EARLY DETECTION OF GADGET ADDICTION IN TEENAGERS USING MAGNETIC RESONANCE SPECTROSCOPY WITH THE SINGLE VOXEL

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ABSTRACT

Gadget addiction is one of the negative effects of excessive gadget use. Gadget addiction is one of the negative effects of excessive gadget use. Currently, there are many studies that investigate internet addiction using a neuroimaging approach with diagnostic modalities. One of the modalities that can be used is Magnetic Resonance Imaging (MRI). One of the developments in MRI is Magnetic Resonance Spectroscopy Imaging (MRS) examination. MRS is a radiological examination that uses MRS supporting software in the MRI modality to show correlations of anatomical and physiological metabolic or biochemical information present in the body, both in normal and abnormal conditions.

The purpose of this study was to analyze the results of metabolite values in adolescents with suspected gadget addiction to prevent and support therapeutic research using MRS. The method used in this study is descriptive qualitative research to determine the results of metabolite values in adolescents with suspected gadget addiction to prevent and support therapeutic research using MRS with the single voxel. The sample used was teenagers with suspected gadget addiction.

The MRS examination can show the value of metabolites in the adolescent's body. The results of the MRS are in the form of graphs of metabolite values. Normal metabolite values will produce a Hunter's Angle. The graph of teenagers with suspected gadget addiction does not form a Hunter's Angle. The values of NAA (5.49), Cho (3.63), Cr (3.65), and Glx (1.06) in adolescents with suspected gadget addiction decreased from the normal values of NAA (10-15), Cho (8), Cr (7), and Glx value (5-10).

Keywords: MRS, gadget addiction, brain

Introduction

The development of technology today is so fast and sophisticated. Almost everyone already has a gadget. All groups including children and adolescents use gadgets in their daily activities. The use of gadgets today cannot be separated from the use of the internet(Parwatha et al., 2019). Based on the results of a survey by the Indonesian Internet Service Providers Association (APJII) of the Ministry of Communication and Informatics of the Republic of Indonesia in 2023 internet users

in Indonesia have reached 78.19% or penetrated 215,626,156 people out of a total population of 275,773,901 people (Indonesia kkdiR. Dirjen PPI, 2023) All people, especially teenagers, have been exposed to and have the risk of experiencing gadget addiction due to the process of adaptation to the surrounding environment and culture. The percentage of Generation Z with an age range of 10-25 years is around 27.94% of 270.20 people in Indonesia (Results of the Population Census, 2020), this number is the largest among the Indonesian population. The COVID-19 pandemic has made the use of the internet in adolescents not only a necessity for academics, but also as a means of playing (Kurniasanti et al., 2019).

Continuous use of gadgets can have positive and negative impacts on users and the surrounding environment. Gadget addiction is one of the negative effects of excessive gadget use. Gadget addiction pathology is characterized by an individual's inability to spend time using gadgets, and feeling that the virtual world is more interesting than life in the real world. Gadget addiction is the same as addiction to drugs or addictive substances such as alcohol or drugs with symptoms where it is difficult for the brain to say no (SM. S, 2013). Someone can be said to be addicted if they use it for more than 3 hours or 4 hours a day or 30 hours a week. (Gultom et al., 2018; Han et al., 2014)

Excessive interaction with gadgets will affect the physical and mental health of adolescents, damage friendships, interfere with work, and lead to issues of cyberbullying (Calvete et al., 2017). Controlling adolescents with internet addiction is an important goal to prevent adolescents from behaviors and lifestyles that can be detrimental to their sufferers, their families and the country, so they need to be identified, identified and taken seriously. Currently there are quite a number of studies investigating internet addiction using a neuroimaging approach using diagnostic modalities. One of the modalities that can be used is Magnetic Resonance Imaging (MRI).

MRI examination is developing very rapidly in the diagnostic field. One of the developments in MRI is the Magnetic Resonance Spectroscopy Imaging examination, or better known as MRS (MR Spectroscopy or MRS). MRS is a radiological examination that uses MRS supporting software in the MRI modality which can show correlations of anatomical and physiological metabolic or biochemical information present in the body, both in normal and abnormal conditions. Unlike the general MRI examination, MRS is a follow-up examination that is carried out after an MRI brain examination without contrast or with contrast. Gadget addiction neuroimaging examination can be done using MRS to see the anatomy and pathology of the brain. MRS examination of brain tissue showed the spectra of several body metabolites(D. P. Soares ML., 2008).

Two basic pulse sequence methods are used for volume sampling in MR Spectroscopy examinations, namely Stimulated Echo Acquisition Mode (STEAM) and Point Resolved Spectroscopy (PRESS). STEAM is used to display metabolites with short T2 relaxation times (eg Lipids (Lip), Glutamine and glutameate (Gx), Myo-inisitol (mI)), for high voxel precision. PRESS is used for the evaluation of brain lesions for concentrations of long T2 metabolites (eg NAA, choline, creatine, and glutamine and glutamate). Sampling in the anatomical area of the brain Proton MR Spectroscopy can use a single voxel (SV) or multivoxel (MV) technique using the chemical imaging shift (CSI) acquisition method with several cubical areas (voxels). CSI can be used to compare changes that occur in certain cases. The single voxel technique is usually 2x2x2cm in size to evaluate the lesion, so the examination time is relatively fast, around 3 to 5 minutes(Irina Mader SR, 2008)

There is no gold standard measurement tool that is used to diagnose internet addiction accurately and can be used universally, therefore it is hoped that the MRS examination can be used as a supporting tool for diagnosing internet addiction. Based on the background description, a study will be carried out to see and analyze the value of the metabolites N-acetyl-aspartate (NAA), choline (Cho), creatinine (Cr) and Glutamate and Glutamine (Glx) using MRI modalities and MRS software in adolescents , because a decrease in the value of NAA and Cr is associated with damage to neurons (nerves) and increased metabolism in cells. Decreased NAA values in the temporal lobe can also cause epilepsy in a person, while decreased metabolite

values in Glx can cause Alzheimer's.(Antonin Skoch FJ, 2008)

Previous research used MRS with the multi-voxel method and showed that NAA concentration levels in game addiction patients were lower than normal patients in the right frontal cortex and choline (Cho) concentrations were also lower in the medial temporal cortex. Other studies state that the metabolites of g-amino butyric acid into Glx can be used to detect internet and smartphone addiction. The Cr value is used to see energy metabolism, the Lipid value is used as an indication of tissue necrosis and the Lactate value is used as an indication of hypoxaemia. This study uses the single voxel method and will discuss the value of NAA, Cho, Cr, and Glx metabolites in adolescents with suspected gadget addiction.

Methods

The method used in this study is descriptive qualitative research to determine the results of metabolite values in adolescents with suspected gadget addiction to prevent and support therapeutic research using MRS with the single voxel. The sample used was teenagers with suspected gadget addiction. The subjects used in this study were teenagers with suspected gadget addiction. The object of this study is the value of NAA, Cho, Cr, and Glx metabolites in adolescents with suspected gadget addiction. Time the research was conducted from October 2022 to February 2023 at the SMC Radiology Installation, Tlogorejo Hospital, Semarang. In this study, the data source was obtained directly from research respondents by conducting MRS examinations on adolescents with suspected gadget addiction. Data analysis was carried out using descriptive analysis by describing or describing the original situation in a systematic and accurate manner regarding early detection of adolescents with suspected gadget addiction through MRS examinations.

Results and Discussion

This This research was conducted at the Telogorejo SMC Radiology Installation in Semarang with a Siemens 1.5 Tesla MRI machine

as modality. Routine MRI Brain Examination is carried out before taking MR Spectroscopy. Routine MRI Brain examinations are carried out according to the protocol at the SMC Telogorejo Hospital Semarang, namely using the T1 SE Sagittal, T2 Tirm Transverse, T2 TSE Transverse and T2 Blade Coronal sequences. The following is one of the results of an MRI Brain image.
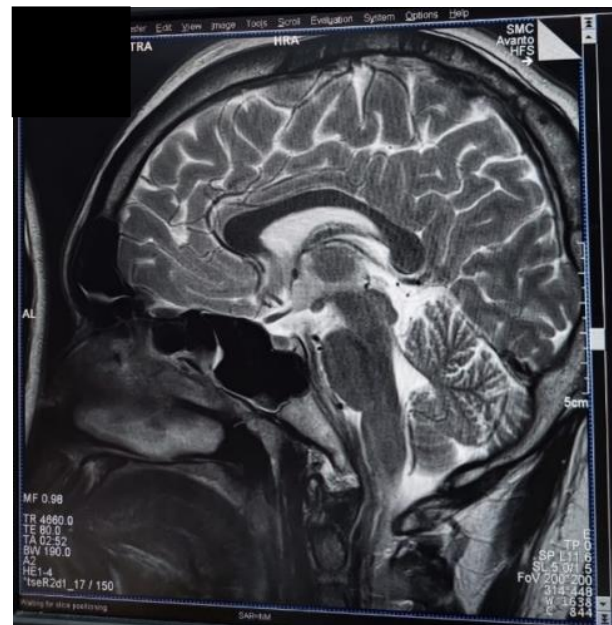

Figure 1. Brain MRI Result

The results above are an overview of the results of the MRI Brain image. After the data was obtained, an MR Spectroscopy examination was carried out to see the results of the NAA, Creatinin, Choline, and Glx metabolites. MR Spectroscopy examination in this study used the single voxel method in the frontal lobe area in the anterior cingulate cortex.
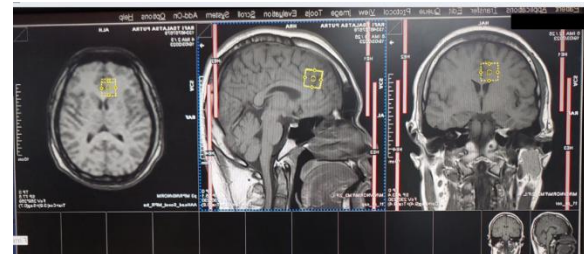

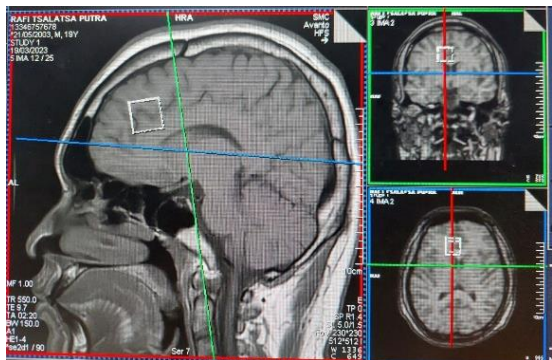Figure 2. voxel placement in the anterior cingulate cortex.

Figure 3. voxel placement in the anterior cingulate cortex with single voxel method.

After a few minutes the results of the MRS brain appear in the form of a graph. MRS graphs can show the results of NAA, Cho, Cr and Glx metabolite values. the advantage of using the single voxel method is that it is shorter to examine.
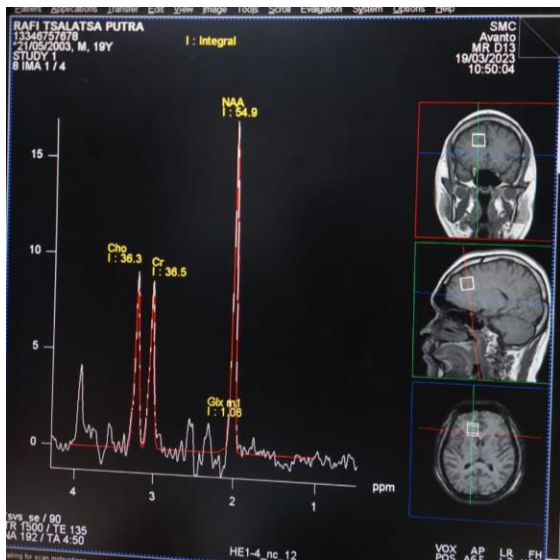

Figure 4. Results of the MRS chart in adolescents with suspected gadget addiction

The MRS graph under normal conditions will form a Hunter's angle on NAA, Cho, and Cr metabolites. The graph of teenagers with suspected gadget addiction does not form a Hunter's Angle. The values of NAA (5.49), Cho (3.63), Cr (3.65) and Glx (1.06) in adolescents with suspected gadget addiction decreased from

the normal values of NAA (10-15), Cho (8), Cr (7) and Glx values (5-10).

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MR Spectroscopy examination is used to see the metabolic physiology of N-Acetyl Aspartate (NAA), Creatinin (Cr), Choline (Cho), glutamine and glutamate (Glx) which are found in the brain, both in normal and abnormal conditions. Assessment of metabolite value using Spectroscopy software on MRI modality. MR Spectroscopy examination in this study used the single voxel method in the frontal lobe area in the anterior cingulate cortex. The choice of the single voxel method is because the examination time is much faster and it is sufficient to provide information on metabolite values in adolescents.

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According to the theory of graph results on MR Spectroscopy, metabolite values will form a hunter's angle or form an angle of 450. The graph results in this study do not form a hunter's angle because there is a change in metabolic values in the sample.

The NAA value (5,49) in the sample is lower than the normal NAA (10-15). A decrease in the value of metabolites in NAA is an important indication of gadget addiction. Decreased NAA values are thought to cause damage to nerve cells (neurons) and increase metabolism in cells. A decrease in NAA or N-Acetyl Aspartate is a dysfunction of normal nerve

cells in a neoplasmic direction because the axons of nerve cells begin to break down. Decreased NAA values in the temporal lobe can also cause epilepsy in a person.

According to researchers, the decrease in NAA metabolites can occur because the NAA value is an important indication of gadget addiction.

This is important for teenagers to know, because using the internet for 4 hours can already result in a decrease in the value of NAA metabolites so that longer use of the internet may result in a greater decrease and have an impact on body physiology.

Based on the results of this study, it is hoped that adolescents can reduce or manage time in their daily internet use. Prevention in adolescents with internet addiction can be further improved by carrying out this MR Spectroscopy**For** examination as an initial screening to see the value of metabolites in adolescents.

The Cr value (3,65) has decreased from the normal value (7). This decrease in creatinine values is related to the occurrence of damage to neurons (nerves) and increased metabolism in cells. According to the researchers, attention must be paid to decreasing creatinine values in the frontal lobe because it can lead to pathology in adolescents. Prevention in adolescents with internet addiction can be further improved by carrying out this MR Spectroscopy examination to see the value of metabolites in adolescents

Choline depletion plays an important role in learning and memory, sleep-wake cycles and emotions. Someone will experience great difficulty in resisting any temptation related to online games or other services, they cannot concentrate in learning activities, become restless or irritated and suffer sleep disturbances and emotional or physiological disturbances after they stop internet activities or reduce online time(29). . According to researchers using the internet continuously for a long time can result in teenagers not being able to control the time they use the internet. This results in adolescents experiencing sleep disturbances. Sleep disorders experienced by adolescents will reduce their rest time, thus making it difficult for adolescents to control their emotions.The Glx value in the samples also decreased. A decrease in Glx can cause Alzheimer's

Conclusion

The results of the MRS are in the form of graphs of metabolite values. Normal metabolite values will produce Hunter's Angle. The graph of teenagers with suspected gadget addiction does not form a Hunter's Angle. The values of NAA (5,49), Cho (3,63), Cr (3,65) and Glx (1.06) in adolescents with suspected gadget addiction decreased from the normal values of NAA (10-15), Cho (8), Cr (7) and Glx value (5-10).

The author suggests using the single voxel method for MRS examination. MRS examination using a single voxel is faster than multi voxel. MRS examination using this method only takes 3 to 5 minutes.

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