluation

This is a **high-impact**, technically robust manuscript with substantial methodological novelty and strong potential clinical relevance. The hybrid BO–GA–XGBoost framework successfully addresses key limitations in hypertension risk modeling—particularly calibration and cross-cohort robustness.