A Deep Convolutional Neural Network for Kawasaki Disease Diagnosis

KD-CNN is a novel deep learning-based screening tool which uses smartphone photographs to differentiate between Kawasaki disease (KD) and its look-alike diseases.

Importance of KD early diagnosis

KD is the #1 cause of acquired heart disease in children, yet it is commonly misdiagnosed.

Why is diagnosis difficult? 1) KD lacks a specific diagnostic test, 2) relies on visual examination of clinical signs, 3) often confused with look-alikes

10-day window for most effective treatment; up to 25% develop coronary artery aneurysms when untreated

Research Question

Given that KD criteria are visual findings, can we develop image-based models to aid detection?

KD-CNN Model Development: Key Challenges

1) Learning from limited data 2) Mitigating class imbalance 3) Medical applicability evaluation

Adaptive weighted loss function increased sensitivity to correctly classify KD:

$$W_L(z, y) = -\alpha_y \log \left( \frac{\exp(z_y)}{\sum_{y=1}^{N} \exp(z_y)} \right)$$

$$\alpha_y = 1 - \frac{y}{N}$$

Results & Clinical Relevance

KD-CNN achieved a median AUC ROC of 0.90, indicating high distinguishing capability (where 1 is a perfect classifier), with 80% sensitivity and 85% specificity.

1. KD-CNN is the first application of deep learning for KD screening, which can aid in early detection and reducing coronary artery risks
2. Highlights methods for training CNNs in medical settings with limited data
3. Opens doors for the future application of deep learning for medical diagnosis

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