Artificial intelligence to classify ear disease from otoscopy: A systematic review and meta-analysis

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November 24, 2021

Abstract

Objective: To summarize the accuracy of artificial intelligence (AI) computer vision algorithms to classify ear disease from otoscopy. Methods: Using the PRISMA guidelines, nine online databases were searched for articles that used AI methods (convolutional neural networks, artificial neural networks, support vector machines, decision trees, k-nearest neighbors) to classify otoscopic images. Diagnostic classes of interest: normal tympanic membrane, acute otitis media (AOM), otitis media with effusion (OME), chronic otitis media (COM) with or without perforation, cholesteatoma, and canal obstruction. Main Outcome Measures: Accuracy to correctly classify otoscopic images compared to otolaryngologists (ground-truth). The Quality Assessment of Diagnostic Accuracy Studies Version 2 tool was used to assess the quality of methodology and risk of bias. Results: Thirty-nine articles were included. Algorithms achieved 90.7% (95%CI: 90.1 – 91.3%) accuracy to difference between normal or abnormal otoscopy images in 14 studies. The most common multi-classification algorithm (3 or more diagnostic classes) achieved 97.6% (95%CI: 97.3.- 97.9%) accuracy to differentiate between normal, AOM and OME in 3 studies. Compared to manual classification, AI algorithms outperformed human assessors to classify otoscopy images achieving 93.4% (95%CI: 90.5 – 96.4%) versus 73.2% (95%CI: 67.9 – 78.5%) accuracy in 3 studies. Convolutional neural networks achieved the highest accuracy compared to other classification methods. Conclusion: AI can classify ear disease from otoscopy. A concerted effort is required to establish a comprehensive and reliable otoscopy database for algorithm training. An AI-supported otoscopy system may assist health care workers, trainees, and primary care practitioners with less otology experience identify ear disease.

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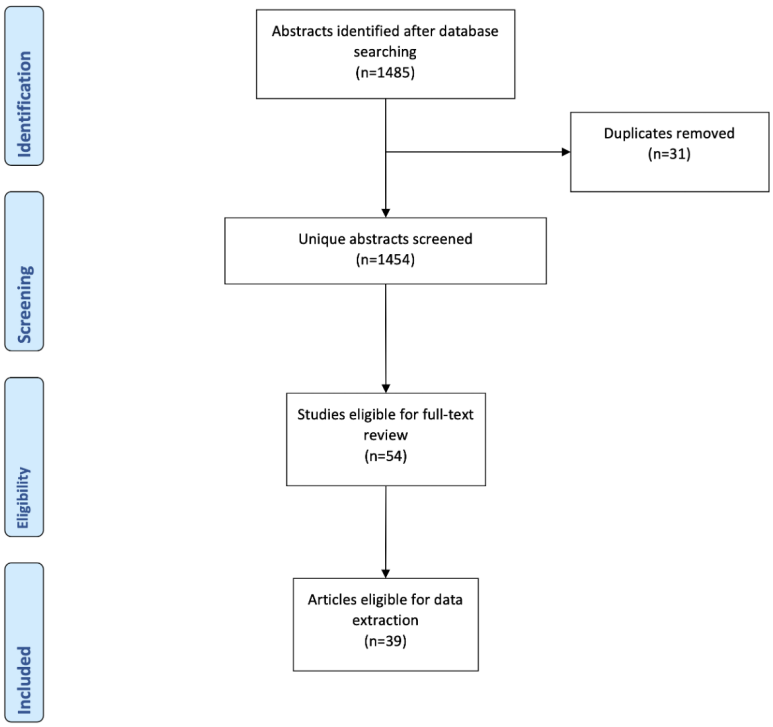

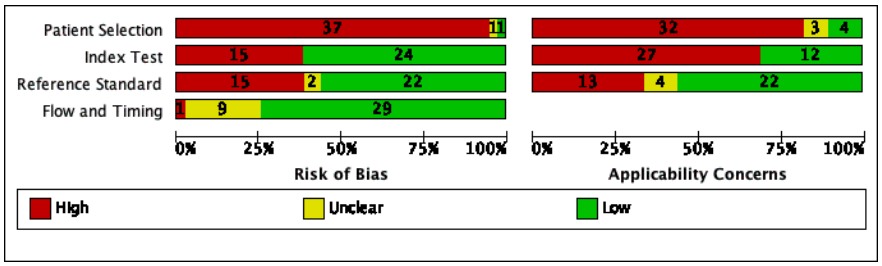

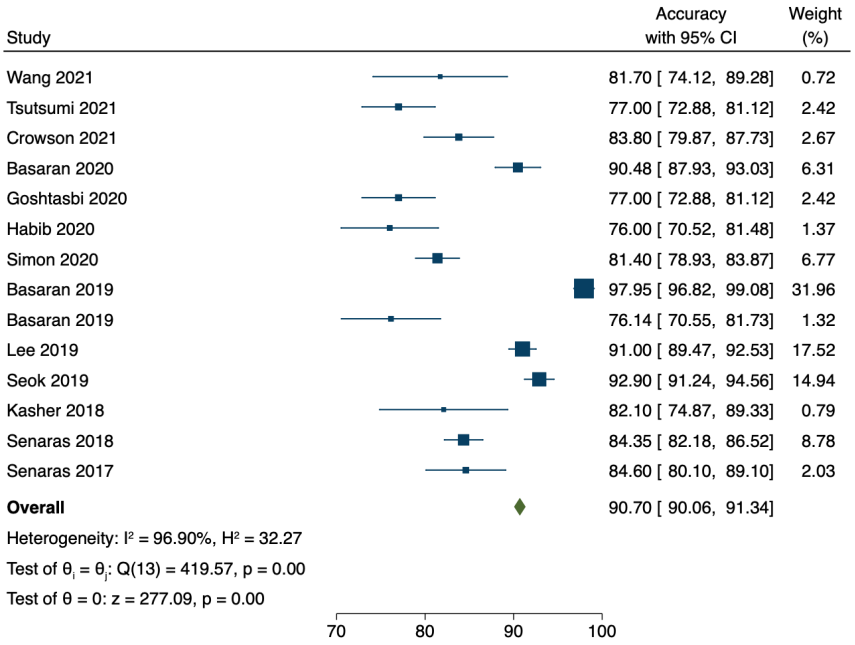

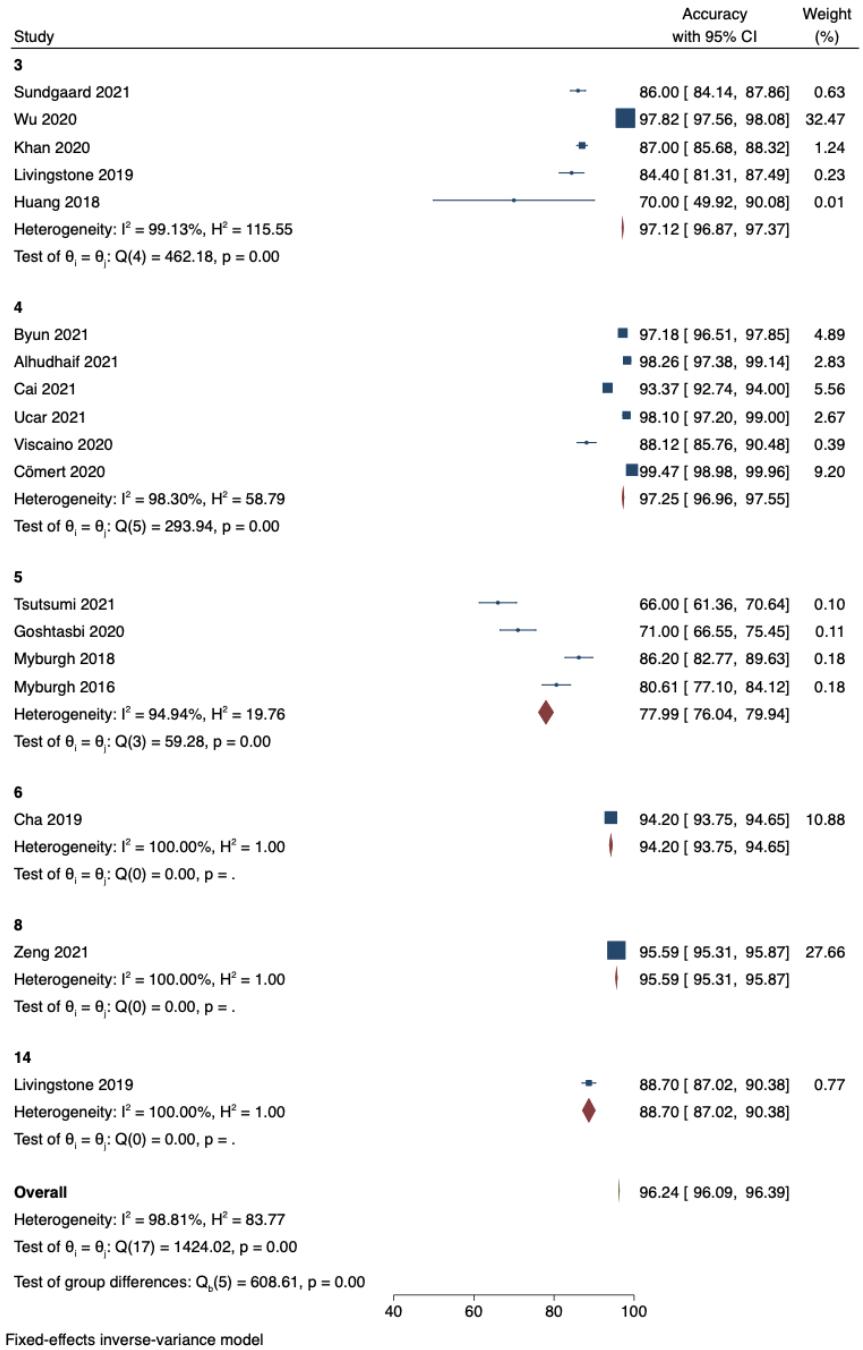

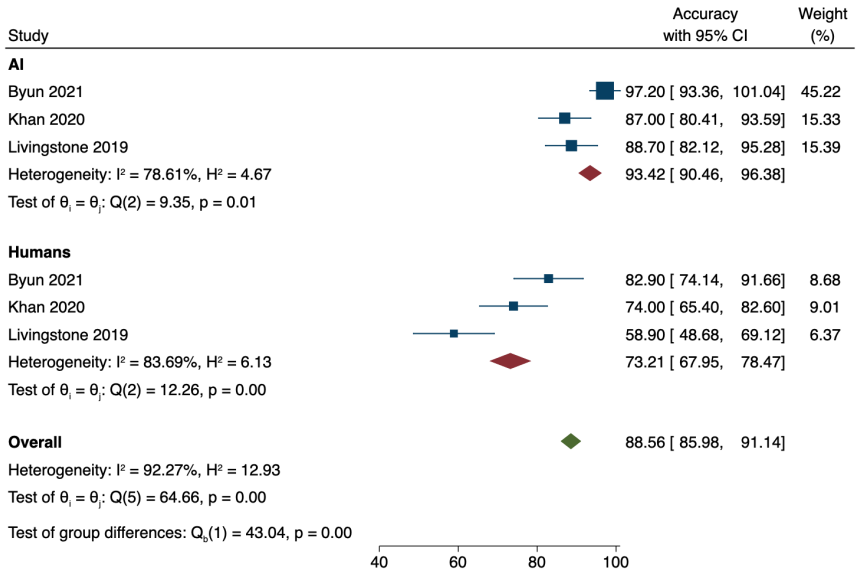

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