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Artificial Intelligence for Refractive Error Prediction in Children

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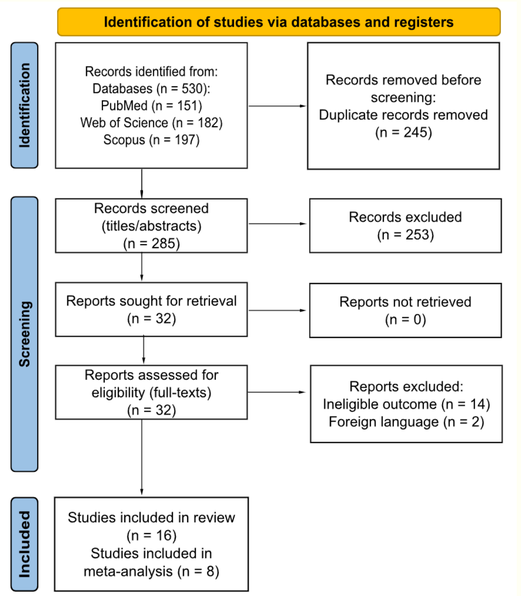
PURPOSE

To evaluate the performance of artificial intelligence (AI) models in predicting pediatric refractive error from clinical, non-image data.

METHODS

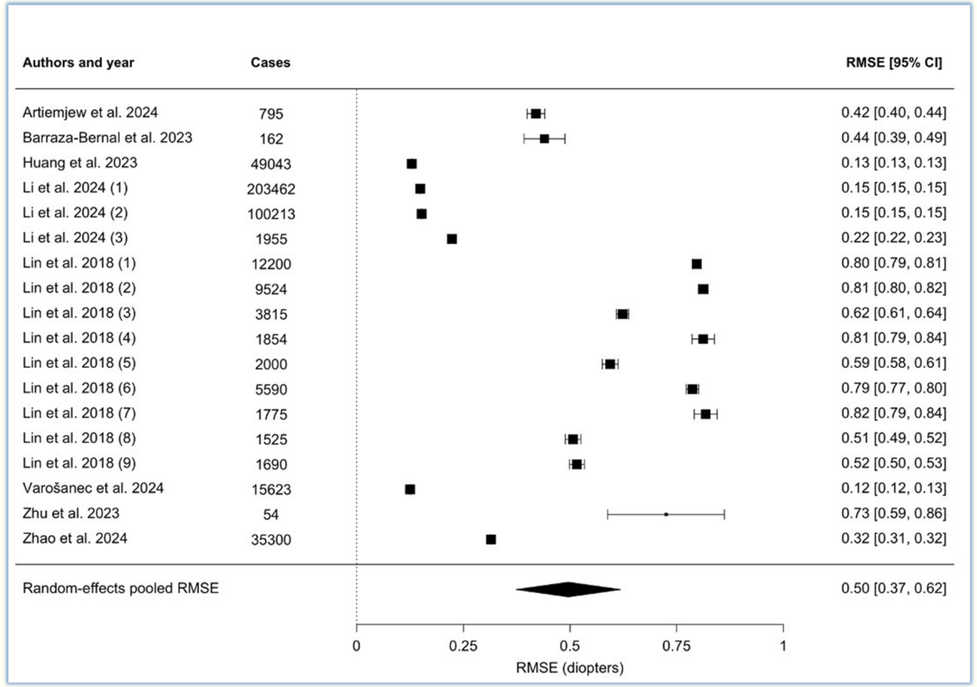
- Systematic review and meta-analysis
- PROSPERO: CRD420251075160
- **Data sources:**
  - MEDLINE, Web of Science, Scopus (April 2025)
- **Eligibility criteria:**
  - Children ≤ 18 years
  - AI-based prediction models
  - Clinical, non-image data
- **Outcomes:**
  - Continuous spherical equivalent (SE) prediction
  - Qualitative synthesis
- **Meta-analysis:**
  - Random-effects model on root-mean-squared error (RMSE)
- **Heterogeneity:**
  - τ^2, I^2; leave-one-out sensitivity analysis
- **Subgroups:**
  - External validation
  - Cycloplegic vs non-cycloplegic refraction
- **Risk of bias:**
  - PROBAST+AI tool



PRISMA Flow Chart

RESULTS

- **Study selection**
  - 16 studies included; 8 in meta-analysis (18 evaluations)
- **Study characteristics**
  - Majority focused on myopia
  - Common inputs: age (69%), sex (56%), parental myopia (50%), axial length (44%), baseline SE (44%)
  - Wide variability in AI models (machine learning, deep learning, ensembles)
  - External validation in 31% of studies
  - Explainability used in 44%
- **Risk of Bias**
  - Generally low risk in participants, predictors, outcomes
  - High/unclear risk in the analysis domain (majority of studies)
- **Meta-analysis**
  - Pooled RMSE: 0.50 D (95% CI: 0.37–0.62)
  - High Heterogeneity: I^2 = 100%
- **Sensitivity analysis**
  - Leave-one-out RMSE: 0.48–0.52 D
- **Subgroup findings**
  - External validation: higher RSME (0.57 vs 0.35 D, p = 0.092)
  - Cycloplegic refraction: higher RSME (0.62 vs 0.30 D, p = 0.002)



Forest plot of root-mean-squared error (RMSE) for spherical equivalent (SE) refractive error prediction across 18 model evaluations.

CONCLUSION

- ✓ AI models show **moderate accuracy** in predicting pediatric refractive errors from clinical, non-image data.
- ✓ **High heterogeneity limits generalizability.**
- ✓ **Performance decreases** with external validations and cycloplegic refraction.
- ➢ **Standardization and robust external validation** are needed.

KEY MESSAGE

❖ AI can support **early risk stratification** of pediatric refractive error, but **variability and methodological limitations** currently limit real-world use.

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Disclosure: None