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Study on the efficacy of Centella Asiatica on Student's Memory and Attention Improvement

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Abstract--*Centella asiatica (CA), locally known as* pegagan, *is a common herb plant used in many Indonesian dishes. CA is also an Ayurvedic herb used to enhance memory and nerve function (Shiva, 2005). To investigate the potential use of CA in improving memory and attention, we examined the effects of daily consumption of CA for 60 days in 57 students divided into 3 groups (2 study and 1 control groups) in a single blind study. Measurements used are memory sub test of IST and Deary-Liewald reaction time test. Paired t-test was applied to know the result within the group and unpaired t-test was used to know the result in between the group. This research is useful to shed lights on the therapeutic benefits of this daily-consumption plant.*

Key words--*(Memory; Attention; Simple Reaction Time; Choice Reaction Time; t-test; Centella asiatica)*

I. INTRODUCTION

Working memory and attention are closely related concepts. The ability to selectively process information (attention) and to store information in accessible circumstances (working memory) are important aspects of cognitive capacity. The capacity to perform several complex tasks depends critically on the ability to store information that is relevant to the task in circumstances that can be accessed from time to time (working memory) and to selectively process information in the environment (attention).

Past studies have shown that attention can be improved[1]. Similar conclusion also applies to working memory capacity, which can be improved both through practice[2,3] or through the use of certain substances[4]. Centella asiatica (CA) has been studied in the past can improve cognitive skills[5,6]. The use of Centella asiatica (CA) might be able to improve memory and attention. If this is the case, then consumption of CA can provide an effective and practical solution to improve students' memory and attention, since CA can easily be found in Indonesia and has been used in many Indonesian dishes.

The purpose of this study is to evaluate the efficacy of CA consumption in improving students' working memory and attention through SRS (Simple Reaction Time) and CRT (Choice Reaction Time) measurements.

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II. LITERATURE REVIEW

2.1 Centella Asiatica

Centella asiatica, locally known in Indonesia as Pegagan, is a herbal plant that is widely consumed by the community, both in processed and in raw form. This plant is known as Brahmi in Ayurvedic medicine, classified into the "rasayana" group, a plant that has rejuvenating properties and can overcome depression, anxiety, mental fatigue, and improve memory[6,7].

2.2 Memory

Memory refers to mental processes relating to retrieving, storing and recalling information or experience when needed[8]. Richard Atkinson and Richard Shiffrin developed a memory model consisting of three components namely; sensory memory, short-term memory (working memory) and long-term memory[9] (see Figure 1).

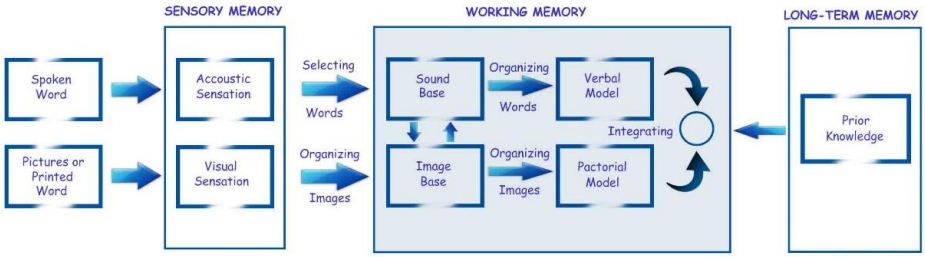

Figure 1. Atkinson-Shiffrin Memory Model

Short-term memory is memory systems that have limited storage capacity and are only temporary for storing and processing information[10]. In other words working memory can be analogous to a memory workspace that not only stores information but also plays a role in manipulating information and supporting rapid cognitive processes such as problem solving or planning. Working memory capacity can be improved, both through practice [2,3] or through the use of certain chemicals[4].

2.3 Attention

Attention refers to the processing or selection of some information at the expense of other information[11]. The study of attention can be conducted by measuring reaction time[12]. The study of reaction time is also correlated with the study of memory. Traditional human information processing tasks such as stimulus naming, choice reaction, and stimulus classification are related to current conceptions of short-term and long-term memory and subsumed under a single information processing theory[13].

Reaction time is defined as the time between the presentation of the stimulus and the initiation of the response to the stimulus, which is one of the most commonly used measures of neurological function[14]. The general paradigm for evaluating reaction time is to measure the time between a stimulus presentation and a response afterwards. This method is considered acceptable for determining reaction time, even though the measured interval actually represents the response time, number of reaction times and time of movement.

There are three classifications of reaction time; simple reaction time, choice reaction time and selective reaction time[15]. In measuring simple reaction time, participants are asked to respond to a stimulus that has been designed, for example, pressing a button as soon as the light is turned on. Measurement of choice reaction time,

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participants are presented with two or more different stimuli and are asked to respond differently to different stimuli, for example, one hand responds to a red light, and another to a white light. Measurement of selective reaction time, participants are asked to only respond to the appearance of one stimulus while ignoring the appearance of another stimulus. This procedure requires participants to distinguish two stimuli, for example, two colors of light, but it does not require a response choice because participants are asked to respond to just one light.

Whatever activity is chosen, the researcher's main target is to measure how quickly participants respond to the stimulus. The time a person needs to respond is called reaction time, response time, or response latency. Usually measured in milliseconds (ms) from the start of the stimulus to the point in time when the response is given[16].

III. METHODOLOGY/MATERIALS

3.1 Participants

Students from a private male-only boarding middle school in West Java, of average intelligence (95 – 104, IST) were taken for the study. Out of 54 students, three of them were omitted due to unfit for the study. 51 students were grouped into 3 groups; 2 study groups and 1 control group, each consisting of 17 students. The groups are as follow:

Group 1: 1 CA capsule intake daily
Group 2: 2 CA capsules intake daily
Placebo Group: 1 placebo capsule intake daily

The CA and placebo capsules were purchased Vitabrain Indonesia.

3.2 Measures and Instruments

The assessment of working memory was conducted using the memory subtest of IST (Intelligenz Struktur Test), and The Deary-Liewald reaction time task for Simple Reaction Time (SRT) and Choice Reaction Time (CRT) were used to measure attention[17].

In the memory assessment, students memorized list of words for three minutes and were given questions related to the words by research administrators. Memory capacity was determined by the number of correct words supplied by the students.

Measurement of attention using SRT and CRT is conducted using a computer program. In SRT measurements, one white box is positioned approximately in the center of the computer screen, with a blue background (see Figure 2a). The stimulus that will be responded to is the appearance of a cross in the box. Every time a cross appears, students must respond by pressing the button as fast as possible. Each cross stays on the screen until the button is pressed, after it disappears and another cross appears shortly after. The inter-stimulus interval (the time interval between each response and when the next cross appears) ranges between 1 and 3 and is randomized within these limits. The computer program records the response time and interim stimulus interval for each experiment.

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Figure 2a. SRT activity **Figure 2b.** CRT activity

In CRT measurements, four white squares are positioned in a horizontal line around the center of the computer screen, set against a blue background (see Figure 2b). Four buttons on a standard computer keyboard correspond to different boxes. The position of the button corresponds to the position of the box on the screen: the 'z' button corresponds to the box on the far left, the 'x' button to the second box from the left, the 'comma' button to the second box from the right and the 'full-stop' button to the box at the most right. The stimulus to respond is the appearance of a cross in one of the boxes. Students are instructed to gently place the index and middle fingers of their left hand on the 'z' and 'x' buttons, and the index and middle finger of their right hand on the 'comma' and 'point' buttons. A cross appears randomly in one box and participants are asked to respond as quickly as possible by pressing the appropriate button on the keyboard. Each cross stays on the screen until one of the four buttons is pressed, after it disappears and another cross appears shortly after that. The inter-stimulus interval ranges between 1 and 3 seconds and is randomized within these limits. The computer program records the response time for each cross, the inter-stimulus interval for each experiment, which button is pressed and, in the case of four choice reaction times, whether the response is right or wrong.

3.3. Procedure

This study is a pretest – posttest nonequivalent groups design, conducted simultaneously in two batches. The first study aimed to determine the effect of CA consumption to students' memory and attention. The second study aimed to compare the effect of CA consumption to student's memory and attention, under two different intake conditions.

The first study involving a study group and a control group, each consisting of 17 students. Prior treatment, students in both groups were measured on the basis of memory and attention. Chronologically the assessment started with attention measurement, followed by the measurement of memory on different day. This was due to the limitation imposed by the school. During each assesments (memory – attention; pre – post study) there were students who could not come due to personal reasons.

Students in the study group (Group 1) were given 1 capsule of 500 mg CA once per day before breakfast. Students in the control group (Placebo Group) were given 1 capsule of placebo, filled with wheat powder, once per day before breakfast. The placebo capsules were made of the same appearance to the CA capsules. The distribution of capsules was done and supervised by two research administrators who stayed in the school. During the experiment period, students were doing their daily study in the school. The research administrators can confirm that the distribution of the capsules to the students was done daily and systematically for 60 days. At the end of the study period, students in both groups were assessed again for memory and attention, similar to the first measurement.

The second study involving two study groups, one capsule daily intake group (Group 1) and two capsules daily intake group (Group 2). Measurements of before and after the treatment were similar to the first batch. The capsule intake in the second batch also done for 60 days.

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3.4. Statistical Analysis

Statistical analysis for this study was conducted using SPSS version 13. As there were two groups in each batch, paired t-test was applied to know the result within the group, for memory and attention.

IV. RESULTS AND FINDINGS

4.1. First Study

4.1.1. Memory study (Group 1 and Placebo Group)

Table1. Normality Test Summary for Group 1 and Placebo Group (Memory)

Group	Test	Shapiro-Wilk		
		Statistic	df	Sig.
Group 1	Pre-test	.972	10	.912
	Post-test	.871	10	.103
Placebo Group	Pre-test	.971	13	.910
	Post-test	.958	13	.728

A Shapiro-Wilk test indicates that Group 1 and Placebo Group both follow a normal distribution, on pre and post test.

A paired t-test on memory study shows there was a significant difference only in the memory scores of Group 1, between pretest (M = 5.6, SD = 2.95) and posttest (M = 10, SD = 1.89) conditions; t(9) = -3.68, p = 0.005. Memory study on Placebo Group shows no significant difference.

4.1.2. SRT study (Group 1 and Placebo Group)

Table2. Normality Test Summary for Group 1 and Placebo Group (SRT)

Group	Test	Shapiro-Wilk		
		Statistic	df	Sig.
Group 1	Pre-test	0.886	12	0.104
	Post-test	0.904	12	0.177
Placebo Group	Pre-test	0.931	12	0.390
	Post-test	0.917	12	0.262

A Shapiro-Wilk test indicates that Group 1 and Placebo Group both follow a normal distribution, on pre and post test.

A paired t-test on SRT study shows there was a significant difference only in the SRT of Group 1, between pretest (M = 287.03, SD = 24.77) and posttest (M = 313.80, SD = 16.25) conditions; t(11) = -3.62, p = 0.005. SRT study on Placebo Group shows no significant difference.

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4.1.3. CRT study (Group 1 and Placebo Group)

Table3. Normality Test Summary for Group 1 and Placebo Group (CRT)

Group	Test	Shapiro-Wilk		
		Statistic	df	Sig.
Group 1	Pre-test	0.941	12	0.517
	Post-test	0.941	12	0.505
Placebo Group	Pre-test	0.931	12	0.390
	Post-test	0.917	12	0.262

A paired t-test on SRT study shows there was not a significant difference in the CRT of Group 1, between pretest (M = 465.73, SD = 71.68) and posttest (M = 431.38, SD = 40.44) conditions; t(11) = 1.84, p = 0.093.

4.2. Second Study

4.2.1. Memory study (Group 1 and Group 2)

Table4. Normality Test Summary for Group 1 and Group 2 (SRT)

Group	Shapiro-Wilk		
	Statistic	df	Sig.
Group 1	0.871	10	0.103
Group 2	0.950	15	0.530

An independent-samples t-test was conducted to compare memory on Group 1 and Group 2. There was no significant difference in the scores for Group 1 (M=10, SD=1.89) and Group 2 (M=11.13, SD=2.25) conditions; t (24) = -1.317, p = 0.200. These results suggest that increase in CA consumption does not have an effect on memory improvement.

4.2.2. SRT study (Group 1 and Group 2)

Table5. Normality Test Summary for Group 1 and Group 2 (SRT)

Group	Shapiro-Wilk		
	Statistic	df	Sig.
Group 1	0.927	14	0.280
Group 2	0.965	16	0.761

An independent-samples t-test was conducted to compare SRT on Group 1 and Group 2. There was a significant difference in the scores for Group 1 (M=312.41, SD=19.71) and Group 2 (M=278.68, SD=22.88) conditions; t (28) = 4.294, p = 0.000. These results suggest that increase in CA consumption has an effect on SRT improvement.

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4.2.3. CRT study (Group 1 and Group 2)

Table6. Normality Test Summary for Group 1 and Group 2 (CRT)

Group	Shapiro-Wilk		
	Statistic	df	Sig.
Group 1	0.974	14	0.930
Group 2	0.942	16	0.378

An independent-samples t-test was conducted to compare CRT on Group 1 and Group 2. There was no significant difference in the scores for Group 1 (M=436.71, SD=44.54) and Group 2 (M=408.48, SD=68.35) conditions; t (28) = 1.319, p = 0.198. These results suggest that increase in CA consumption has no effect on CRT improvement.

V. DISCUSSION

The results show that the daily intake of CA 500 mg consumption has a positive impact on improving students' memory and attention. Daily intake of CA 500 mg capsules significantly increases students' memory after 60 days. Similar results also received attention, measured by SRT and CRT measurements. However, this study also revealed that additional consumption of CA capsules did not significantly improve memory and CRT. Although there is a significant finding about the increase in SRT, this increase is still trivial and still needs further evaluation.The fact that all participants live in the dormitory, enables study administrators to supervise the consumption of capsules optimally, ensuring the reliability of the results. While the fact that the participants in this study were all male, this study shows the effect of CA on male students. Future studies need to evaluate the efficacy of CA in female students.

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