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EDITORIAL COMMENT

Editorial comment on "Diagnosing autism spectrum disorder in children using conventional MRI and apparent diffusion coefficient based deep learning algorithms"

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Abstract

This editorial comment refers to the article: "Diagnosing autism spectrum disorder in children using conventional MRI and apparent diffusion coefficient based deep learning algorithms" by Guo et al. (*Eur Radiol*, 2021).

Key Points

•*Deep learning may help to uncover imaging features of autism spectrum disorder on MRI.*

Autism spectrum disorder (ASD) includes a wide range of conditions associated with some degree of difficulty with social communication and interaction. Although autism may be diagnosed in early childhood, some individuals are not diagnosed until much later, sometimes in adulthood, which can have ramifications on education and employment. It is estimated that about 1 in 59 children has an ASD, with the prevalence increasing over the last decade [1]. The exact aetiology is unclear with likely a mix of genetic and environmental factors [2].

Early detection of ASD can help in deciding therapy and improve quality of life for individuals with ASD and their families. Currently, screening and diagnosis of ASD includes assessing developmental milestones such as how children interact, speak, and act which can unfortunately be subjective. Imaging currently plays a limited role in the workup of ASD, predominantly assessing other conditions that may be associated with developmental delay such as tuberous sclerosis or neurofibromatosis. There are currently no diagnostic features of ASD on magnetic resonance imaging (MRI); however, there are some structural features that have been reported in patients with ASD. In younger patients, studies have demonstrated an increase in whole brain volume when compared with controls [3, 4]. Other features include increased cortical thickness in particular in the frontal lobes, increased gyrification, ventriculomegaly, and reduced corpus callosal volume [5, 6]. Many studies however have small sample sizes, with more research in this area still required [7]. Furthermore, many of these features can be subtle and are not routinely assessed in daily reporting.

Machine learning, and in particular deep learning, has been increasingly applied to imaging in different neurological conditions where imaging can have subtle or no features in early stages of the condition, for example in Alzheimer's disease, Parkinson's disease, and the topic of this paper, ASD. Several papers have demonstrated the development of superficial and deep neural networks in the evaluation of ASD trained on both functional MRI (fMRI) and structural MRI (sMRI) [8]. There still remain limited deep learning models evaluating ASD on sMRI. Furthermore, multiple studies using sMRI for deep learning algorithm development have used the Autism Brain Imaging Data Exchange (ABIDE) database [8].

Published in *European Radiology*, Guo et al. explores the development of a series of deep learning algorithms to distinguish between individuals with ASD from typically developing controls [9]. The authors used a unique dataset from their organization with cases including age-matched controls. The deep learning algorithms were trained on multiple MRI sequences with the primary model developed on ResNet-18, a well-known deep learning architecture, embedding a "Channel-Spatial" block into the 3D ResNet-18 model. The models were evaluated on an independent test set with metrics including AUC, accuracy, sensitivity, and specificity. Of note, the paper demonstrates a higher performance in FLAIR and ADC sequences highlighting that

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further work into these sequences may be beneficial. Importantly, the authors also look to visually understand the deep learning algorithms' output through the use of gradient-weighted class activation heat maps, which highlighted several regions of the brain including the corpus callosum, cingulate gyrus, and middle cerebral peduncle.

As the applications of deep learning in radiology are increasing, researchers are beginning to explore conditions which may not traditionally use radiology for diagnosis. This in turn highlights the importance of the need for visually explainable deep learning models, which may enable clinicians and researchers to uncover new features associated with different medical conditions, potentially making radiology a useful screening or diagnostic tool in conditions such as autism spectrum disorder in the future.

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Informed consent Written informed consent was not required for this study because this is an editorial without any study subjects.

Ethical approval Institutional review board approval was not required because this is an editorial without any study subjects.

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