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Comparison of Push-Up Exercise Methods on Push-Up Test Ability in Medical Students at Warmadewa University

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Abstract

TBM members require muscle endurance to implement their tasks, particularly while performing cardiopulmonary resuscitation (CPR), which requires chest, shoulder, and upper arm muscle endurance. Push up is a type of muscle endurance training for the chest, shoulders, and upper arms that do not require any particular equipment or skills. Therefore, the Push Up Test is required for TBM members, and the results suggest that 62% of 2020 TBM members' abilities are below average. The study was conducted on members of the Warmadewa University FKIK Medical Assistance Team to compare the Push Up workout regiments with the same concentric and eccentric phase tempo (P1) and a slower eccentric phase tempo (P2). The two methods are compared to determine which method is more effective in increasing Push Up Test ability. A total of 46 TBM members were involved in this study. The data was analyzed using the paired t-test to compare muscle endurance before and after the exercise was performed. The push up test used during the screening revealed a decrease in muscle endurance fitness, with of students having normal abilities the previous year, but only 16.4 percent in 2021. The exercise intervention 38% had a significant effect on the push up score, which increased by 4.7 points for male after the intervention, while the push up scores for women increased by 5.6 points (95% CI, 3.32 - 8.01). The results revealed that P2 intervention had a greater influence on changes in push-up scores than P1 intervention (mean change was 5.7 for males and 7.3 for females; mean change was 3.8 for males and 4.0 for females; respectfully). This difference, however, was not statistically significant. It can be concluded that push up training improved push up test ability significantly, whereas the comparison of training methods between P1 and P2 was not significantly different.

Keywords: muscle endurance, push up method, push up test

BACKGROUND

During the Covid-19 pandemic, health became extremely important, whereas previously, degenerative diseases such as hypertension, diabetes mellitus, hypercholesterolemia, and obesity were relatively easy to control with drugs, even without changing lifestyle factors such as a balanced nutritional diet, regular exercise, adequate rest, and good stress management. Unfortunately, most of the above disease conditions (comorbid factors) are risk factors for an increase in the Case Fatality Rate (CFR) of Covid-19, and even though these comorbid factors can be controlled with drugs, they still experience symptoms. Covid-19 infection has resulted in fatal conditions.(1) A study in China found that obese Covid-19 patients had a 142% increased risk of severe pneumonia; research in New York found that obesity with a BMI above 40 is the second risk factor after age for Covid-19 sufferers who require hospitalization.(2)

Regular physical activity is one of the requirements for attaining an optimal level of health. Several studies have shown that physical inactivity is a major risk factor for a variety of health issues today, particularly obesity.(3) Physical inactivity, according to research, increases the risk of various diseases, particularly coronary heart disease, stroke, type 2 diabetes, obesity, and cancer, which reduce life expectancy.(3,4) Physical inactivity also exacerbates Covid-19 infection; for example, research on physical activity in increasing immunity during the Covid-19 period was published on 20 April 2020 by Professor Zhen Yan of the University of Virginia under the title "Regular exercise could protect against COVID."(5) Professor Yan reported that

regular physical activity reduces the risk of acute respiratory distress syndrome (ARDS), the leading cause of death from Covid-19, by 3-17 percent of all infected patients. [5]

Medical students are future doctors who will enter the community. Therefore they must not only be capable of solving various health problems, but it will also be difficult for them to maintain public health if they are not healthy themselves. Doctor Sam Hazledine of New Zealand is renewing the Hippocratic oath, which is over 2500 years old, by stating that doctors care about their health as much as their patients. "I will take care of my health, well-being, and personal abilities so that I can provide maximum health services," one revision of the Hippocratic oath states.[6] The Covid-19 pandemic, which has lasted more than a year, has had an impact not only on the health and economic sectors, but also on education. There has been a significant decline in physical activity among students and college students worldwide. Lopez-Valenciano et al found that five studies showed a decrease in light physical activity (walking) ranging from 32.5 percent to 365.5 percent, while seven studies showed a decrease in heavy physical activity ranging from 2.9 percent to 52.8 percent. [7]

The medical assistance team (TBM) is a student-led medical faculty activity that works in the emergency and humanitarian fields. Students in the TBM must have basic medical assistance skills as well as excellent physical fitness because emergencies can occur anywhere and in terrain conditions ranging from mild to extreme severe. TBM members require physical fitness, including muscle endurance (musculoskeletal endurance), to performing their duties, particularly when performing cardiopulmonary resuscitation (CPR), which requires chest, shoulder, and upper arm muscle endurance.[8] Push up are one of the exercises for muscle endurance for the chest, shoulders, and upper arms that do not require any special equipment or skills. As a result, the Push Up Test is one of the mandatory tests for TBM members, and the results of the Push Up Test on TBM members of the 2020 generation show that 62 percent of their abilities are below average, and a negative correlation was also found between weight gain and mass index in this study. a body with poor cardiopulmonary fitness and muscle endurance. [9,10]

Skeletal muscle contraction is divided into two phases: when the muscle shortens (the concentric phase), and when the muscle lengthens (the eccentric phase). The concentric phase of resistance exercise occurs when the muscle shortens and the load is lifted against gravity, whereas the eccentric phase occurs when the muscle lengthens and the load returns to the direction of gravity.[11] Eccentric contraction is linked to muscle metabolism and the release of Ca2+ ions from the sarcoplasmic reticulum. Once eccentric contraction occurs, the cross bridges of the myosin and actin proteins move away from each other, resulting in sarcomere elongation. The sarcoplasmic reticulum also stretches and releases calcium ions as a result of this elongation. This elongation also causes tension in the sarcomere, which increases actin and myosin protein metabolism, resulting in stronger and larger muscles after the recovery period.[11,12]

Various initiatives have been launched to improve human physical fitness. According to the Specific Adaptation of Impose Demand (SAID) principle, the body will adapt specifically to the exercise received, for example, aerobic exercise will significantly improve cardiorespiratory fitness, with a moderate effect on body composition but little effect on muscle strength. Body fitness will adapt based on the training process received; thus, exercise stimulation must be carried out in accordance with the Gradual Progressive Overload (GPO) principle, in which exercise is modified based on intensity, frequency, duration of exercise, and recovery process.[11]

Resistance exercise, also known as weight training or muscle toning exercise, is a type of exercise that aims to improve

muscle strength, endurance, and body composition. The technique used varies greatly depending on the purpose of the exercise, with changes in the intensity of the load, frequency and duration of the exercise, number of sets, rest between sets, number of repetitions, repetition tempo, and recovery time. [11,13]

METHOD

This study utilized an experimental design with a pre-test-post-test group design and two treatment groups, each of which received a different push-up exercise method. The study lasted 7 months, from May to December 2021, at FKIK Unwar. The research subjects were 46 people from the 2020 TBM generation who had moderate to low results from a muscle endurance fitness test. The ethical suitability has been submitted to and approved by the Warmadewa University FKIK. The collected data will be descriptively analyzed, and the results will be displayed in the form of frequencies, tables, percentages, and graphs.

Research Procedure

1. The research was conducted between June and October 2021.
2. Research subjects are gathered in order to obtain technical guidance and information on how to carry out data collection.
3. Before taking measurements, the research subject completes the basic respondent data
4. Measured muscle endurance by performing push-ups. The number of repetitions the subject can complete in one minute is then recorded by the accompanying student.
5. Standard push-up procedure:
    a. Male respondents use standard push-up positions, while female respondents use bent knees (weight on knees not toes). The body should be straight and taut.
    b. Male sit with his toes under his feet and his hands shoulder-width apart, under his shoulders.
    c. Female resting on her knees (on the mat), hands slightly in front of shoulders in the above position, so that when the position is under, the hands are directly under the shoulders.
    d. The subjects lower their bodies until their chest makes a fist with the floor. Then, return the body to its original position.
6. The test is repeated for 1 minute or until the individual can no longer maintain perfect form. (Note the common error: subjects fail to keep their back straight.)
7. Subjects were randomly divided into two groups based on gender, with treatment group 1 (P1) performing push ups at a tempo of 1 second concentric phase and 1 second eccentric phase, and treatment group 2 (P2) performing push ups at a tempo of 1 second concentric phase and 2 seconds eccentric phase.
8. The study lasted four weeks, with the push-up exercise performed three times per week. Push ups are performed for 15 seconds (first set), then rest for 2 minutes before repeating (second set). Push ups are performed for 30 seconds (first set), rest for 2 minutes, and then performed for another 30 seconds in the second week (second set). Push ups are performed for 45 seconds (first set), rest for 2 minutes, and then performed for 45 seconds in the third week (second set). Push ups are performed for 60 seconds (first set), rest for 2 minutes, and then performed for 60 seconds in the fourth week (second set).
9. The exercises are performed at home and are directly supervised by the accompanying students, with data on push ups collected every weekend. Students who do the exercise less

than eight times in a month will be expelled.

10. The push-up test was repeated in the ninth week. The results of the pre and post push up tests were then compared in the P1 group and the P2 group
11. After all the subject data and measurement results have been collected, the data then were analyzed.

RESULTS

There were 55 people in the physical test of the new members of TBM Baswara Prada, including 29 female students and 26 male students. The test was conducted in May 2021, and because the pandemic was at high peak, it was conducted online.

According to the results of the push -up test, 83.6% or 46 students were at a moderate to lower level, so they were considered unfit to carry out activities as a medical assistance team. The 46 students were then divided into treatment groups, with treatment group 1 (P1) performing push ups with a tempo of 1 second concentric phase and 1 second eccentric phase, and treatment group 2 (P2) performing push ups with a tempo of 1 second concentric phase and 2 seconds eccentric phase. The exercises are performed in their respective locations three times per week for four weeks, and they are supervised online.

Table 1 Pretest results

Catagory	Male	Female	Total
Very good	4% (1)	0	1,8% (1)
Good	4% (1)	24,1% (7)	14,5% (8)
Moderate	19% (5)	58,6% (17)	40% (22)
Low	61,5% (16)	17,2% (5)	38,1% (21)
Very low	11,5% (3)	0	5,5% (3)
Total	26	29	100% (55)

There were 46 students with moderate to low fitness levels who participated in the training program, 35 of whom were able to complete the program, and 11 who were declared dropouts due to their inability to participate in the training program according to the specified schedule.

Table 2. Paired t test result of push up scores after and before the intervention

Gender	Mean (SD)		Mean difference (95% CI)	t statistic	P value
	Pre	Post			
Male (n=17)	23.2 (4.58)	27.9 (2.28)	4.7 (2.76, 6.64)	5.14	<0.001
Female (n=18)	20.3 (5.56)	25.9 (1.34)	5.6 (3.32, 8.01)	5.09	<0.001

According to table 2, the intervention has a significant effect on the push-up score for both male and female participants ($p<0.001$). After the intervention, men's push up scores increased by 4.7 points (95 percent CI, 2.76 - 6.64), while women's push up scores increased by 5.6 points (95% CI, 3.32 - 8.01).

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Table 3. The difference of independent t test results in push-up scores between P1 and P2

Gender	Post-pre Mean (SD)		Difference in Mean (95% CI)	t statistic	P value
	P1	P2			
Male (n=17)	3.8 (3.30)	5.7 (4.20)	1.9 (-5.85, 1.91)	1.08	0.29
Female (n=18)	4.0 (3.84)	7.3 (5.12)	3.3 (-7.85, 1.19)	1.56	0.13

According to table 3, P2 has a greater effect on changes in push-up scores (mean is 5.7 in male and 7.3 in female) than P1 (mean is 3.8 in male and 4.0 in female). This difference, however, was not statistically significant. Thus, there was no statistical difference in push up scores between odd and even interventions for both male and female students (p> 0/05).

DISCUSSION

The Covid-19 pandemic, which lasted more than two years, had a widespread impact. Including on campus learning activities, one of which is online lecture activities, students are less likely to engage in physical activity. During screening tests, it was discovered that there was a significant decrease in muscle endurance fitness, whereas in 2020 (before the pandemic), 38% of students' muscle endurance abilities were normal. However, a screening test in 2021 revealed that only 16.4% of students had normal muscle endurance.

Students with muscle endurance levels below normal receive training in accordance with the principles of Specific Adaptation of Impose Demand (SAID) in the form of appropriate exercises to improve certain physical fitness, such as push up exercises. While the training method adheres to the Gradual Progressive Overload (GPO) principle, in which students are given an exercise program that gradually increases each week. As a result, both male and female participants' push-up scores increased significantly (p0.001). [(11)]

Various studies examined the manipulation method on muscle contraction in the concentric and eccentric phases. Roig et al discovered that eccentric exercise was superior to concentric exercise in stimulating strength and muscle mass[(14)], while Schoenfeld et al discovered that eccentric muscle training produced a greater muscle hypertrophy effect than concentric exercise.[(15)] Previous research focused on muscle strength, explosive power (power), and muscle composition (hypertrophy), with no regard for the relationship with muscle endurance. The goal of this study is to measure muscle endurance rather than strength or muscle composition by intervening at the tempo of the concentric and eccentric phases rather than the weight of the load or repetition.

The study's findings revealed that tempo manipulation in the concentric and eccentric phases improved muscle endurance fitness, with a significant increase in push-up test results. Slowing the tempo during the eccentric phase (P2) resulted in a mean change of 5.7 in male and 7.3 in female, while keeping the tempo constant between the concentric and eccentric phases (P1) resulted in a mean change of 3.8 in male and 4.0 in female, although there is no statistically significant difference between the P1 and P2 treatments.

CONCLUSION

The Covid-19 pandemic forced lecture activities to be conducted online, resulting in a significant decrease in physical activity and, consequently, a decrease in student physical fitness, particularly muscle endurance fitness of TBM members. The training program that implements SAID principles and is conducted on a GPO basis, leads to significant improvements in physical fitness. Regular push-up training that is gradually increased each week leads to a significant increase in push-up test ability in both male and female. Slowing the tempo in the eccentric phase resulted in

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a greater average increase in push-up test ability, whilst this was not statistically significant when compared to the same tempo in the concentric and eccentric phases.

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