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Effectiveness of Using CT Scan in EarlyDetection of Brain Tumor

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Abstract

The aim of this research is to determine the effectiveness of using CT Scans in Early Detection of Brain Tumors. The type of research is meta-analysis research. The data sources in this research come from 11 national and international journals published in 2021-2024. Inclusion criteria in the meta-analysis are research from indexed journals SINTA, EBSCO, Copernicus International and Scopus, research obtained from the Google Scholar, Pubmed, Researchgate, Mendeley and ScienceDirect databases, research related to the effectiveness of using CT scans in early detection of brain tumors, research must be an experimental method or experimental method, and research that has complete data in effect size analysis. Data analysis is calculating the effect size value with the help of Revman 5.1. The research results concluded that the average effect size value was 1.17 with a high effect size category. These findings explain that the use of CT Scans has a positive impact in early detection of brain tumors in humans.

Keywords: CT Scan, Effect Size, Brain Tumor

Introduction

Brain tumors are one disease that requires effective early detection because of the possibility of a better prognosis when found at an early stage. However, early detection of brain tumors is often challenging because of their often nonspecific symptoms and resemblance to other conditions (Suta et al., 2019). Therefore, the development of reliable and effective diagnostic methods is critical to increasing the chances of early detection and successful treatment. In this context, computed tomography (CT) scans have become one of the main diagnostic tools used in the detection of brain tumors (Febrianti et at., 2020), but more in-depth research is needed to evaluate the extent of its effectiveness in detecting brain tumors at an early stage (Up & Patel, 2013).

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Previous studies have investigated the ability of CT scans to detect brain tumors, but results often vary and are not always consistent (Sarkar et al., 2020; Shoban Babu &; Varadarajan, 2017). Some studies show high levels of sensitivity and specificity, while others show less than satisfactory results. This variability may be due to a variety of factors, including the size and type of tumor, as well as differences in the imaging protocols used (Soni &; Rai, 2021). Therefore, more focused and detailed follow-up research is needed to provide a more comprehensive understanding of the effectiveness of using CT scans in the early detection of brain tumors. By deepening our knowledge of this, we can improve approaches to early diagnosis and management of brain tumors, as well as improve the prognosis and quality of life of affected patients (De Gonzalez et al., 2016).

Research on the effectiveness of using CT scans in early detection of brain tumors has several problems that need to be overcome (Shabana et al., 2015). One of them is the limited sensitivity of CT scans in detecting brain tumors that are very small or located in locations that are difficult to reach by the tool. Brain tumors in the early stages often have a very small size and do not cause obvious symptoms (Urooj & Amir et al., 2015), making it difficult to detect using conventional imaging methods such as CT scans. This can lead to delays in diagnosis and treatment that can negatively impact a patient's prognosis and treatment outcomes (A.Lakshmi, 2012).

In addition, another problem that arises is the diversity of interpretations of CT scan results between radiologists. The interpretation of brain tumor CT scan results can sometimes be subjective and depends on the experience and expertise of the radiologist evaluating them (Jose et al., 2014). This uncertainty can lead to variations in patient diagnosis and treatment, and increase the risk of misdiagnosis. Therefore, efforts are needed to minimize the factors that cause variations in interpretation of CT scan results and improve consistency in assessment to ensure that this method can be a more reliable tool in early detection of brain tumors.

Previous research by Roy & Bandyopadhyay (2012) has investigated the effectiveness of using CT scans in early detection of brain tumors. These studies have provided mixed insights into the ability of CT scans in identifying brain tumors at an early stage. Some research by (Joseph et al.,, 2014) shows that CT scans have a high enough sensitivity in detecting the presence of brain tumors in patients with early symptoms that may be associated with the condition. However, these findings are not always consistent across all studies, and several other studies suggest that CT scans may be less sensitive, especially to brain tumors that are small or located in areas

difficult to reach by imaging devices. Previous research has also highlighted the weaknesses and technical limitations of CT scans in detecting brain tumors at an early stage. The limited spatial resolution of a CT scan can result in less clear images, especially when identifying brain tumors that have small sizes or complex structures (Shahwani et al,, 2015). In addition, the diversity of imaging parameters and interpretation of results between radiologists can also affect the accuracy of diagnosis using CT scans. Therefore, previous research has highlighted the importance of continuously improving imaging techniques and CT scan interpretation standards to ensure more effective and consistent early detection of brain tumors.

Therefore, this study aims to determine the effectiveness of using CT Scan in Early Detection of Brain Tumors.

Research Methods

Research is a type of meta-analysis research. The data sources in this study come from 11 national and international journals published in 2021-2024. The inclusion criteria in the meta-analysis are research derived from indexed journals SINTA, EBSCO, Copernicus International and Scopus, research obtained from google scholar databases, Pubmed, Researchgate, Mendeley and ScienceDirect, Research related to the effectiveness of using CT Scan in early detection of brain tumors, research must be experimental methods or experimental kuai, and research that has complete data in effect size analysis. Data analysis is to calculate the value of effect size with the help of Revman 5.1 Furthermore, the effect size criteria in this study are guided by the effect size criteria (Cohen et al., 2007) namely $0.00 \leq ES \leq 0.20$ small effect size criteria, $0.20 \leq ES \leq 0.80$ medium effect size criteria, and $ES \geq 0.80$ large effect size criteria.

Results and Discussion

Based on the results of data search through Google Scholar, Pubmed, Researchgate, Mendeley and ScienceDirect obtained 223 journals related to knowing the effectiveness of using CT Scan in Early Detection of Brain Tumors. However, only 11 journals met the inclusion criteria that had been set. Furthermore, the results of data selection can be seen in Figure 1.

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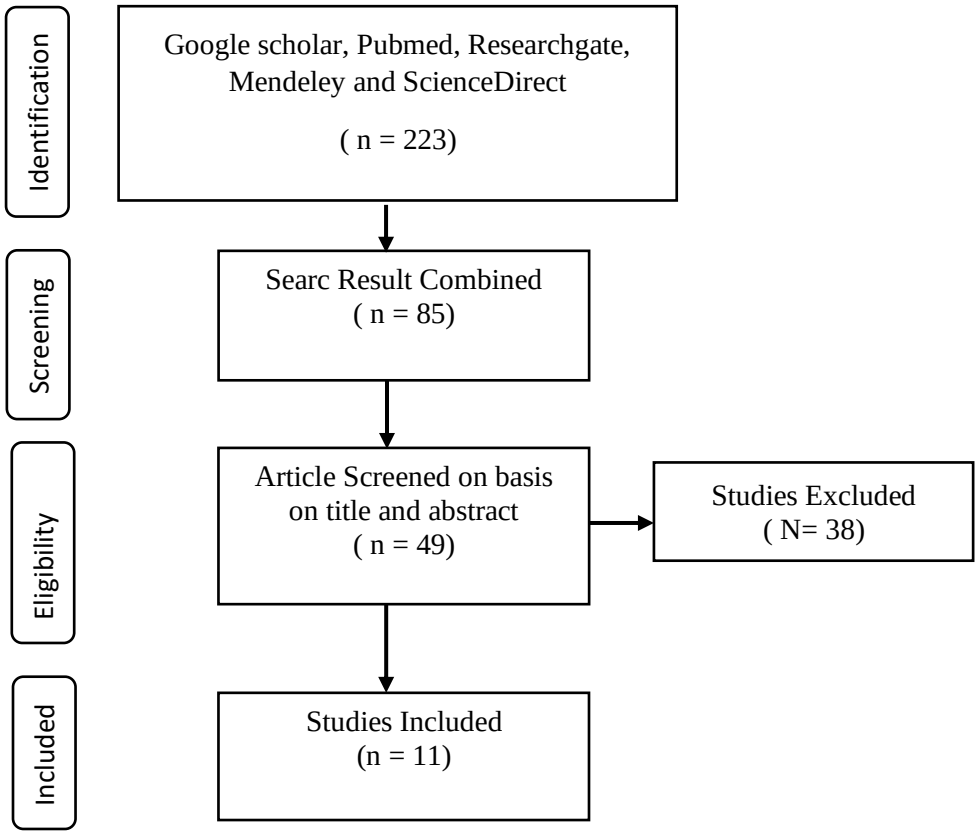

Figure 1. Data Selection Process

Furthermore, data that have met the inclusion criteria are calculated effect size values which can be seen in Table 1.

Table 1. Effect Size Value

Journal Code	Year	Effec Size	Criterion
Journal 1	2021	1.92	High
Journal 2	2020	0.88	High
Journal 3	2020	0.62	Medium
Journal 4	2023	0.59	Medium
Journal 5	2023	2.08	High
Journal 6	2024	1.24	High
Journal 7	2021	1.06	High

Journal 8	2022	0.72	High
Journal 9	2020	0.81	High
Journal 10	2021	1.52	High
Journal 11	2022	1.49	High
Average effect size		1.17	High

Based on Table 1, the results of effect size analysis obtained two journals have medium criteria effect size values and nine journals have large criteria effect size values. Furthermore, with an average effect size value of 1.17 with large criteria, the use of CT Scan has a positive effect on early detection of brain tumors. One of the main aspects to consider is the sensitivity and specificity of CT scans in detecting brain tumors at an early stage. Although CT scans can produce detailed images of brain structure, their ability to detect very small brain tumors or those located in hard-to-reach areas is still a question (Ratan et al., 2009). Therefore, it is necessary to conduct further studies that are more focused to evaluate the factors that affect the sensitivity and specificity of CT scans in detecting brain tumors at an early stage (Hanwat &; Chandra, 2019).

In addition, comparison with other imaging technologies is also an important part of this discussion. Magnetic resonance imaging (MRI), for example, is often considered a more sensitive imaging method in detecting brain tumors, especially in small ones. Therefore, the comparison between the sensitivity and specificity of CT scan with MRI in detecting brain tumors at an early stage needs to be further evaluated to evaluate the performance of CT scans in detecting various types of brain tumors is also an important part of this discussion. Brain tumors have diverse characteristics, including location, size, and histological type, which can affect a CT scan's ability to detect them. Therefore, it is necessary to conduct studies covering different types of brain tumors to understand the extent to which CT scans are effective in detecting each type of tumor (Juneja et al., 2018). CT scans in early detection of brain tumors, it is also important to consider the clinical implications of the findings of this study. Research that strengthens the evidence that CT scans can be effective in detecting brain tumors at an early stage can have a significant impact on clinical practice, including in diagnostic decision-making and treatment planning (Amin et al., 2022). Therefore, it is important to investigate not only the ability of CT scans in detecting brain tumors,

but also how those results can be applied in clinical practice to improve the care and prognosis of affected patients.

Findings supporting the effectiveness of CT scans in detecting brain tumors at an early stage can have a major impact on clinical practice, including in diagnostic decision-making and treatment planning. Follow-up research exploring the direct consequences of these outcomes in patient management and treatment outcomes will provide a more holistic view of the role of CT scans in the early detection of brain tumors. Next, analyze the effectiveness of using CT Scan using CT Scan in Early Detection of Brain Tumors with N-Gain test.

Table 2. N-Gain Test Results

Effect Size	N-gain	Criterion
1.17	0.58	Tall

Table 2. N-gain test results of 0.58 with high effectiveness, then the use of CT Scan the use of CT Scan is very effective in Early Detection of Brain Tumors in Humans. Research comparing the advantages of CT scans with other imaging technologies, such as MRI, can provide valuable insights into the selection of the most appropriate imaging method for each case. MRI is often considered a more sensitive method of detecting brain tumors, but CT scans still have advantages in terms of availability and shorter examination times. This comparison can help determine the best imaging strategy according to each patient's needs (Onyije et al., 2024). Equally important is to pay attention to the practical implications of the results of this study in the management of brain tumor patients. Findings supporting the effectiveness of CT scans in detecting brain tumors at an early stage could have a major impact in everyday clinical practice (Xu & Mohammadi, 2024), including in treatment-related decision-making and follow-up. This research could pave the way for the development of better clinical guidelines in the diagnosis and management of brain tumors (Panduri &; Rao, 2023).

Conclusion

Based on the study, it can be concluded that the average value of effect size is 1.17 with a high effect size category. These findings explain that the use of CT scans has a positive impact in early detection of brain tumors in humans. As nCT scans have

become a commonly used diagnostic tool, there are several challenges that need to be overcome to improve early detection of brain tumors using this technology. Evaluation of the sensitivity, specificity, and accuracy of CT scans in detecting brain tumors at an early stage was the main focus in this study.

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