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The Effect of Healthy Heart Exercises and Virtual Muscle Strength Exercises during the COVID-19 Pandemic on the Risk Factors of Cardiovascular Disease and Physical Fitness in Healthcare Personnel at Puskesmas †

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Abstract: The incidence of cardiovascular disease has increased significantly worldwide, and it is a major cause of death. Cardiovascular disease in health workers can increase absenteeism and become a problem for healthcare systems. Quarantine during the COVID-19 pandemic can reduce physical activity and daily physical exercise, thereby interfering with physical fitness and heart health. There is a need for the development of physical exercises to prevent the risk of cardiovascular disease, for example, Senam Jantung Sehat (healthy heart exercises) and muscle strength training. This was an interventional study comparing two groups (test and control). Five subjects (health workers) completed the study in the intervention group, participating in Senam Jantung Sehat and muscle strength training administered virtually through Zoom. Thirty-four subjects (health workers) in the control group were provided with physical activity education. The intervention was delivered for 3 months, for a total of 36 sessions. Data analysis was carried out to assess the mean and delta differences using unpaired T tests and Mann–Whitney tests. Data analysis was carried out for the five intervention subjects according to the criteria of >60% attendance. The main risk factor for cardiovascular disease is the body mass index (BMI). The average physical exercise adherence rate in the test group was 33.1%. It was found that the decrease in BMI and percent body fat was higher in the test group than the control group ($p = 0.025$ and $p = 0.031$). The decrease in back muscle strength was higher in the control group than the test group ($p = 0.007$). The decrease in systolic blood pressure, total cholesterol, and low-density lipoprotein and the increase in cardiorespiratory fitness tended to be higher in the test group, although the differences were not statistically significant.

Keywords: cardiovascular disease; fitness; health workers; healthy heart exercise; muscle strength training

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1. Introduction

Cardiovascular disease occurs due to disorders of the heart and blood vessels [1]. The incidence of cardiovascular disease is increasing significantly worldwide, and it is currently considered a major cause of death. Cardiovascular disease can increase absenteeism and create problems for the healthcare system. If its prevalence increases in health workers, it will be very disruptive and hamper health-promotion efforts.

A study conducted at a hospital in Ghana found that the rate of hypertension in health workers was 16.07%, obesity 12.50%, dyslipidemia 26.79%, and diabetes 4.5%. As many as 50% of the subjects had at least one risk factor for cardiovascular disease [2]. A study conducted by Bin Zhao et al. in 2017 found that the prevalence of hypertension in nurses in China was 28.96%, overweight 23.96%, and obesity as high as 6.74% [3]. The study conducted by Ramadhaniah et al. found that 235 subjects (43.50%) were obese, and the body mass index (BMI) for the obese group was 29.05 kg/m^2 [4].

It is necessary to control cardiovascular disease in health workers. An intervention with this aim was the Healthy Living Community Movement (GERMAS) program, which included active movement. One of the pillars of being active is physical exercise. Participation in good, correct, measurable, and regular physical exercise is expected to reduce the risk of cardiovascular disease.

In Indonesia, there are various types of physical exercise aimed at preventing cardiovascular disease, including healthy heart exercises (SJS). According to several studies, this type of exercise is most commonly used by elderly groups and has not been widely used by the adult age group, so further research needs to be carried out.

Beginning in December 2019, the novel corona virus (COVID-19) outbreak in China has infected more than 9.97 million people, resulting in more than 480,000 deaths worldwide and leading to global quarantines. The decisions to implement quarantines caused many fitness facilities to close, and professional athlete training and competitions were also suspended, potentially reducing daily physical activity and exercise time.

A decrease in daily physical activity and exercise can impair overall physical fitness and heart health in particular [5–8]. It is necessary to adjust the provision of physical activity and daily physical exercise to health workers to prevent risk factors for cardiovascular disease in the context of global quarantines.

2. Method

This research comprised an interventional study involving two groups conducted in June–October 2021. The inclusion criteria were: age 25–45 years; health workers who worked during normal working hours (08.00–16.00 WIB), were willing to participate in the study, and had signed an informed consent form. Exclusion criteria were: displaying symptoms indicative of cardiovascular, metabolic, or kidney diseases according to the ACSM criteria and algorithm; exhibiting knee and ankle pain or impaired movement [9]; being on a diet; and taking drugs that could affect exercise. The drop-out criterion was: subject could not complete 60% of the total practice sessions.

The independent variables were healthy heart exercises and muscle strength training, while the dependent variables were cardiovascular disease risk factors (BMI, waist circumference, systolic blood pressure, fasting blood sugar, and lipid profile); percent body fat; cardiorespiratory fitness; muscle strength (hand gripping and back and lower limb strength); and flexibility.

The intervention comprised healthy heart exercises and muscle strength training carried out online via the Zoom application [10]. The healthy heart exercises session was held 3x/week on Wednesday, Friday, and Sunday afternoons. Muscle strength training was carried out 2x/week on Wednesday and Sunday afternoons after the healthy heart exercises. The exercises were guided online by instructors from the Indonesian Heart Foundation using appropriate clothing. There was a minimum of two instructors, so that the movements could be displayed from the front and side. The research team consistently conducted talking tests during the interventions (at least every 5 min). The research team also recorded the heart rate, the BORG fatigue scale before and after exercise, and the condition of the subject for each intervention in the test group using a logbook for monitoring and evaluation. Data analysis was conducted using SPSS version 20.0.

3. Result

A total of 68 subjects were included in both groups (the intervention and control groups contained 34 subjects each). All subjects in the control group were able to complete the study, while in the intervention group, one subject moved workplaces, two subjects did not complete any exercise at all, and 26 subjects did not take part in at least 60% of the exercises, so the number of samples that could be processed amounted to five subjects.

As shown in Table 1, regarding the demographic characteristics, the subjects in the test and control groups were dominated by women (100% and 87.9%, respectively), and most of the health workers in the test group were midwives (20%), doctors (10%), and dentists (10%). The control group mainly contained midwives (30.3%), doctors (27.2%), and nurses (15.2%).

Table 1. Demographic characteristics of subjects.

Characteristics	Category	Total		Test		Control	
		n	%	n	%	n	%
Sex	Male Female	4 34	10.5 89.5	0 5	0 100	4 29	12.1 87.9
Health worker type	Medical doctor	10	26.3	1	20	9	27.2
	Dentist	3	7.9	1	20	2	6.1
	Nurse	6	15.8	1	20	5	15.2
	Dentist assistant	2	5.3	0	0	2	6.1
	Midwife	12	31.6	2	20	10	30.3
	Nutritionist	1	2.6	0	0	1	3.0
	Environmental health worker	3	7.9	0	0	3	9.1
	Psychologist	1	2.6	0	0	1	3.0

In terms of age and risk factors for cardiovascular disease, there was no significant difference between the two groups. Regarding the component of health-related fitness, there was no significant difference between the two groups, as in Table 2.

Table 2. Age, cardiovascular risk factors, and physical fitness.

Characteristics	Test (n = 5)	Control (n = 33)	*p*
Age	35.4 ± 6.8	32 (26–45)	0.834 [b]
IMT	27.4 ± 6.6	24.2 (17.8–39.8)	0.449 [b]
Systolic blood pressure	110.8 ± 5.8	116.8 ± 13.2	0.329 [a]
Waist circumference	83 ± 10.7	83.6 ± 7.6	0.876 [a]
Fasting blood glucose Level	99.2 ± 2.7	100 ± 8.1	0.813 [a]
Lipid profile			
- Total cholesterol	154 ± 65.5	142 (100–291)	0.738 [b]
- HDL	40.2 ± 5.1	38 (20–95)	0.353 [b]
- LDL	77.2 ± 23.3	73 (30–249)	0.900 [b]
- TG	112.2 ± 20.4	77 (50–378)	0.084 [b]
Body fat percentage	39.1 ± 6.9	36.4 ± 5.8	0.368 [a]
Hand grip strength	51.1 ± 7.1	50 (19–81)	0.802 [b]
Back muscle strength	50.4 ± 13.9	43 (15–96)	0.376 [b]
Lower extremities strength	53 ± 17.8	50 (20–110)	0.529 [b]
Flexibility	6.2 ± 2.8	4.5 ± 7.6	0.628 [a]
Cardiorespiratory fitness	12.1 ± 12.3	15.5 ± 11.2	0.540 [a]

Note: a: *t*-Test, b: Mann–Whitney test.

In Table 3, the average physical exercise adherence rate of all subjects in the test group (n = 34) was 33.1% over 3 months. The average physical exercise adherence rate of all subjects in the analyzed test group (n = 5) was 85.5% over 3 months. Several reasons provided by the subjects regarding the difficulties they experienced participating in the intervention were recorded in the logbook, i.e., busy with puskesmas-related activities; occupied by personal activities (family events, etc.); on the way home from the hospital; etc.

All sessions (36 sessions) went according to a predetermined schedule, and no problems were encountered, such as: internet interference; interference with supporting devices (laptops, light, and sound); and problems with the gymnastics instructor.

Table 3. Average compliance with physical exercises among all subjects at the beginning of the study (n = 34) and at the analytic stage (n = 5).

Month	N = 34 %	N = 5 %
1	33.5	86.6
2	31.3	83.3
3	34.3	86.6
Total	33.1	85.5

Effect of Intervention on Cardiovascular Disease Risk and Health-Related Fitness

Table 4 is showing the delta differences in the effect of the intervention on the risk of cardiovascular disease. There was a significant difference in the BMI variable (p = 0.025) between the test and control groups, while there was no significant difference in the other variables. Significant differences were also found in percent body fat (p = 0.031) and back muscle strength (p = 0.007), and no significant differences were found in the other variables.

Table 4. Influence of intervention on cardiovascular risks and health-related fitness.

Variables	Test (n = 5)	Control (n = 33)	p
Cardiovascular Risk			
Body mass index	−0.3 ± 0.4	−0.2 ± 0.5	0.025 [a]
Systolic blood pressure	−6 ± 11.5	−6 (−20–19)	0.475 [b]
Waist circumference	0.2 ± 1.9	−0.07 ± 0.0	0.532 [a]
Fasting blood glucose Level	3 ± 7.3	2.93 ± 10.6	0.990 [a]
Lipid profile			
- Total cholesterol	−17.8 ± 43	1.12 ± 34.48	0.275 [a]
- HDL	−5.6 ± 8.4	2 (−56–37)	0.172 [b]
- LDL	−12.8 ± 30.2	2.9 ± 36.2	0.363 [a]
- TG	−1.8 ± 38.9	7 (−139–209)	0.585 [b]
Health-Related Fitness			
Body fat percentage	−1.6 ± 2.9	1.30 (−10.10–10.60)	0.031 [b]
Hand grip strength	−1.4 ± 6.4	1.4 ± 7.8	0.433 [a]
Back muscle strength	−16 ± 9.2	0.0 ± 11.8	0.007 [a]
Lower extremities strength	−9 ± 9.2	−0.8 ± 14.4	0.229 [a]
Flexibility	−1.8 ± 3.6	1.2 ± 3.1	0.135 [a]
Cardiorespiratory fitness	6.6 ± 11.7	4.10 ± 7.66	0.531 [a]

Note: a: *t*-Test, b: Mann–Whitney test.

4. Discussion

In this study, most of the participants were female (89.5%). The most common types of health worker were midwives 31.6% and doctors 26.3%. The risk factors for cardiovascular disease found in the health workers included BMI of 27.4 ± 6.6 kg/m^2 for the test group and 24.2 ± (17.8–39.8) kg/m^2 for the control. In a study conducted in Malaysia in 2019, the highest proportion of participants were also female (75.3%), with 12.3% being general practitioners and 45.4% nurses; 33.1% of the health workers had a BMI of 25–29.9 kg/m^2 [11]. In this study, the increased risk represented by the BMI was almost the same as that in the study conducted in Malaysia, so it can be concluded that the main risk of cardiovascular disease in this study was represented by the BMI.

This research was conducted at the District X Health Center, East Jakarta in May–October 2021. The increase in active cases of COVID−19 in DKI Jakarta in May was 1.87–2.51%, and it became one of the areas with the highest numbers of active cases in Indonesia [12]. Based on data from June 27, DKI Jakarta again experienced the highest increase in cases (77.3%) with a total of 520.061 cases, and the highest number of cases was in East Jakarta (126,331 cases). DKI Jakarta continues to present the highest number of cases nationally, according to reports from July 18 (746,306 cases), August 29 (849,847 cases), and

September 26 (857,232 cases). When the COVID-19 vaccination program was launched by the government, involving all health workers in Indonesia, the vaccination rate at the District X Health Center from May to August had not yet reached the target, namely 2.11%, 64.11%, 51%, and 28.9%, so the health workers of the District X Health Center were especially busy with the vaccination program.

In this study, the average rate of physical exercise adherence for the entire test group was 33.1%, though a figure above 60% was expected to obtain good results. From the personal details recorded in the logbook, it was found that there were several reasons why health workers in the test group had difficulty participating in the training, including the fact that the number of COVID-19 cases in DKI Jakarta was still very high and the vaccination rates at the District X Health Center during the data collection period had not met the targets, so the health workers found it difficult to attend the training sessions that had been scheduled. In addition, the health workers were too tired and had other personal activities to attend to at the same time as the scheduled physical exercise. With these low exercise-adherence rates, it was difficult to obtain optimal results. According to Lemstra et al. programs that are supervised and monitored have increased compliance rates. In this study, monthly supervision and monitoring were carried out, but the results obtained were not maximized, possibly due to the influence of the COVID-19 pandemic [13].

4.1. Effect of Intervention on Cardiovascular Disease Risk

In this study, there was a decrease in BMI of -0.3 ± 0.4 kg/m^2 in the test group and -0.2 ± 0.5 kg/m^2 in the control group, which was statistically significant (p = 0.025). A meta-analysis by Lee et al. [14] found a significant reduction in BMI in the group that performed a combination of aerobic and strength training at a moderate intensity for a duration of 8–40 weeks (d = 0.50 (95%CI, −0.78–−0,21; p < 0.001)). The values obtained in this study were not in accordance with the figures from the meta-analysis conducted by Lee H.S et al., but they exhibited a good decreasing trend. In a study conducted on obese and overweight individuals for a duration of 8–36 weeks, combining physical exercise and dietary regulation, the authors found a reduction in BMI of 1.5 kg/m^2 (95% CI 1.5–2.5) [15]. Optimum BMI reduction, according to obesity management guidelines, is a viable approach comprising both physical exercise and diet regulation, but further, more comprehensive research is needed for better results [16].

In this study, we found a decrease in TDS of -6 ± 11.5 mmHg in the test group and −6 (−20–19) mmHg in the control group. Borjesson et al. also found a decrease in systolic blood pressure of 10.8 mmHg in individuals who performed physical exercise three times per week at a moderate intensity for a duration of 40–60 min [17]. Clinically, a reduction of 2 mmHg could decrease the risk of stroke (6%) and coronary heart disease (4%). Interventions carried out in both groups involving physical activity tended to reduce the risk of cardiovascular disease and could maintain systolic blood pressure within normal limits [18].

In this study, there was no decrease in LP (0.2 ± 1.9) in the test group, though a decrease in LP of -0.07 ± 0.0 was observed in the control group. Dash et al. [19] found a 3.05 cm reduction in waist circumference in subjects who performed 50 min of moderate-intensity aerobic exercise over 24 weeks. Individuals who perform high-intensity physical exercise five times a week exhibit greater reductions in waist circumference than individuals who perform moderate-intensity physical exercise [20]. This study used an exercise intervention lasting 12 weeks at a moderate intensity; in general, the intervention was not able to reduce waist circumference. A longer exercise duration and higher intensity were required to achieve a significant reduction in waist circumference, especially in the test group.

In this study, we found no decrease in fasting blood sugar levels (KDGP). Colberg et al. found a decrease in KGDP of 39 ± 48.6 mg/dL in individuals who performed moderate-intensity physical exercise for a duration of 30 min, and a significant decrease occurred in the first hour (49.3 ± 53.1 mg/dL) compared to after three hours (34.3 ± 53.5 mg/dL) [21]. The absence of a change in the KGDP rate in this study could have been caused by several factors [22]: first, excessive carbohydrate intake, even though the participants had been told to fast 8 h before the examination; second, stress, which can produce the hormone cortisol and increase blood sugar levels. The pre-intervention KGDP values for both groups were still within normal limits, so it can be concluded that there was no decrease in KGDP due to good pre-intervention values.

Total cholesterol (KT) decreased in the test group by −17.8 ± 43 mg/dL and increased in the control group by 1.12 ± 34.48 mg/dL. High-density lipoprotein (HDL) decreased in the test group by −5.6 ± 8.4 mg/dL and increased in control group 2 by −56–37 mg/dL, while low-density lipoprotein (LDL) decreased by −12.8 ± 30.2 mg/dL in the test group and increased by 2.96 ± 36.27 mg/dL in the control group. In addition, there was a decrease in TG of −1.8 ± 38.9 mg/dl in the test group and an increase in LDL in control group 7 (−139–209 mg/dL). In general, we did not find a statistically significant decrease in the lipid profile. Considering the results of other studies [23–25], it may take a longer exercise duration (24 weeks) and higher intensity to obtain better results.

From a clinical point of view, a decrease in KT of as much as 4.8 mg/dl can reduce the risk of ischemic heart disease (HR: 1.04), and a decrease of 28.3 mg/dl can reduce the risk of cerebrovascular disease (HR: 1.01) [26]. A reduction of 18 mg/dl in LDL and TG can reduce the risk of stroke (15%), heart disease (22%), and cardiovascular disease in men (32%) and women (76%) [27,28].

4.2. Effect of Intervention on Health-Related Fitness

We observed a decrease in body fat percentage of −1.6 ± 2.9% in the test group and an increase of 1.30 (−10.10–10.60)% in the control group, which was statistically significant (p = 0.031). Studies conducted by Wu et al. on overweight and obese individuals found a decrease in body fat percentage of −1.03% after moderate-intensity physical exercise five times a week for 12 weeks [29]. A study carried out on 57 subjects performing combination exercises (aerobic and weight training) at a moderate intensity, three times a week for 12 weeks, found a decrease of −2.04% in percent body fat [30].

Muscle strength in the form of hand grip decreased by −1.4 ± 6.4 kg in the test group compared to the control group, which experienced an increase of 1.44 ± 7.82 kg. There was a decrease in back muscle strength −16 ± 9.2 kg in the test group compared to the control group 0.0 ± 11.8 kg, which was statistically significant (p = 0.007). We observed a decrease in lower leg muscle strength −9 ± 9.2 kg in the test group compared to the control group, which experienced an increase of 0.8 ± 14.4 kg. Participating in combination exercises for 10 weeks, comprising aerobic exercises performed using a stationary bicycle at a moderate intensity and muscle strength training performed via three sets of 12 repetitions at 70–80% maximum with 1 min rest between sets, resulted in an increase in hand grip strength of 0.8 ± 0.7 kg [31]. The authors found an increase in strength of 29.5 ± 1.7 kg in individuals who performed 3–5 sets of specific muscle strength training exercises (bridges, planks, squats, pushups, and back extensions), with an RPE of 11–16, 2x/week for 12 weeks [32].

In terms of the type of strength training provided, this study was in accordance with the FITTVP rules for muscle strength training, but the difference in results could have been caused by several factors, including an inappropriate increase in training load, thus failing to achieve the optimal hypertrophy of the muscles (progressive overload). It is necessary to significantly increase the load and adjust it to the capacity of each individual. In addition, the muscle protein synthesis was poor, due to the lack of protein intake. A protein intake of 0.8 g/kg/day is required to maximize muscle protein synthesis [33].

In this study, we observed a decrease in flexibility of −1.8 ± 3.6 cm in the test group and an increase in flexibility of 1.2 ± 3.1 cm in the control group. A study by Gallon et al. found a 30% increase in hamstring flexibility after the administration of a stretching program three times a week for 8 weeks [34]. A study conducted for 4 months involving an upper and lower body stretching program, wherein stretching was carried out for four repetitions and held for 15–60 s, with a pause of 15 s between repetitions, found that the intervention could increase flexibility by 11 ± 2 cm as measured by the Sit and Reach method [35]. The poor results of this study could have been caused by the training program, which was not specifically designed to improve the body's flexibility. We hope that in future research, stretching exercises will be included in physical exercise programs.

We found an increase in cardiorespiratory fitness of 6.6 ± 11.7 mL/kg/min in the test group and 4.10 ± 7.66 mL/kg/min in the control group. A meta-analysis found an increase in cardiorespiratory fitness of 3.90 mL/kg/min in subjects who performed a combination of physical exercises (aerobic and muscle strength training) at a moderate intensity for 12 weeks [36]. The intervention proved to have a positive effect on increasing cardiorespiratory fitness.

This study was the first in Indonesia to examine the effect of virtual physical exercise on the risk of cardiovascular disease in health workers during the COVID-19 pandemic. This study also described the general risk of cardiovascular disease in health workers, which has rarely been addressed in Indonesia. The physical exercise provided was in accordance with the FITTVP rules and used virtual methods that could be improved in the future. The supervision of the exercises was carried out directly by the research team, so that unwanted events (injuries) did not occur. On the other hand, this research was a field study, so it was difficult to regulate the habits of the research subjects in terms of the number of exercise sessions attended, the maintenance of diets, and the physical activity patterns. At the beginning of the study, the research team advised the participants not to change their diets and daily physical activity.

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