https://doi.org/10.35401/2541-9897-2025-10-1-93-100

Check for updates

Artificial Intelligence With Neural Network Algorithms in Pediatric Astrocytoma Diagnosis: A Systematic Review

©Floresya K. Farmawati[1], Della W.A. Nurwakhid[2], Tifani A. Pradhea[3], Rayyan Fitriasa[4], Hutami H. Arrahmi[5], Muhana F. Ilyas[1], Fadhilah T. Nur[1*]

[1] Sebelas Maret University, Surakarta, Indonesia
[2] Brawijaya University, Malang, Indonesia
[3] Tanjungpura University, Pontianak, Indonesia
[4] YARSI University, Jakarta, Indonesia
[5] Trisakti University, Jakarta, Indonesia

* Fadhilah T. Nur, Sebelas Maret University, Jalan Ir. Sutami 36 Kentingan, Jebres, Surakarta, Central Java 57126, Indonesia, fadhilahtia@staff.uns.ac.id

Received: November 11, 2024. Received in revised form: November 15, 2024. Accepted: January 14, 2025.

Abstract
Background: Astrocytoma is a common pediatric brain tumor that poses a significant health burden. Recent advancements in artificial intelligence (AI), particularly neural network algorithms, have been studied for their precision and efficiency in medical diagnostics via effectively analyzing imaging data to identify patterns and anomalies.
Objective: To systematically review AI-based diagnostic tools with neural network algorithms' methodologies, sensitivities, specificities, and potential clinical integration for pediatric astrocytoma, providing a consolidated perspective on their overall performance and impact on clinical decision-making.
Methods: As per PRISMA 2020 guidelines, we conducted a comprehensive search in PubMed, Scopus, and ScienceDirect on February 5, 2024. The search strategy was guided by a PECO question focusing on pediatric astrocytoma diagnosis using AI algorithms vs computed tomography or magnetic resonance imaging (MRI). Keywords were terms related to AI and neural network algorithms. We included studies analyzing the diagnostic accuracy of AI-based methods in cases of pediatric astrocytoma (World Health Organization grades 1-3), with no restrictions on a publication year or country. We excluded papers written in languages other than English or Bahasa Indonesia and nonhuman studies. Data was assessed using the Effective Public Health Practice Project tool.
Results: Of 454 articles screened, 6 met inclusion criteria. These studies varied in design, location, and sample size, ranging from 10 to 135 subjects. The AI methods showed high sensitivity and specificity, often surpassing traditional radiological techniques. Notably, neural network algorithms using 3-dimensional MRI demonstrated improved accuracy compared with 2-dimensional MRI (96% vs 77%). The AI models exhibited performance levels comparable to or exceeding that of expert radiologists, with metrics such as tumor classification accuracy of 92% and high values of the area under the receiver operating characteristic curve.
Conclusions: AI with neural network algorithms shows significant promise in enhancing accuracy of pediatric astrocytoma diagnosis. The studies reviewed indicate that these advanced methods can achieve superior sensitivity and specificity compared with conventional diagnostic techniques. Integrating AI into clinical practice could substantially improve diagnostic precision and patient outcomes.
Keywords: artificial intelligence, astrocytoma, diagnosis, neural networks, pediatrics
Cite this article as: Farmawati FK, Nurwakhid DWA, Pradhea TA, et al. Artificial intelligence with neural network algorithms in pediatric astrocytoma diagnosis: a systematic review. *Innovative Medicine of Kuban.* 2025;10(1):93–100. https://doi.org/10.35401/2541-9897-2025-10-1-93-100

Искусственный интеллект с алгоритмами нейронной сети в диагностике астроцитомы у детей: систематический обзор

©Ф.К. Фармавати[1], Д.В.А. Нурвахид[2], Т.А. Прадхеа[3], Р. Фитриаса[4], Х.Х. Аррахми[5], М.Ф. Ильяс[1], Ф.Т. Нур[1*]

[1] Университет «Одиннадцатое марта», Суракарта, Индонезия
[2] Университет Бравиджая, Маланг, Индонезия
[3] Университет Танджунгпура, Понтианак, Индонезия
[4] Университет ЯРСИ, Джакарта, Индонезия
[5] Университет Трисакти, Джакарта, Индонезия

* Ф.Т. Нур, Университет «Одиннадцатое марта», Джалан Ир. Сутами 36 Кентинган, Джебрес, Суракарта, Центральная Ява 57126, Индонезия, fadhilahtia@staff.uns.ac.id

Поступила в редакцию 11 ноября 2024 г. Исправлена 15 ноября 2024 г. Принята к печати 14 января 2025 г.

Резюме

Актуальность: Астроцитома представляет собой распространенный вид опухолей головного мозга у детей и является существенной проблемой для здравоохранения. Последние достижения в области искусственного интеллекта (ИИ), в частности, алгоритмов нейронных сетей, изучаются на предмет точности и эффективности в медицинской диагностике посредством эффективного анализа данных визуализационных исследований для выявления закономерностей и аномалий.

Цель: Провести систематический обзор диагностических инструментов на основе ИИ с методологией, чувствительностью, специфичностью алгоритмов нейронных сетей, а также изучить вопрос потенциального внедрения в клиническую практику для диагностики астроцитомы у детей. Таким образом, можно получить представление об их общей эффективности и влиянии на принятие клинических решений.

Методы: Согласно рекомендациям PRISMA 2020, 5 февраля 2024 г. был проведен обширный поиск в PubMed, Scopus и ScienceDirect. Стратегия поиска основывалась на вопросе PECO, посвященном сравнению КТ- и МРТ-диагностики астроцитомы у детей с помощью алгоритмов ИИ. Ключевые слова составляли термины, относящиеся к ИИ и алгоритмам нейронных сетей. В обзор были включены исследования, анализировавшие точность диагностики методов на основе ИИ у детей с астроцитомой (1–3 степени по классификации ВОЗ). Ограничений по году или стране публикации не было. Из обзора были исключены исследования, опубликованные на языках, отличных от английского и индонезийского, а также исследования без участия людей. Качество данных оценивали с помощью инструмента Effective Public Health Practice Project.

Результаты: Из 454 отобранных статей критериям включения соответствовали 6. Данные исследования различались по дизайну, месту проведения и размеру выборки (от 10 до 135 человек). Диагностическая эффективность методов ИИ показала высокую чувствительность и специфичность, часто превосходившую традиционные рентгенологические методы. Примечательно, что алгоритмы нейронных сетей с использованием 3D-МРТ продемонстрировали более высокую точность (96%) по сравнению с 2D-МРТ (77 %). Модели ИИ показали уровень эффективности, сопоставимый с экспертами-рентгенологами или превосходящий их уровень, причем точность классификации опухолей составила 92%, а значения AUROC были высокими.

Заключение: ИИ с алгоритмами нейронных сетей демонстрирует значительные перспективы в повышении точности диагностики астроцитомы у детей. Исследования показывают, что данные передовые методы могут обеспечить более высокую чувствительность и специфичность по сравнению с традиционными. Внедрение ИИ в клиническую практику может существенно повысить точность диагностики и улучшить результаты лечения пациентов.

Ключевые слова: искусственный интеллект, астроцитома, диагностика, нейронные сети, педиатрия

Цитировать: Фармавати Ф.К., Нурвахид Д.В.А., Прадхеа Т.А. и др. Искусственный интеллект с алгоритмами нейронной сети в диагностике астроцитомы у детей: систематический обзор. *Инновационная медицина Кубани.* 2025;10(1):93–100. https://doi.org/10.35401/2541-9897-2025-10-1-93-100

Introduction

Astrocytoma is one of the most common types of pediatric brain tumor with a significant burden. It arises from star-shaped glial cells known as astrocytes or astroglia and can develop anywhere in the brain and spinal cord.[1,2] Among different brain and central nervous system tumors, pediatric astrocytomas account for 40% to 50%, making them one of the most diagnosed solid tumors in children.[3] Children can develop astrocytoma at any age, with boys and girls equally affected as well as minimal racial differences have been found.[4] Most reported cases of pediatric astrocytoma are low-grade and account for more than 85% of all reported cases. In contrast, high-grade cases account for 12% to 15% of all reported cases. Although the 5-year survival rate for low-grade pediatric astrocytoma is favorable, ranging between 80% and 97%, the median survival for high-grade pediatric astrocytoma is devastatingly low, with a survival rate of less than 20%.[5]

In recent years, artificial intelligence (AI) has brought promising advancements in medical diagnostics.[6-8] Specifically, AI applications have shown significant potential in increasing diagnostic precision and efficiency and improving patient outcomes.[9-12] Automated image analysis and machine learning techniques support clinical decision-making by reducing the variability caused by human visual perception.[13] Convolutional neural networks (CNN) have emerged among these AI technologies as effective tools for diagnosing complex medical conditions.[14-16] Inspired by the human visual cortex's structure and operation, CNNs are designed expressly to handle and analyze both structured and unstructured data with a grid-like architecture, such as sequences and images. These networks consist of convolutional, pooling, and fully-connected layers, making them especially powerful in medical imaging.[17-19]

Previous research on AI neural network algorithms in diagnosing pediatric astrocytoma has yielded varied results. Arle et al (1997) provided early insights into diagnostic accuracy of neural networks, showing promising but limited results.[20] Subsequently, Bidiwala et al (2004) expanded on this by comparing different imaging modalities and their integration with neural networks, revealing variability in sensitivity and specificity.[21] Fetit et al (2015) demonstrated a significant improvement in diagnostic accuracy using 3-dimensional (3D) magnetic resonance imaging (MRI) analysis compared with 2-dimensional (2D) methods.[22] Grist et al (2020) assessed the performance of neural networks with MRI parametric analysis, highlighting mixed outcomes across different features.[23]

Our systematic review aims to comprehensively evaluate the role of AI-based applications as diagnostic tools in pediatric astrocytoma cases. This review delves into the methodologies employed by various AI-based diagnostic tools, their reported sensitivities and specificities, and their potential integration into existing clinical workflows. This study contributes valuable insights to the evolving discourse on AI applications in pediatric neuro-oncology, with the ultimate goal of informing future research directions and influencing clinical practices for the benefit of young patients facing challenges of astrocytoma.

Methods

This systematic review was performed based on the PRISMA 2020 guideline.[24] The search was conducted on February 5, 2024, in international databases, including PubMed and Scopus. The study protocol has been registered on the International Prospective Register for Systematic Review (Registry No. CRD42024508890).

Search Strategy

We formulated a PECO question as follows: population (pediatric patients with astrocytoma); exposure (diagnosing via AI application using neural network algorithms); comparison (computed tomography [CT] or MRI scans); outcome (diagnostic accuracy, specificity, and sensitivity). The keywords used were related to AI and algorithms (Table 1). Including all AI-related algorithms in the keyword search ensures that the study captures papers that may focus on neural networks in the full text, even if they do not explicitly mention them in the title or abstract. This approach is also crucial in the rapidly evolving field of AI, where new terms and hybrid methods frequently emerge. Subsequently, we conducted a systematic search to collect relevant research, followed by a manual search of the references cited in the included studies to prevent pertinent missing publications.

Eligibility Criteria

The inclusion criteria were all studies analyzing specificity and sensitivity of AI-based applications using neural network algorithms for diagnosing pediatric astrocytoma (World Health Organization grades 1-3) were included in the study. No restrictions were placed on a year and country of publication. Studies written in languages other than English or Bahasa Indonesia were excluded, and their full texts were not retrieved. Nonhuman studies were also excluded.

Selection Process

Four reviewers (DWAN, TAP, RF, and HHA) independently screened titles and abstracts to identify possibly relevant studies during selection. Then, full-text papers were found and evaluated for eligibility using the inclusion and exclusion criteria. Any disagreements among the reviewers were handled through mutual discussion and then with the consensus of the fifth reviewer (FKF).

Quality Assessment

The Effective Public Health Practice Project (EPHPP) was utilized to evaluate the studies' quality.[25] We used 6 criteria: selection bias, study design, confounders, blinding, data collection techniques, and withdrawals or dropouts. There were 2 questions for each criterion—a total of 14—apart from the "study design" component, which contained 4 questions (in case of a randomized clinical trial). The rate (weak, moderate, and strong) represented the outcome of each criterion. The study's global rating (weak, moderate, and strong) was then determined by considering the rates of all the 6 criteria. Four reviewers (DWAN, TAP, RF, and HHA) blindly and independently assessed the quality of the studies. Any discrepancies across all the reviews were resolved by discussion with the fifth reviewer (FKF).

Data Analysis

The data analysis in this systematic review involved narrative synthesis of the findings from the included studies. The data extracted included the author, year of publication, study location, study design, sample size, diagnostic method used, and comparative aspects of these methods. Specifically, we summarized the diagnostic accuracy outcomes reported in each study, encompassing sensitivity, specificity, positive predictive (PPV) and negative predictive values (NPV).

Results

Study Selection

In the initial search using keywords across the 3 databases, a total of 454 articles were identified: PubMed

Table 1
The keywords used for the search strategy
Таблица 1
Ключевые слова, использованные в стратегии поиска

Databases	Keywords
PubMed and Scopus	("artificial intelligence" OR "computational intelligence" OR "computer reasoning" OR "computer vision systems" OR "knowledge acquisition" OR "knowledge representation" OR "machine intelligence" OR "machine learning" OR "computer heuristics" OR "expert systems" OR "deep learning" OR "natural language processing" OR "computational neural networks" OR "robotics") AND ("astrocytoma" OR "astroglioma" OR "oligoastrocytoma" OR "pleomorphic xanthoastrocytomas" OR "astrocytic glioma" OR "subependymal glioma" OR "mixed oligodendroglioma-astrocytoma" OR "oligodendroglioma") AND (pediatric* OR pediatric* OR child* OR infant OR newborn OR congenital)
ScienceDirect	("artificial intelligence" OR "machine learning" OR "computational neural networks") AND ("astrocytoma") AND ("paediatric" OR "pediatric")

(88 articles), Scopus (119 articles), and ScienceDirect (247 articles). Following the identification and screening steps for duplicates, 49 duplicated articles were removed, leaving 405 articles. A subsequent screening based on titles and abstracts led to the exclusion of 380 articles, resulting in 25 remaining articles. Full-text reading and assessment based on the eligibility criteria were then conducted, leading to the exclusion of 19 articles: 12 articles were not specific to pediatric cases; 5 did not use neural network algorithms, and 2 were not diagnostic studies. Finally, 6 articles were included in our study. The PRISMA flow diagram of study selection is presented in Figure 1.

Study Characteristics

The included studies exhibited a range of designs, study locations, sample sizes, and diagnostic methods for evaluating AI neural network algorithms in diagnosing pediatric astrocytoma (Table 2). These studies employed cross-sectional and prospective cohort designs and were conducted in the USA and UK, with sample sizes ranging from 10 to 135 subjects. Diagnostic approaches varied, including comparisons of AI with neural network algorithms against traditional methods such as neuroradiologic assessments, CT and MRI scans. The outcomes assessed included several metrics: specificity, sensitivity, PPV, NPV, and overall accuracy. The 6 studies were assessed using the EPHPP tool, with most being rated overall weak due to methodological issues, particularly in the study design (D2), confounder control (D3), blinding (D4), as well as withdrawals and dropouts (D6). Only

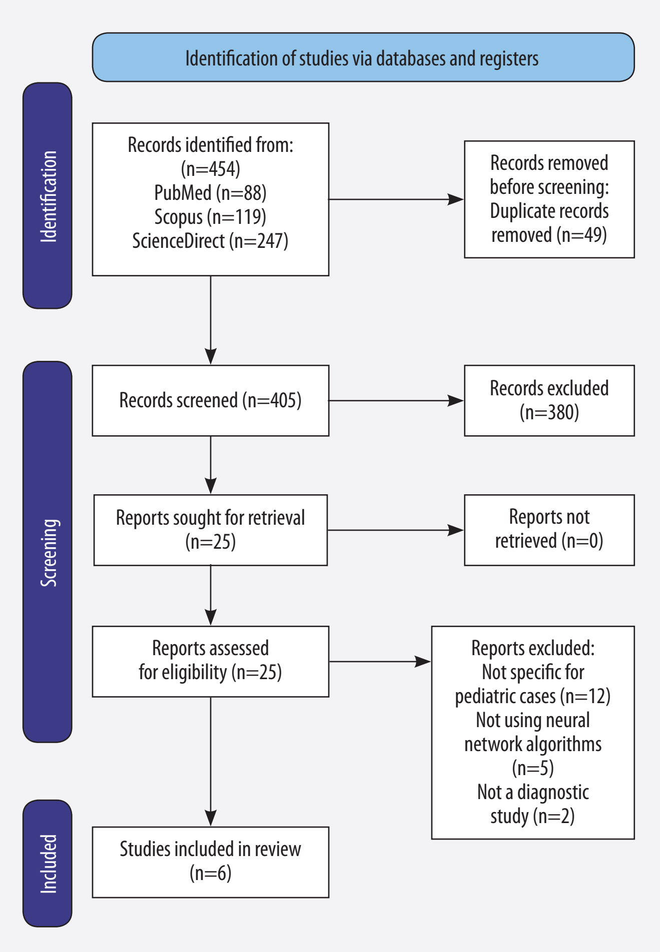

Figure 1. PRISMA flow diagram of study selection
Рисунок 1. Блок-схема PRISMA

Table 2
Characteristics of all included studies
Таблица 2
Характеристика всех включенных исследований

No.	Author (year)	Country	Study design	Total subjects	Index test	Reference standard/ comparison	Outcomes assessed
1	Arle et al[20] (1997)	USA	Cross-sectional	10	AI with a neural network algorithm	Neuroradiologist	Specificity, sensitivity, PPV, NPV
2	Bidiwala et al[21] (2004)	USA	Cross-sectional	14-33	AI with a neural network algorithm	CT/MRI+Neuroradiologist	Sensitivity, specificity, PPV
3	Fetit et al[22] (2015)	UK	Prospective cohort	20	AI with a neural network algorithm (2D vs 3D)	MRI	Accuracy, sensitivity, specificity
4	Grist et al[23] (2020)	UK	Prospective cohort	22	AI with a neural network algorithm	MRI	Accuracy
5	Orphanidou-Vlachou et al[27] (2014)	UK	Cross-sectional	14	Probabilistic neural networks	MRI	Sensitivity, specificity
6	Quon et al[26] (2020)	USA	Prospective cohort	135	AI with a neural network algorithm	MRI+Neuroradiologist	Accuracy

Note: 2D/3D, 2-/3-dimensional; AI, artificial intelligence; CT, computed tomography; MRI, magnetic resonance imaging; NPV, negative predictive value; PPV, positive predictive value

Прим.: 2D/3D – двух-/трехмерный; AI – искусственный интеллект; CT – компьютерная томография; MRI – магнитно-резонансная томография; NPV – отрицательная прогностическая ценность; PPV – положительная прогностическая ценность

Study	D1	D2	D3	D4	D5	D6	Overall
Arle et al., 1997	-	X	X	-	+	X	X
Bidiwala et al., 2004	-	X	+	X	+	X	X
Fetit et al., 2015	-	-	X	X	+	+	X
Grist et al., 2020	-	-	X	-	+	X	X
Orphanidou-Vlachou et al., 2014	-	X	X	-	+	X	X
Quon et al., 2020	+	-	-	-	+	+	+

Figure 2. Results of quality assessment
Рисунок 2. Результаты оценки качества

1 study (Quon et al,[26] 2020) achieved a strong overall score rating. The entire results of the quality assessment are visualized in Figure 2.

Discussion

The accurate and early diagnosis of astrocytoma in pediatric patients is crucial for effective treatment and improved outcomes. The advent of AI and neural network algorithms presents a promising avenue for enhancing diagnostic accuracy. Among the studies reviewed, Fetit et al (2015) demonstrated the highest diagnostic accuracy with 3D MRI analysis using neural networks, achieving 96% accuracy compared with 77% for 2D analysis.[22] This highlights the critical role of advanced imaging techniques in maximizing AI performance. Quon et al (2020) reported tumor classification accuracy of 92%, an F1 score of 0.80, and area under the receiver operating characteristic curve exceeding 0.99, indicating that their neural network model performed comparably to, or better than, some radiologists.[26]

Similarly, Orphanidou-Vlachou et al (2014) showed that probabilistic neural network analysis on T1- and T2-weighted images achieved high sensitivity (90.5%-95.2%) and specificity (96.2%-98.7%), significantly outperforming conventional radiology.[27] In contrast, Bidiwala et al (2004) found that combining CT and MRI yielded a specificity of 94.1% and a sensitivity of 66.7%, demonstrating the benefits of integrating multiple imaging modalities.[21] Grist et al (2020) reported maximum diagnostic accuracy of 75% with univariate features, underscoring the need for optimal feature selection.[23] Arle et al (1997) achieved a sensitivity of 70% and a specificity of 75%, marking an early but less advanced stage of neural network performance.[20] Overall, AI and neural network algorithms show substantial promise in improving diagnostic tools for pediatric astrocytoma, offering more accurate and reliable diagnoses as these technologies evolve.

Comparing our results with those from other AI approaches, we observed notable differences in diagnostic performance. In our study the highest accuracy, achieved with 3D MRI neural network analysis at 96%, surpasses Gutierrez et al's accuracy of 0.914 with support vector machines (SVM),[28] indicating superior performance with advanced imaging techniques. Additionally, it exceeds Li et al's accuracy of 0.8775 and area under the curve of 0.8646 using SVMs,[29] as well as Zarinabad et al's combined SVM, random forest, and linear discriminant analysis accuracy of 0.86.[30] Furthermore, it outperformed Zhou et al's general linear model, which, despite high area under the curve of 0.92, had a lower accuracy of 0.74.[31] However, several other diagnostic studies did not show significant differences; some demonstrated lower performance.

AI, particularly deep learning (DL) techniques, especially using neural network algorithms, has revolutionized medical imaging diagnostics by automating feature extraction and improving accuracy. It shows superior results compared with other algorithms. Traditional machine learning (ML) methods often require manual feature extraction and extensive tuning.[32] Subsequently, DL models may also possibly handle large datasets efficiently. Transfer learning further enhances DL by enabling fine-tuning of pretrained models for specific tasks, reducing the need for extensive labeled datasets.[33,34] In addition, DL algorithms can automatically extract relevant features from MRI scans, correct artifacts, and facilitate precise tumor localization and segmentation.[34,35] Finally, unlike ML algorithms, which are more labor-intensive and prone to human error, DL provides superior accuracy and efficiency in complex tasks, such as brain tumor segmentation and classification.[32,33]

Integrating AI and neural network algorithms into clinical practice could revolutionize diagnostic workflows and protocols. By providing more accurate and reliable diagnoses, these technologies have the potential to significantly improve patient outcomes through early detection and intervention. Clinicians and radiologists could leverage AI tools to complement their expertise, leading to more informed decision-making. However, successful implementation would require comprehensive training for health care professionals to use these advanced systems effectively. Subsequently, deploying AI systems in clinical settings comes with several challenges. Technical and infrastructural requirements, such as advanced computing capabilities and secure data management systems, are essential for the effective use of AI. Regulatory and ethical considerations also play a crucial role, as AI in health care must adhere to strict standards to ensure patient safety and privacy. Furthermore, continuous validation and updates of AI algorithms are necessary to maintain their accuracy and relevance in a rapidly evolving medical landscape.

Study Limitations and Future Recommendations

Despite the promising results, the current body of research has notable limitations. The studies included in this review varied widely in design and sample sizes, which may affect generalizability of the findings. Additionally, geographic representation was primarily limited to the USA and UK, suggesting the need for broader, more inclusive studies. There was also a lack of uniformity in diagnostic tools and methods across the studies, complicating direct comparisons.

Future research should focus on larger, more diverse cohort studies to validate the findings of this review. There is a need to explore the application of AI algorithms in various clinical settings and among different populations to ensure broad applicability. Developing standardized protocols for AI-based diagnostic tools would facilitate more consistent and reliable implementation. Long-term studies assessing the impact of AI on patient outcomes and health care costs are essential to fully understand these technologies' benefits and potential drawbacks. Moreover, the practicality of implementing such advanced AI technologies remains inconclusive in developing countries like Indonesia, where resource limitations may impact the feasibility and effectiveness of these innovations.

Conclusions

This systematic review highlights the promising potential of AI and neural network algorithms in diagnosing pediatric astrocytoma. The studies consistently show that AI-based methods can achieve high diagnostic accuracy, often surpassing traditional radiological techniques. Specifically, 3D MRI analysis and probabilistic neural networks analysis demonstrated significant improvements in sensitivity and specificity. Furthermore, neural network algorithms provided reliable tumor classification, with performance comparable to or exceeding that of expert radiologists in certain instances. These findings suggest that integrating AI and neural networks into clinical practice could enhance precision and reliability of pediatric astrocytoma diagnosis, ultimately improving patient outcomes. However, further research with larger, more diverse cohorts is needed to confirm these results and facilitate broader clinical application.

Author contributions
Concept and design: All authors
Acquisition, analysis, and interpretation of data: All authors
Manuscript drafting and reviewing: All authors

Вклад авторов
Разработка концепции и дизайна: все авторы
Сбор, анализ и интерпретация данных: все авторы
Подготовка и редактирование текста: все авторы

Литература/References

1. Konovalov NA, Asyutin DS, Shayhaev EG, Kaprovoy SV, Timonin SY. Molecular biomarkers of brain and spinal cord astrocytomas. *Acta Naturae*. 2019;11(2):17–27. PMID: 31413876. PMCID: PMC6643348. https://doi.org/10.32607/20758251-2019-11-2-17-27

2. Kapoor M, Gupta V. Astrocytoma. In: *StatPearls*. StatPearls Publishing; 2024. PMID: 32644468.

3. Ostrom QT, Price M, Ryan K, et al. CBTRUS statistical report: pediatric brain tumor foundation childhood and adolescent primary brain and other central nervous system tumors diagnosed in the United States in 2014-2018. *Neuro Oncol*. 2022;24(Suppl 3):iii1–iii38. PMID: 36066969. PMCID: PMC9447434. https://doi.org/10.1093/neuonc/noac161

4. Mo Z, Xin J, Chai R, Woo PYM, Chan DTM, Wang J. Epidemiological characteristics and genetic alterations in adult diffuse glioma in East Asian populations. *Cancer Biol Med*. 2022;19(10):1440–1459. PMID: 36350002. PMCID: PMC9630523. https://doi.org/10.20892/j.issn.2095-3941.2022.0418

5. Gajjar A, Bowers DC, Karajannis MA, Leary S, Witt H, Gottardo NG. Pediatric brain tumors: innovative genomic information is transforming the diagnostic and clinical landscape. *J Clin Oncol*. 2015;33(27):2986–2998. PMID: 26304884. PMCID: PMC4567701. https://doi.org/10.1200/JCO.2014.59.9217

6. Al-Antari MA. Artificial intelligence for medical diagnostics-existing and future AI technology!. *Diagnostics (Basel)*. 2023;13(4):688. PMID: 36832175. PMCID: PMC9955430. https://doi.org/10.3390/diagnostics13040688

7. Alowais SA, Alghamdi SS, Alsuhebany N, et al. Revolutionizing healthcare: the role of artificial intelligence in clinical practice. *BMC Med Educ*. 2023;23(1):689. PMID: 37740191. PMCID: PMC10517477. https://doi.org/10.1186/s12909-023-04698-z

8. Al-Antari MA. Advancements in artificial intelligence for medical computer-aided diagnosis. *Diagnostics (Basel)*. 2024;14(12):1265. PMID: 38928680. PMCID: PMC11202700. https://doi.org/10.3390/diagnostics14121265

9. Hu Z, Tang J, Wang Z, Zhang K, Zhang L, Sun Q. Deep learning for image-based cancer detection and diagnosis − a survey. *Pattern Recognition*. 2018;83:134–149. https://doi.org/10.1016/j.patcog.2018.05.014

10. Levine AB, Schlosser C, Grewal J, Coope R, Jones SJM, Yip S. Rise of the machines: advances in deep learning for cancer diagnosis. *Trends Cancer*. 2019;5(3):157–169. PMID: 30898263. https://doi.org/10.1016/j.trecan.2019.02.002

11. Habuza T, Navaz AN, Hashim F, et al. AI applications in robotics, diagnostic image analysis and precision medicine: current limitations, future trends, guidelines on CAD systems for medicine. *Informatics in Medicine Unlocked*. 2021;24:100596. https://doi.org/10.1016/j.imu.2021.100596

12. Khalifa M, Albadawy M. AI in diagnostic imaging: revolutionising accuracy and efficiency. *Computer Methods and*

Programs in Biomedicine Update. 2024;5:100146. https://doi.org/10.1016/j.cmpbup.2024.100146

13. Ho CWL, Soon D, Caals K, Kapur J. Governance of automated image analysis and artificial intelligence analytics in healthcare. *Clin Radiol*. 2019;74(5):329–337. PMID: 30898383. https://doi.org/10.1016/j.crad.2019.02.005

14. Dai L, Zhou M, Liu H. Recent applications of convolutional neural networks in medical data analysis. In: Hassan A, Prasad VK, Bhattacharya P, Dutta P, Damaševičius R, eds. *Federated Learning and AI for Healthcare 5.0*. IGI Global; 2023:119–131. https://doi.org/10.4018/979-8-3693-1082-3.ch007

15. Mohammed FA, Tune KK, Assefa BG, Jett M, Muhie S. Medical image classifications using convolutional neural networks: a survey of current methods and statistical modeling of the literature. *Machine Learning and Knowledge Extraction*. 2024;6(1):699–736. https://doi.org/10.3390/make6010033

16. Desai YK, Jadhav T, Nirmal S, et al. Diagnosis of medical images using convolutional neural networks. *Journal of Electrical Systems*. 2024;20(6s):2371–2376. https://doi.org/10.52783/jes.3220

17. Li Q, Cai W, Wang X, Zhou Y, Feng DD, Chen M. Medical image classification with convolutional neural network. In: *2014 13th International Conference on Control Automation Robotics & Vision (ICARCV)*. IEEE; 2014:844–848. https://doi.org/10.1109/icarcv.2014.7064414

18. Yu H, Yang LT, Zhang Q, Armstrong D, Deen MJ. Convolutional neural networks for medical image analysis: state-of-the-art, comparisons, improvement and perspectives. *Neurocomputing*. 2021;444:92–110. https://doi.org/10.1016/j.neucom.2020.04.157

19. Sarvamangala DR, Kulkarni RV. Convolutional neural networks in medical image understanding: a survey. *Evol Intell*. 2022;15(1):1–22. PMID: 33425040. PMCID: PMC7778711. https://doi.org/10.1007/s12065-020-00540-3

20. Arle JE, Morriss C, Wang ZJ, Zimmerman RA, Phillips PG, Sutton LN. Prediction of posterior fossa tumor type in children by means of magnetic resonance image properties, spectroscopy, and neural networks. *J Neurosurg*. 1997;86(5):755–761. PMID: 9126888. https://doi.org/10.3171/jns.1997.86.5.0755

21. Bidiwala S, Pittman T. Neural network classification of pediatric posterior fossa tumors using clinical and imaging data. *Pediatr Neurosurg*. 2004;40(1):8–15. PMID: 15007223. https://doi.org/10.1159/000076571

22. Fetit AE, Novak J, Peet AC, Arvanitits TN. Three-dimensional textural features of conventional MRI improve diagnostic classification of childhood brain tumours. *NMR Biomed*. 2015;28(9):1174–1184. PMID: 26256809. https://doi.org/10.1002/nbm.3353

23. Grist JT, Withey S, MacPherson L, et al. Distinguishing between paediatric brain tumour types using multi-parametric magnetic resonance imaging and machine learning: a multi-site study. *Neuroimage Clin*. 2020;25:102172. PMID: 32032817. PMCID: PMC7005468. https://doi.org/10.1016/j.nicl.2020.102172

24. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71. PMID: 33782057. PMCID: PMC8005924. https://doi.org/10.1136/bmj.n71

25. Thomas BH, Ciliska D, Dobbins M, Micucci S. A process for systematically reviewing the literature: providing the research evidence for public health nursing interventions. *Worldviews Evid Based Nurs*. 2004;1(3):176–184. PMID: 17163895. https://doi.org/10.1111/j.1524-475X.2004.04006.x

26. Quon JL, Bala W, Chen LC, et al. Deep learning for pediatric posterior fossa tumor detection and classification: a multi-institutional study. *AJNR Am J Neuroradiol*. 2020;41(9):1718–1725. PMID: 32816765. PMCID: PMC7583118. https://doi.org/10.3174/ajnr.A6704

27. Orphanidou-Vlachou E, Vlachos N, Davies NP, Arvanitis TN, Grundy RG, Peet AC. Texture analysis of T1 - and T2 -weighted MR images and use of probabilistic neural network to discriminate posterior fossa tumours in children. *NMR Biomed*. 2014;27(6):632–639. PMID: 24729528. PMCID: PMC4529665. https://doi.org/10.1002/nbm.3099

28. Rodriguez Gutierrez D, Awwad A, Meijer L, et al. Metrics and textural features of MRI diffusion to improve classification of pediatric posterior fossa tumors. *AJNR Am J Neuroradiol*. 2014;35(5):1009–1015. PMID: 24309122. PMCID: PMC7964560. https://doi.org/10.3174/ajnr.A3784

29. Li M, Wang H, Shang Z, Yang Z, Zhang Y, Wan H. Ependymoma and pilocytic astrocytoma: differentiation using radiomics approach based on machine learning. *J Clin Neurosci*. 2020;78:175–180. PMID: 32336636. https://doi.org/10.1016/j.jocn.2020.04.080

30. Zarinabad N, Abernethy LJ, Avula S, et al. Application of pattern recognition techniques for classification of pediatric brain tumors by in vivo 3T ^{1}H-MR spectroscopy-a multi-center study. *Magn Reson Med*. 2018;79(4):2359–2366. PMID: 28786132. PMCID: PMC5850456. https://doi.org/10.1002/mrm.26837

31. Zhou H, Hu R, Tang O, et al. Automatic Machine learning to differentiate pediatric posterior fossa tumors on routine MR imaging. *AJNR Am J Neuroradiol*. 2020;41(7):1279–1285. PMID: 32661052. PMCID: PMC7357647. https://doi.org/10.3174/ajnr.A6621

32. Kaifi R. A review of recent advances in brain tumor diagnosis based on AI-based classification. *Diagnostics (Basel)*. 2023;13(18):3007. PMID: 37761373. PMCID: PMC10527911. https://doi.org/10.3390/diagnostics13183007

33. Mathivanan SK, Sonaimuthu S, Murugesan S, Rajadurai H, Shivahare BD, Shah MA. Employing deep learning and transfer learning for accurate brain tumor detection. *Sci Rep*. 2024;14(1):7232. PMID: 38538708. PMCID: PMC10973383. https://doi.org/10.1038/s41598-024-57970-7

34. Khalighi S, Reddy K, Midya A, Pandav KB, Madabhushi A, Abedalthagafi M. Artificial intelligence in neuro-oncology: advances and challenges in brain tumor diagnosis, prognosis, and precision treatment. *NPJ Precis Oncol*. 2024;8(1):80. PMID: 38553633. PMCID: PMC10980741. https://doi.org/10.1038/s41698-024-00575-0

35. Cè M, Irmici G, Foschini C, et al. Artificial intelligence in brain tumor imaging: a step toward personalized medicine. *Curr Oncol*. 2023;30(3):2673–2701. PMID: 36975416. PMCID: PMC10047107. https://doi.org/10.3390/curroncol30030203

Author credentials

Floresya K. Farmawati, MD, Medical Doctor Profession Program, Faculty of Medicine, Sebelas Maret University (Surakarta, Indonesia). https://orcid.org/0009-0001-6182-5319

Della W. A. Nurwakhid, MD, Department of Pediatrics, Faculty of Medicine, Brawijaya University (Malang, Indonesia). https://orcid.org/0009-0000-4564-131X

Tifani A. Pradhea, MD, Medical Doctor Profession Program, Faculty of Medicine, Tanjungpura University (Pontianak, Indonesia). https://orcid.org/0009-0009-0223-826X

Rayyan Fitriasa, MD, Medical Doctor Profession Program, Faculty of Medicine, YARSI University (Jakarta, Indonesia). https://orcid.org/0009-0001-5856-8585

Hutami H. Arrahmi, MD, Medical Doctor Profession Program, Faculty of Medicine, Universitas Trisakti (Jakarta, Indonesia). https://orcid.org/0009-0003-0354-349X

Muhana F. Ilyas, MD, Medical Doctor Profession Program, Faculty of Medicine, Sebelas Maret University (Surakarta, Indonesia). https://orcid.org/0000-0002-0176-9773

Fadhilah T. Nur, MD, Department of Pediatrics, Sebelas Maret University (Surakarta, Indonesia). https://orcid.org/0009-0008-6184-4318

Conflict of interest: *none declared.*

Acknowledgment

Artificial intelligence was utilized to enhance language clarity and readability. Final checks and manual adjustments were subsequently performed to ensure accuracy and appropriateness.

Сведения об авторах

Фармавати Флоресья Картика, MD, программа профессиональной подготовки врачей, медицинский факультет, Университет «Одиннадцатое марта» (Суракарта, Индонезия). https://orcid.org/0009-0001-6182-5319

Нурвахид Делла Вахдатул Ангела, MD, кафедра педиатрии, медицинский факультет, Университет Бравиджая (Маланг, Индонезия). https://orcid.org/0009-0000-4564-131X

Прадхеа Тифани Антониа, MD, программа профессиональной подготовки врачей, медицинский факультет, Университет Танджунгпура (Понтианак, Индонезия). https://orcid.org/0009-0009-0223-826X

Фитриаса Райян, MD, программа профессиональной подготовки врачей, медицинский факультет, Университет ЯРСИ (Джакарта, Индонезия). https://orcid.org/0009-0001-5856-8585

Аррахми Хутами Хасбила, MD, программа профессиональной подготовки врачей, медицинский факультет, Университет Трисакти (Джакарта, Индонезия). https://orcid.org/0009-0003-0354-349X

Ильяс Мухана Фавуази, MD, программа профессиональной подготовки врачей, медицинский факультет, Университет «Одиннадцатое марта» (Суракарта, Индонезия). https://orcid.org/0000-0002-0176-9773

Нур Фадхилах Тиа, MD, кафедра педиатрии, Университет «Одиннадцатое марта» (Суракарта, Индонезия). https://orcid.org/0009-0008-6184-4318

Конфликт интересов

Авторы заявляют об отсутствии конфликта интересов.

Дисклеймер

Для улучшения читаемости и понятности текста использовался искусственный интеллект. Внесенные изменения тщательно выверены на предмет точности и уместности и отредактированы авторами.