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RESEARCH ARTICLE

The Effect of Reading Activity on Verbal Fluency in Older Adults

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ABSTRACT

Introduction: *The high prevalence of dementia affecting verbal fluency have been one of the global major concerns. Therefore, strategies to maintain or improve the verbal fluency in older adults is needed. Neuroplasticity-based program in the form of reading has been shown to affect the verbal fluency.*
Objective: *This study aims to evaluate the effect of reading activity on verbal fluency in the older adults.*
Methods: *This was a quasi-experimental study with pretest-posttest control group design. Thirty older adults were included. The inclusion criteria were more than 60 years of age, being to speak, being able to read, scores > 24, for the Mini-Mental State Examination (MMSE) score, having intention to fill out the reading habits questionnaire criteria. The exclusion criteria were the history of hypertension, diabetes mellitus, and psychiatric disorders, head trauma injury of neurological disorders, hearing loss and alcohol use. The patients were assigned into three groups: the control group (C-G), the 15-minute reading intervention group (G-15), and 30-minute reading intervention group (G-30). The reading aloud activity was given for 14 days. The verbal fluency was evaluated. Statistical analysis was performed using oneway ANOVA, Post Hoc, and paired T-test.*
Results: *There were significant differences among groups in post-test phonemic score ($p<0.05$). post-test phonemic score in G-15 and G-30 increased significantly compared to that of pre-test phonemic score ($p<0.05$). Meanwhile, there were no significant difference in semantic score in all groups ($p>0.05$).*
Conclusion: *The reading activity intervention for two weeks affects verbal fluency in older adults by increasing the phonemic score but not semantic score.*

Keywords: *Reading, Verbal Fluency, Neuroplasticity, Older adults*

ABSTRAK

Pendahuluan: Prevalensi demensia yang tinggi pada lansia merupakan masalah serius di setiap negara, yang memengaruhi penurunan fungsi kelancaran berbicaranya. Untuk mempertahankan ataupun memperbaiki fungsi kelancaran berbicara pada lansia diperlukan aktivitas membaca. Neuroplastisitas dalam bentuk membaca dinilai mempengaruhi kelancaran berbicara. **Tujuan:** untuk mengetahui pengaruh aktivitas membaca terhadap kelancaran berbicara pada lansia.
Metode: Penelitian bersifat analitik eksperimental dengan metode *quasi-experimental study pretest posttest control group design*. Subjek penelitian sebanyak 30 lansia usia >60 tahun, dengan kriteria inklusi meliputi: dapat berbicara, dapat membaca, skor MMSE >24, memenuhi kriteria kuisioner kebiasaan membaca, tidak memiliki penyakit hipertensi, diabetes mellitus, riwayat gangguan psikiatri, riwayat trauma kepala, riwayat gangguan neurologi, gangguan pendengaran, dan tidak mengkonsumsi alkohol. Kelompok dibagi menjadi tiga kelompok, terdiri dari kelompok kontrol (C-G), kelompok intervensi membaca 15 menit (G-15), dan kelompok intervensi membaca 30 menit (G-30). Aktivitas membaca dengan lantang diberikan selama 14 hari pada kelompok intervensi, kemudian diukur kelancarannya dengan menggunakan *verbal fluency test.* Analisa statistik dilakukan dengan uji One Way ANOVA, Post Hoc, dan pair t test.
Hasil: hasil analisis anova menunjukkan terdapat perbedaan bermakna rerata skor fonemis *posttest* di antara kelompok, $p<0.05$. Hasil uji pair T-test menunjukkan bahwa terjadi peningkatan bermakna rerata skor fonemis *post-test* jika dibandingkan *pretest* pada G-15 dan G-30, $p<0.05$. Sedangkan rerata skor semantic pada seluruh kelompok tidak terjadi perbedaan bermakna, $p>0,05$.
Kesimpulan: intervensi aktivitas membaca selama dua minggu meningkatkan kelancaran berbicara pada orang lanjut usia dengan meningkatkan skor fonemis tapi tidak pada skor semantik.

Kata Kunci: Membaca, Kelancaran Berbicara, Neuroplastisitas, Lansia

INTRODUCTION

The prevalence of neurodegenerative diseases, especially dementia, continue to increase in older adults. In Indonesia, the number of patients with dementia have increased to 2.2 million from 220 million people in 2013 (Sengkey, Mulyadi and Bawotong, 2017). Dementia in the older adults requires an early diagnostic and curative measures to inhibit its severity. One of the form of cognitive function that appears to decrease with age is speaking fluency. Fluency in speech is defined

as the ability to speak two or more phrases between pauses. Old age is one of the factors that affect fluency in speaking. The previous studies showed that semantic speaking fluency decreases after age 35 and phonemic speaking fluency decreases after age 50 years. The fluency function of speaking can be evaluated by a verbal fluency test. Semantic fluency is assessed by mentioning words related to certain categories (for example: animal names) and phonemic fluency is assessed by mentioning words starting with certain letters (Elgamal, Roy and Sharratt, 2011; Shao et al., 2014; Thapliyal, Halder and Mahato, 2016; Aninditha and Wiratman, 2017).

The decline in the cognitive function of fluency in speech in the older adults is due to the decreased structure and function of the neurogenic area. This decrease can be due to a decrease in interneuron connections (Katsimpardi and Lledo, 2018). The preventive and curative measures related neuroplasticity have been developed. Neuroplasticity is the process of reorganizing the structure and function of the brain as a form of adaptation by the presence of intrinsic and extrinsic factors (Kania, Wrońska and Zięba, 2017). Neuroplasticity-based intervention in the older adults has a great potential to improve age-related cognitive decline. A meta-analysis showed that neuroplasticity of physical activity and cognitive activity in the older adults can improve cognitive function (Gheysen et al., 2018).

Neuroplasticity based strategies include learning process such as reading activity (Gitler, Dhillon and Shorter, 2017). The study reported that children who read more frequently had higher scores on tests of reading words, reading fluency, and rapid naming. This is due to an increase in the volume of maturation of the left inferior parietal cortex and the left inferior of frontal lobe (Houston et al., 2014). Reading has been shown to have a positive effect on neuroplasticity. However, the existing research is limited to its effect in children. Studies related to effect of reading on neuroplasticity is expected to be a breakthrough for improving cognitive function in the older adults (Houston et al., 2014).

This study aims to determine whether reading activity can affect the fluency of speech in the older adults. This study evaluated the effect of the different duration of reading (short and long) on the speech in older adults.

METHODS

This was an experimental study with a pretest posttest control group design. The research was conducted among thirty older adults participates in Ponorogo regency and Kediri, Indonesia. Signed informed consent forms were obtained from all participants. The inclusion criteria were more than 60 years of age, being able to speak, being able to read, scores > 24 for the Mini-Mental State Examination (MMSE) score, having intention to fill out the reading habits questionnaire criteria. The exclusion criteria were the history of hypertension, diabetes mellitus, and psychiatric disorders, head trauma injury of neurological disorders, hearing loss and alcohol use.

The older adult participants were randomly divided into 3 groups of 10 people using a computer generated random number. The first group served as the control group (CG). The second and third group were assigned to the reading for 15 minutes (G- 15) and 30 minute (G- 30, respectively. The study was conducted after obtaining Ethical clearance (37/UN27.06.6.1/ KEPK/ EC/2020) from the Health Research Ethics Committee, Universitas Negeri Sebelas Maret (UNS), Indonesia.

Reading activity

The intervention of reading aloud for 14 consecutive days with a duration according to the group's requirements. The book used was Zainollah Ahmad's "Tahta di Timur Jawa" (Fig.1)

Verbal fluency test

Participants were subjected to K-A-M Phonemic Verbal Fluency Test adapted in Indonesian from F-A-S test. The examinees were given one minutes to name as many words as possible beginning with the first letter; the procedure was then repeated for the two remaining letters. The participants were informed that repetitions, proper names were to be eliminated from the analysis. To evaluate the semantic verbal fluency (SVF), the participants were asked to name as many words as possible within a specified semantic category of Animals in one minute.

The instrument had already been subjected to validity and reliability test with cronbach's alpha 0.934., r table of 0.361. Furthermore, for the validity, Pearson Correlation found that the value of the correlation was positive and the value of the probability of the correlation was <0.05 for the verbal fluency test. Then the verbal fluency test measuring instrument was reliable and valid.

Statistical Analysis

Data were analyzed using paired t-test to assess differences in the mean pre and post-intervention in one group. A one-way ANOVA was conducted to

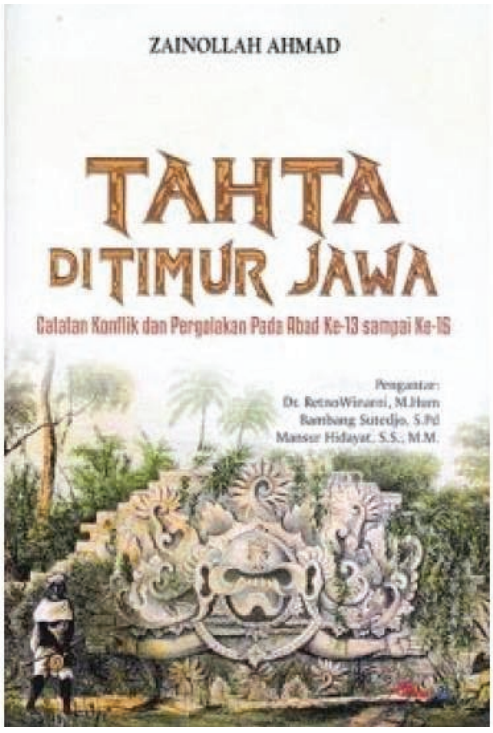

Fig 1. The book cover of Zainollah Ahmad's "Tahta di Timur Jawa"

Tabel 1. The baseline charactristics of participants

characteristics	Group		
	C-G	G-15	G-30
Jumlah	10	10	10
gender			
male	7	6	5
female	3	4	5
MMSE score			
24	1	1	0
25	1	1	0
26	2	3	5
27	3	1	3
28	1	3	2
29	2	1	0
Phonemic score			
Pre-test	27.40	29.20	32.80
Semantic Score			
Pre-test	13.60	15.60	17.00

Tabel 2. Mean phonemic and semantic scores of the participants after the reading activity intervention

Variables	Groups					
	C-G		G-15		G-30	
	Pre-test	Pos-ttest	Pre-test	Post-test	Pre-test	Post-test
Phonemic score	27.40	28.00	29.20	35.40	32.80	40.00
Semantic score	13.60	14.50	15.60	16.70	17.00	18.10

investigate the difference between mean score before and after the intervention between the groups followed by post-hoc analysis Bonferroni. All statistical analyses were performed with IBM SPSS Statistics 23 for

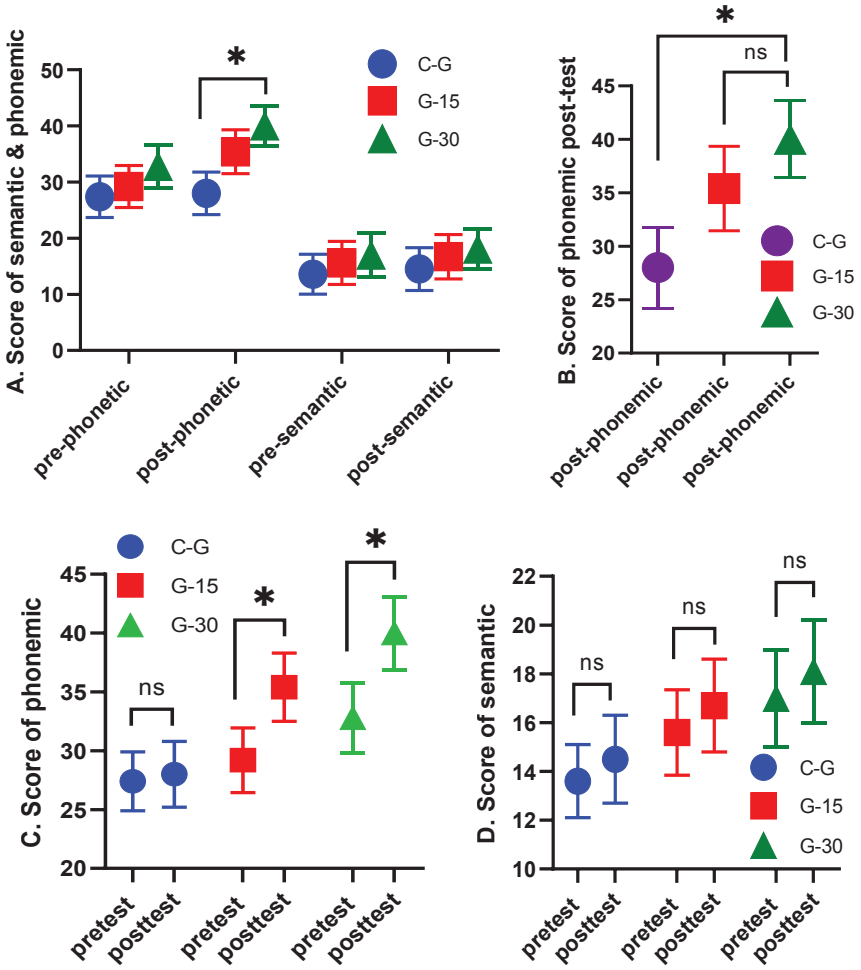

Figure 2. mean differences among groups. A. ANOVA statistical analysis among groups; B. Post hoc statistical analysis among post phonemic; C. Paired-t test of phonemic score between pre and post-test; D. Paired-t test of semantic score between pre and post-test. * p<0.05. ns: not significant

Windows. The threshold of statistical significance was set at 0.05.

RESULTS

The baseline characteristics of participants are shown in table 1.

After the reading activity intervention was carried out for two weeks on 30 study subjects, the results are as shown in table 2.

To determine whether the mean score of phonemic and semantic pitch can be the difference between groups is necessary to test One Way ANOVA. The analysis showed that there was a significant difference in the post-test phonemic scores between the groups ($p<0.05$). Meanwhile, the mean pre-test phonemic scores and the pre-test and post-test semantic scores between the groups were not significantly different ($p> 0.05$) (Figure 2). This illustrates that the research subjects in the pre-test position are comparable, whereas after the intervention with reading activities there is a change in results. Given that only the post-test phonemic scores were significantly different, to determine which group's mean phonemic scores were significantly different, a post hoc test was performed. The results of the Bonferroni's post-hoc test showed that the phonemic score of G- 30 was significantly higher than of CG ($p <0.05$). On the other hand, the mean phonemic score of G-30 was higher than that of the G-15, but the difference was not significant ($p> 0.05$)

To evaluate whether there was an increase in phonetic and semantic scores after the reading activity intervention, a pair t test was applied. The analysis showed that the post-test phonetic scores at G- 15 and G-30 increased significantly compared to that of the pre-test ($p <0.05$). Meanwhile, there was no significant difference between pre and post semantic score ($p> 0.05$) (Figure 2).

DISCUSSION

Reading activities for two weeks for 15 and 30 minutes led to an improvement in the phonemic verbal fluency scores. This finding supports that of previous

study on the effect of a person's reading habits for 15 years on speaking fluency and episodic memory (Sörman, Ljungberg and Rönnlund, 2018). The improvement in speaking fluency after the intervention proves that reading time will stimulate maturation and strengthen interneuron connections as a form of neuroplasticity leading to improved function of speech fluency (Houston et al., 2014; Sörman, Ljungberg and Rönnlund, 2018).

There was no significant improvement in the semantic fluency score after the intervention. This finding is similar to that of previous study on neuroplasticity in the form of telephone interventions that improve speaking fluency. In this study, the improvement of phonemic fluency in the intervention group was due to the visualization of semantic fluency and semantic fluency which were more sensitive to aging (Sutter, Zöllig and Martin, 2013). Visualization of semantic fluency is intended when the subject is tested by mentioning the name of the animals lading to subject's visualization of the memory of the known animal name. This visualization activates the retrospinal cortex and a large part of the cerebral cortex of the right hemisphere. Meanwhile, the neuroplasticity of reading activities is intended to improve the left hemisphere (Sutter, Zöllig and Martin, 2013; Gordon, Young and Garcia, 2017). Semantic fluency is more sensitive to aging, where semantic fluency has decreased in older adults compared to young adults. In the semantic fluency test at in older adults, there is additional activation of the frontal gyrus in the right hemisphere which inhibits the work of the left hemisphere as a dominant area for word production (Sutter, Zöllig and Martin, 2013; Zhuang et al., 2016).

Improvements in phonemic scores were also found to be consistent with observational studies showing that reading habits for 15 years improved speaking fluency and episodic memory. In this study, the results showed that the improvement in phonemic fluency was more significant than semantic fluency. This was associated with the reading intervention. In reading activities, the subject was asked to read words that are commonly or rarely used. With the number of words displayed, the activity adds new vocabulary to the subject. Large vocabulary size has more influence on phonemic fluency (Houston et al., 2014; Shao et al., 2014; Sörman, Ljungberg and Rönnlund, 2018). Another reason related to reading interventions is the difficulty level of reading. The book a medium of intervention given the same book. In the research subject, no observations were made regarding what books are usually read and how difficult the readings are usually read in order to receive the information. This difference makes one type of book can or has not provided stimulation as neuroplasticity (Thapliyal, Halder and Mahato, 2016; Sörman, Ljungberg and Rönnlund, 2018).

Speaking on the phonemic aspect activates the posterior-dorsal left inferior frontal gyrus, the pre supplementary motor area, and the left caduatus. Thus, the activation of the dominant phonemic fluency in left cerebral hemisphere (Hall and Guyton, 2016; Gordon, Young and Garcia, 2017). Phonemic fluency can be improved by reading activity because it activates the left cerebral hemisphere. When reading, the cerebrum will experience a decrease in the volume of the gray matter and an increase in the substantia alba. This process occurs in the left inferior parietal lobe and the left inferior frontal lobe. This thickening reflects an increase in synaptic density and myelination leading to a neuroplasticity to improve phonemic fluency (Houston et al., 2014; Hall and Guyton, 2016).

CONCLUSION

This study showed that the reading intervention for two weeks affected the fluency of speaking fluency among the older adults in Ponorogo Regency and Kediri by improved phonemic verbal fluency.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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