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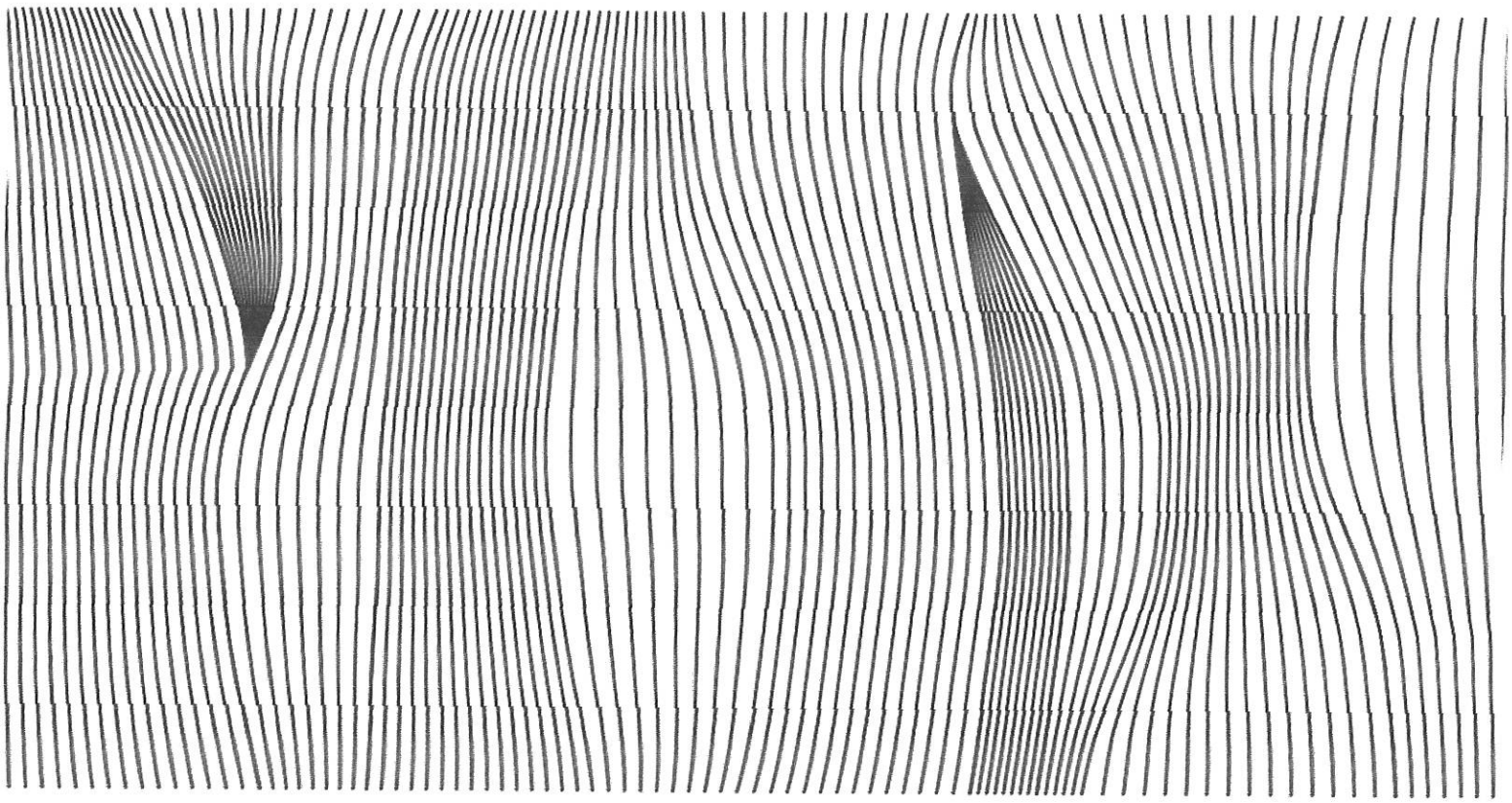

REVIEWER

EDITORIAL NOTE

Surabaya Physical Medicine and Rehabilitation Journal (SPMRJ) is a journal formed by Department of Physical Medicine and Rehabilitation, Faculty of Medicine, Universitas Airlangga. Physical medicine and rehabilitation is a branch of medicine that is responsible for the function of patients with various disease conditions. In this edition, we can learn about rehabilitation interventions in various cases involving different organ systems from cases of diabetes, dysvascular problems, tuberculous meningitis, and stroke. We can also learn about how the clinical manifestations of asthma affect physical activity and how gender and age differences affect walking biomechanics.

Regards,

EDITOR

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Original Research

Effect of Acute Persadia Gymnastic on The Ability to Concentrate in Diabetic Patients

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ABSTRACT

Background: Diabetes Mellitus (DM) can affect the peripheral and central nervous system. It can affect cognitive function, one of which can be seen from the decrease in the concentration ability. The concentration ability can be assessed by measuring the reaction time. Reaction time is the time interval between the onset of a stimulus and the initiations of a response. One of the important treatments for DM is physical exercises. Persadia gymnastic is one example of physical exercise that is specially designed for people with DM.

Aim: The purpose of this study was to identify the effect of acute Persadia gymnastic on the concentration ability of people with DM.

Material and Methods: This was an experimental study in type 2 DM patients. Fourteen subjects who met the inclusion criteria were randomly grouped into control (without performing Persadia gymnastic) and intervention group (performing Persadia gymnastic). The subjects' reaction times were measured before and after the intervention. The mean results of the reaction time of all subjects were then compared between the control and the intervention groups using the Independent-T test and Mann-Whitney tests.

Results: The analyzed data were only 7 subjects per group with a total of 14 subjects. The mean value of reaction time in the intervention group was decreased, both audio (-0.04 ± 0.85) and visual (-0.09 ± 0.56). However, there was no significant difference of the reaction time between control and intervention groups ($p > 0.05$).

Conclusion: Many factors can affect reaction time and some still cannot be controlled in this study due to a lot of limitations. Further research is still needed to figure out the effect of persadia gymnastics on the ability to concentrate in people with Diabetes Mellitus.

Keywords: *cognitive function, Diabetes Mellitus, Persadia, physical exercise, reaction time*

Introduction

Diabetes Mellitus (DM) is a metabolic disease characterized by an increase in blood glucose levels above normal or it is commonly referred to as hyperglycemia.[1] The Indonesian Basic Health Result 2018 showed the prevalence of DM based on blood tests in people aged ≥ 15 years old according to the 2015 Indonesian Society for Endocrinology Consensus criteria was 10.9% and according to the 2011 Indonesian Society for Endocrinology Consensus criteria was 8.5%. This number showed an increase in prevalence from 2013 which was only 6.9%.[2]

High blood sugar levels in people with type 2 DM often caused neurological negative effects that affect the peripheral and central nerves.[3] People with DM are more likely to experience impaired cognitive function compared to those without DM.[4,5] Cognitive function is a process that includes executive function, attention or reasoning, speed of processing, memory, and language.[4,5,6]

The most common way to evaluate the speed of processing is to assess reaction times (RTs).[7] Reaction time or response latency is defined as the time interval between the delivery of a stimulus and the initiation of a response.[7,8] Reaction time is an index of processing speed in the central nervous system with the stimulation of sensory input modalities such as visual, auditory, pain, touch or temperature.[3]

In the management of DM, there are important pillars in controlling the disease which are education, medical nutritional therapy, physical exercise, and pharmacological therapy.[9] Physical exercise can increase specific improvements in neuropathy symptoms, including an increase of nerve fibers branches.[10] Other research showed that there was an increase in speed of reaction time after aerobic exercise, which was 4% 7% faster reaction than the initial reaction.[11]

The criteria of physical exercise recommended for people with DM are aerobic low impact and rhythmic.[12,13] In Indonesia, there is a physical exercise that was specially designed for people with DM, namely Indonesian Diabetes Association (IDA) exercises or commonly known as Persadia (*Persatuan Diabetes Indonesia*) gymnastic.[12,13,14] However, until now no one has discussed the effect of acute Persadia gymnastic on the concentration ability of people with DM. Based on this background, a study was conducted to identify the effect of acute Persadia gymnastic on the concentration ability of people with DM.

Material and Methods

This research was an experimental study with a pre-post evaluation design. The population in this study were people with type 2 DM. The sample size of this study was determined by using the Lemeshow formula, and based on research conducted by Ando et al,[15] we obtain the value of n = 6. To anticipate the possibility of the subject dropping out, the researchers set a correction factor of 30%, so that the result became 8 samples per study group. The sampling technique used in this study was purposive sampling. Samples were determined according to the inclusion and exclusion criteria determined by the researchers.

Inclusion criteria of this study were people with type 2 DM who were willing to participate in research by filling out the informed consent, age between 40-65 years old, having diabetes for at least 5 years, Random Blood Glucose (RBG) level 100 - 250 mg/dl, and Body Mass Index (BMI) 18.5 - 29.9 kg/m^2. Exclusion criteria of this study were people with impaired physical mobility, significant cardiovascular disorders (e.g. coronary heart disease, heart failure, and stroke), vision and hearing problems (related to the reaction time examination), end-stage renal disease (nephropathy), and uncontrolled hypertension (blood pressure ≥ 140/90 mmHg). Drop out's criteria of this study were subjects who were not able to complete the research protocol and subjects who were suffered from illness or injury during the research.

The instruments used in this study were whole-body reaction measuring equipment, active speakers, scale and height measuring device, blood glucose kit, tensimeter, stethoscope, and pulse-oximetry. This research was conducted at the Department of Physiology Laboratory, Faculty of Medicine, Universitas Airlangga on 22 – 23 February 2020. This research has been declared to be ethically appropriate by Health Research Ethics Committee, Faculty of Medicine, Universitas Airlangga (No. 27/EC/KEPK/FKUA/2020). Signed informed consent was obtained from all participants.

This research was divided into 2 days. Each day was attended by 8 research subjects. Subjects were instructed to have breakfast 1 hour before doing the exercise. The screening was done before doing the exercise by measuring RBG levels, blood pressure (BP), heart rate (HR), oxygen saturation (SpO_2), height, and weight of all subjects. After screening, those 8 subjects were divided randomly into 2 groups (intervention and control group) using a lottery paper which also had the serial number written for the queue. According to the 2015 Indonesian Society for Endocrinology Consensus,[9] if the subject has RBG level of more than 250 mg/dl, the subject is advised to postpone the physical exercise. Therefore, the researchers decided to immediately assign the subject to the control group if such a case was found.

The concentration ability test was assessed by measuring the speed of subject's auditory and visual reaction time using the whole-body reaction measuring equipment alternately, according to the serial number on the lottery paper (alternating between the intervention and control groups). Each subject was tested with audio stimulation for 3 times and visual stimulation for 3 times. Every time a stimulus was given, the subject must respond as quickly as possible by pressing the button that matches the stimulus.

After measuring the reaction time of all subjects, the intervention group immediately continued to perform Persadia gymnastic together within 35 minutes that consists of warm-up (5 minutes), core (15 minutes), transition (10 minutes), and cool-down (5 minutes). It was a single bout or one session of aerobic low-impact exercise, with moderate intensity (50-70% HR max). After exercising, the heart rate, oxygen saturation, blood pressure, and RBG level were measured again immediately. The control group who did not perform Persadia gymnastic at that time was asked to wait for 35 minutes according to the exercise time. Then, their heart rate, oxygen saturation, blood pressure, and RBG level were also immediately measured. After that, the concentration ability was assessed again alternately according to the lottery serial number. The mean value of reaction times changes before and after intervention were then compared between the control and the intervention groups. In this study, the normality test was done by using the Shapiro-Wilk test. The data that were not normally distributed ($p < 0.05$) were then continued by using Mann-Whitney test, while the data that were normally distributed were then continued by using the T-test.

Results

Of the total 16 subjects with type 2 DM who participated in this study, 2 subjects were dropped out. Therefore, the data analyzed were became 14 subjects with 7 subjects per group.

Table 1. General Characteristics of Research Subjects

	Control (n=7)			Intervention (n=7)		
	Min	Max	Mean ± SD	Min	Max	Mean ± SD
Age (years old)	49	67	58.57 ± 6.45	49	60	56.43 ± 3.70
BMI (kg/m^2)	20.77	29.77	26.78 ± 3.18	21.17	27.04	24.83 ± 1.91
HR-pre (bpm)	65	98	88.57 ± 11.33	73	91	85.00 ± 6.66
BPsys-pre (mmHg)	120	170	144.29 ± 17.18	110	150	128.57 ± 13.45
BPdyas-pre (mmHg)	80	100	90.00 ± 8.17	80	90	85.71 ± 5.34
O_2 Sat.-pre (%)	98	100	98.71 ± 0.76	95	99	97.57± 1.81
RBG-pre (mg/dl)	128	462	210.00 ± 116.30	142	250	192.86 ± 41.06
RTvisual-pre (sec)	0.414	2.922	1.32 ± 0.93	0.33	1.49	0.81 ± 0.45
RTaudio-pre (sec)	0.767	2.327	1.59 ± 0.64	0.41	1.95	1.33 ± 0.51

Table 2. Posttest Results

	Control (n=7)			Intervention (n=7)		
	Min	Max	Mean ± SD	Min	Max	Mean ± SD
HR-post (bpm)	67	105	87.71 ± 13.20	82	114	96.29 ± 10.44
BPsys-post (mmHg)	120	170	145.71 ± 15.12	120	160	132.86 ± 14.96
BPdyas-post (mmHg)	80	110	88.57 ± 10.69	80	90	81.43 ± 3.78
O_2 Sat-post (%)	98	99	98.43 ± 0.53	97	99	97.86 ± 0.69
RBG-post (mg/dl)	82	313	214.00 ± 85.77	83	252	163.14 ± 56.51
RTvisual-post (sec)	0.38	2.80	1.31 ± 1.05	0.33	1.67	0.72 ± 0.44
RTaudio-post (sec)	0.87	4.46	2.27 ± 1.19	0.59	2.03	1.29 ± 0.51

Table 3. P Value of Delta between The Control and Intervention Groups

Variable	Group	Mean ± SD	P value
Delta RT visual (sec)	Control	-0.01 ± 1.04	0.87*
	Intervention	-0.09 ± 0.56	0.87*
Delta RT audio (sec)	Control	0.68 ± 0.92	0.14**
	Intervention	-0.04 ± 0.85	0.16*

* = Independent T-test; ** = Mann-Whitney test

The mean value of the intervention group that performed Persadia gymnastic showed a decrease in the reaction time, both audio (-0.04 ± 0.85) and visual (-0.09 ± 0.56). This can be seen from the minus value in the delta which indicates that the value after the intervention is smaller than the value before the intervention. This decrease in value indicates that the average speed of the subject's reaction time was faster after being given the intervention.

From the results of the Independent T-test and the Mann-Whitney test, all the data in the intervention group and the control group obtained a $p > 0.05$ which means that there was no significant difference between the control group and the intervention group.

Discussion

Physical exercise could have acute or chronic effects. The effect will be chronic if it is done repetitively, and will be acute if it is only done once. A previous study used the ergocycle to analyze the effect of a single bout or acute moderate-intensity physical exercise on the level of concentration in teenagers. In this study significant differences of concentration level between pre- and post-exercise were found.[16] Other types of physical exercise such as sprints were also improved response accuracy in another study.[17] Several studies also showed that after moderate-intensity physical exercise of 50-70% HR max, the executive function, especially response accuracy was increased.[18,19,20]

In this study, it was difficult to find subjects that really met the expected criteria and willingly took part in the research. The total number of subjects obtained were 16 people, and 2 were dropped out. Therefore, the total subjects analyzed were only 14 people and all of them were females. This research was divided into 2 days due to the limited instrument availability.

Diabetics are advised to do regular physical exercise for 3-5 days a week with moderate-intensity (50-70% maximum HR) for 30-45 minutes.[9] In this research, the physical exercise taken was in moderate intensity and only a single bout or one session exercise. The intervention group performed the gymnastic for once and the changes observed here are the acute responses from the result of exercise. Before and after the intervention, the visual and audio reaction time of each subject was measured in turn according to the queue serial number because there was only one instrument used to measure the reaction time. The instrument can measure the visual and audio reaction time.

Reaction time is an important physiological parameter to provide information on how fast a person reacts to a stimulus and is often used to evaluate the timing of the thought process and coordination between the sensory and motor systems.[21] The process stages that determine the reaction time include the arrival of stimuli, the process of sensation, perception, which is then manifested in the form of a response to stimuli.[22] If there was interference in one of these factors, then the person's reaction time will not be on optimum value.

The executive function of the brain, especially the function to concentrate, could be improved by acute physical exercise. Inhibition control which is one of the executive functions had an important role in concentration. When other stimuli were suppressed, it could lead the subjects to only focus on one stimuli.[23] Many factors can affect the speed of reaction time, including age, gender, arousal, right/left-handed dominance, diet, exercise, practice and errors, intelligence, fatigue, distraction, personality type (psychological), alcohol, stimulants (caffeine), brain injury, illness, type of stimulus (audio or visual), the sequence of stimulus given, and intensity of the stimulus.[24]

In this study, only 3 of the total 14 subjects (21.43%) have routinely exercised for at least 3 times a week as recommended by American Diabetes Association and Indonesian Society for Endocrinology.[1,9] For diet and nutritional intake, consumption of alcohol and stimulant drugs or caffeine were not observed in this study. The level of understanding and the ability to remember the type of stimulus varied between

subjects due to the differences of intelligence and education background. In this research, mental and psychological conditions of each subject were also not observed by the researchers.

Exercise can increase the Nerve Growth Factor (NGF)[25] and BDNF (brain-derived neurotrophic factor) release.[26] Exercise can also increase Dopamine (DA), noradrenaline (NE), and serotonin (5-HT) levels.[27] In addition, exercise can increase insulin sensitivity,[28] heart rate, cardiac output, and cerebral blood flow to blood oxygenation to the brain.[29] Exercise can also increase the amplitude of P300 and decrease the latency of P300, a component of ERP (event-related potential) that has a role in the decision-making function or the allocation of the body's response which is related to the attention function.[30]

Indonesian Diabetes Association (2000), as quoted by Rahim et al,[14] stated that diabetes exercise is a physical exercise designed based on age and physical status and is part of the treatment of DM. Previously, diabetes exercise had 6 series of movements in the form of rhythmic stretching and relaxation in muscles, joints, vascular, and nerves.[12,13,31] According to *Senam Diabetes Persadia* 1 (2017), as quoted by Asrizal,[32] Persadia gymnastic series 1 is a continuation of the previous series diabetes exercises with a structured, rhythmic, aerobic low impact, moderate-intensity exercise dominated by eccentric movements consisting of warm-up, core, transition and cool-down sections. This exercise is in accordance with American Diabetes Association and Indonesian Society for Endocrinology recommendations as moderate-intensity aerobic exercise, but the main movement is eccentric movement, that previous research has shown to increase the activity of GLUT 4 and GLUT 1 in the function of blood glucose uptake so that it is expected to further improve blood glucose, glucose tolerance, and insulin resistance.[1,9,12,13,33]

In this study, the reaction time was measured after the intervention and cannot be done simultaneously and immediately on all subjects because there was only 1 instrument available to assess all the subjects. Because of these limitations, the acute effects caused after exercise cannot be detected immediately. For subjects who have waited for a long time, the levels of the neurotrophic factor, dopamine, epinephrine, and HR that initially increased, can fall back to normal again so that the increase cannot be detected. The differences that occurred when the measurement test was carried out between one subject to another may be the reason for the insignificant difference in reaction time.

Conclusion

There was no significant difference in both audio and visual reaction time ($p > 0.05$), between the control and intervention groups. Although the difference was not significant, there was a change in reaction time before and after the intervention.

Some factors that can affect the reaction time were still cannot be controlled in this study due to a lot of limitations. Although no significant difference was found, Persadia Gymnastic still can be recommended for people with Diabetes Mellitus in daily living activities to maximize their quality of life and can be used as a treatment and prevention because it can increase physical fitness, improve glucose tolerance and reduce HbA1c.[12,13,14] Further research with a proper instrument and appropriate subject is still needed to figure out the effect of persadia gymnastics on the ability to concentrate in people with Diabetes Mellitus.

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