

Increased physical fitness levels of mountaineering athletes: a study of the effects of high-intensity interval training and oregon circuit training

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Abstract

The purpose of this study was to compare the impact of giving High Intensity Interval Training (HIIT) and Oregon Circuit Training on cardiorespiratory endurance abilities. This study used an experimental method with a two group pretest-posttest design. The study population consisted of 20 people, the sample was determined by the total sampling method so that a sample of 20 people was obtained, the sample was then divided into two groups, the HIIT group (10 people) and the Oregon Circuit Training (10 people). The instrument used was the Multistage Fitness Test (MFT). Data analysis using Paired T-Test and Independent T-Test. The results showed that there was an effect of High Intensity Interval Training (HIIT) on the increase in VO2 Max (p value = 0.001), there was an effect of Oregon Circuit Training on the increase in VO2 Max (p value = 0.002) and, there was no significant effect comparison between High Intensity Interval Training (HIIT) and Oregon Circuit Training (p value = 0.759), the conclusion is that the increase in cardiorespiratory endurance ability is influenced by the provision of both types of exercise but there is no significant comparison of the effects between the two, as well as the High Intensity Interval Training (HIIT) training method.) showed more effective results (39, 69%). From these results, the HIIT training method or Oregon Circuit Training can be an alternative exercise to increase VO2 Max and can be used for further research with different variables.

Keywords: HIIT, Circuit Training, Physical Fitness Level, Endurance

INTRODUCTION

Mountain climbing has become one of the most pop recreations in many countries. This is evidenced by the number of tourists impermanent

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the batch and those involving in high-altitude recreations including mounting trekking, and various snowfall recreations which birth accrued in new daysprings (Davies et al., 2019). Annually, more 100 meg travellers go to highland spaces roughly the world. Also specifically, almost 40 meg mountaineers and skiers climbing as high-pitched as 5, 000 m in the Ranges (Loos et al., 2018). In Africa annually, roughly 40, 000 travellers climbing the 5, 800m-high crown of Kilimanjaro, and more than 4, 000 climbers birth well-tried to climb Mt. Aconcagua which is 6, 962 m high-pitched (Bunn, 2016). Thither was a huge growth in the number of climbers in Nepal between 1994 and 2000, by 450%, on with a sevenfold growth in climbers search to ascend any of the Himalayan's near ambitious and challenging tops supra 8000 m. From 1995 to 2006, more 30, 000 climbers attempted to reach the highest crown in the man Mountain Everest (Mourey et al., 2019).

But on the other hand, climbing mountains is a sport full of adventure and requires great skill, intelligence, strength, and fighting power. Mountain climbing is also included in the category of strenuous exercise based on its intensity and energy requirements (Festiawan et al., 2020b; Kusuma et al., 2020). So it is not uncommon for many problems that often occur when climbing, one of which is physical problems, expedition participants must have good physicality from every component of the physical condition. Preparation for physical exercise that is done well will result in satisfactory achievement (Festiawan et al., 2020a; Tirtayasa et al., 2020).

Physical exercise also trains participants to adapt to mountains. In principle, physical training preparation is important in expeditions because good training determines the quality and ability to achieve optimal performance demands (Setiawan et al., 2020). The importance of the training preparation model as a basis for maximum achievement, especially in the mountains according to the training standards of the physical condition itself, wherein an open state disturbance is very likely to

occur, let alone the purpose of outdoor adventure climbing that realm is for attainment then physical exercise is very important (Kusuma et al., 2020).

Strong-arm consideration is the original essential and as a basis for following breeding in achieving attainment Strong-arm consideration is the cornerstone and barometer of the achievement of performance and bodily aptitudes or fittingness components needful by an athlete (Mola & Bayisa, 2020; Yuliandra & Nugroho, 2020). Cardiovascular endurance is often referred to as VO₂ Max VO₂ Max is the maximum capacity of the lung, heart, and muscle systems to absorb oxygen (Bacon et al., 2013; Smirmaul et al., 2013). Several factors can affect the VO₂ Max level including age, gender, fitness, and exercise (Criya Permana & Sugiyanto, 2019; Ramos et al., 2015; Wen et al., 2019), in line with the opinion that to get good VO₂ Max quality, many training methods can be applied such as circuit training methods and Oregon circuit training. Circuit training is one of the most efficient exercises in improving physical abilities which includes strength, aerobic and anaerobic endurance, flexibility, and coordination in one training session (Festiawan et al., 2021; Khattak et al., 2020; Sperlich et al., 2018)

To build the VO₂ Max Training project ought to be done cautiously, efficiently, consistently, and constantly, following precise preparing standards and strategies to accomplish the normal objectives. Hence, an elective exercise that can be utilized and applied to expand VO₂ Max is Circuit Training. Circuit Training is an exercise system that can improve overall body fitness, namely endurance, strength, agility, speed, and other components of physical condition (Paoli et al., 2013). Circuit training is an exercise model that combines strength, strength, speed, and anaerobic endurance training or aerobic endurance. Circuit training can be said to affect the quality of an athlete's stamina in the short term. This is because circuit training includes almost all components of physical conditions that are performed at a high tempo simultaneously in a relatively short period (Yudiana, 2015).

The selection of training loads at Circuit Training must be adjusted to the general goals to be achieved. Circuit Training which is held in a designated area has several posts, for example, 8 posts. Each post, the implementation must be carried out in a certain form of practice. Activities in each post are a development for all components of physical fitness (Ilissaputra & Suharjana, 2016)

Some of the results of previous research related to High-Intensity Interval Training (HIIT) and Oregon circuit Training include: (1) HIIT can significantly increase the increase in physical fitness levels for both young and adult ages. Furthermore, when comparing the two training modes, the advantage in VO₂ Max is greater with HIIT. Also, the determination of intensity, volume and type affects the results obtained (Milanović et al., 2015). (2) Oregon circuit exercise has a significant effect in increasing maximum oxygen consumption and resting pulse rate (Sharma et al., 2015).

One of the cardiorespiratory qualities can be seen from the increase in physical fitness level, which is the maximum amount of oxygen the body can consume in milliliters per kilogram (bodyweight), per minute (ml / kg-1 / minute) (Marcinko et al., 2015). The greater the a person has, the better the physical fitness will be, where the quality of the biometric components will also be better (Sylta et al., 2016). If the VO₂ Max value gets better, the body's ability to consume oxygen for metabolism will get better. VO₂ Max is the maximum aerobic capacity representing the maximum amount of oxygen consumed per unit of time by a person (Sawyer et al., 2016). Thus, the more oxygen the body consumes, the better, VO₂ Max is needed, including for sports activities such as mountain climbing.

This study aims to determine the effect of HIIT and Circuit Training on the improvement of the physical fitness levels of The Soedirman Expedition VII Athletes and from some of the studies above, all of them have only one independent variable, besides that no study has tested these two training models on mountaineering athletes, so this research can be an alternative source for mountain climbing athletes.

METHODS

Research Methods

This study used an experimental method with the design of "Two Group Pretest and Posttest Design" (Sugiyono, 2012), this method divides the sample into two groups, namely the HIIT group and the Oregon Circuit Training group. The method used to divide the group is ordinal pairing. An overview of the research design can be seen in Figure 1.

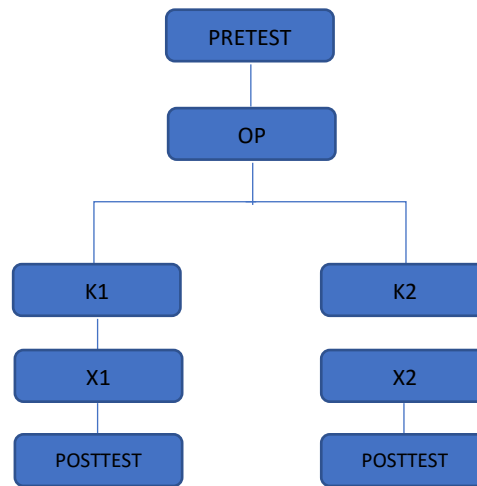


Figure 1. Two Group Pretest and Posttest Design

Information:

Pretest: An initial test

OP: Ordinal Pairing

K1: Group 1

K2: Group 2

X1: High-Intensity Interval Training (HIIT)

X2: Oregon Circuit Training

Posttest: the final test

Research Population and Sample

The population of this research is all athletes Soedirman Expedition VII totaling 20 people ($n = 20$, age = 18.2 ± 1.1 years, height = 169.1 ± 2.9 cm, weight = 59.9 ± 5.8 kg) with the sampling technique using total sampling. The ordinal pairing design was used to divide the sample into

two experimental groups, the pretest results were ranked from best to worst, then divided and entered into group 1 and group 2 then paired with the formula 1-2-1-2 (Sugiyono, 2016), so that it was divided into two a group of 10 people. Group 1 was given HIIT treatment, and group 2 was given Circuit Training treatment.

Research Procedure

This study aims to determine the effect of High-Intensity interval Training (HIIT) and Oregon circuit Training on the improvement of the physical fitness level of the athletes of the Soedirman VII Expedition

After that, this study also compared the difference in influence between the two. The study began with a pretest, after which treatment was given for 16 meetings using the High-Intensity Interval Training (HIIT) training method and Oregon Circuit Training which had a balanced portion between the two exercises, then in the final stage continued with a posttest.

The details of the meeting were the pretest at the 1st meeting, the provision of treatments at the 2nd to the 15th meeting, and posttest at the 16th meeting.

Research Instrument

The research instruments used in this study were Multistage Fitness Test (MFT), The Multistage Fitness Test is a test used to determine a person's physical fitness level (Jaakkola et al., 2016). In this study, the Multistage Fitness Test (MFT) instrument was used to measure the physical fitness levels of the two groups, namely the HIIT and Oregon Circuit Training groups.

Data Analysis

Data analysis techniques in this study include a prerequisite test consisting of a data normality test using Shapiro Wilk and a data homogeneity test using Levene's Test (Sugiyono, 2016), followed by hypothesis testing consisting of paired t-test and independent t-test.

RESULTS

Table 1 shows the descriptive results of the mountain climbing athletes that be a sample in this research (age, height, and weight).

Table 1. Descriptive physical characteristics of mountain climbing athletes

Variables	Study Group N=20	Group		P Value
		HIIT (n=10)	Oregon (n=10)	
Age (years)	18.2 ± 1.1	18.1 ± 1.3	18.3 ± 1.2	0.017
Height (cm)	169.1 ± 2.9	168.5 ± 3.1	169.3 ± 2.9	0.002
Weight (kg)	59.9 ± 5.8	59.1 ± 5.1	60.1. ± 4.9	0.012

Analysis of research results

The dependent variable of this research is VO₂ Max ability. Compilation of ability data using the Multistage Fitness Test (MFT). The data obtained from the test can be seen in the table 2.

Table 2. Research Data

Variables	Group		P Value
	Pre VO2 Max	Post VO2 Max	
HIIT	43.5 ± 1.946	60.3 ± 2.802	0.001
Oregon	42.2 ± 2.236	58.6 ± 2.871	0.002

From the table 2, for the variable of increasing physical fitness levels of Soedirman VII Expedition Athletes (Goes to Aconcagua: Argentina) which has a total sample size of 20 samples, the minimum value = 38, maximum value = 64, the mean of the HIIT group is pre-test = 43.5 and post-test = 60.3, while the mean of the oregon circuit group is pre-test = 42.2 and post-test = 58.6, then the standard deviation of the HIIT group is pre-test = 1.946 and post-test = 2.802, while the standard deviation of the oregon circuit group was pre-test = 2.236 and post-test = 2.871.

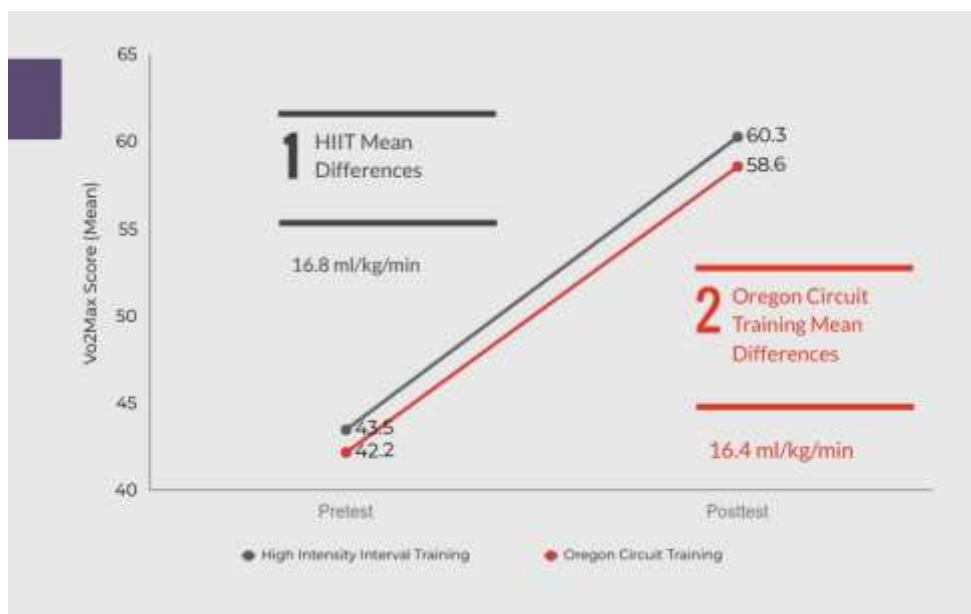


Figure 2. Mean Difference Pretest - Posttest

From table 2 it can also be seen that there is a difference in the average obtained between the pretest and posttest. For the High Intensity Interval Training (HIIT) method, there is a change in the average VO₂ Max value of 16.8 kg / ml / min, while for the Oregon circuit training there is a change in the average VO₂ Max value of 16.4 kg / ml / min. The graph of the average change can be seen in Figure 2.

Table 3. Results in Physical fitness level improvement

No.	Category	Value	Pretest		Posttest	
			Frequency	Percentage	Frequency	Percentage
1	Very Fit	> 60	0	0%	4	20%
2	Fit	52-60	0	0%	16	80%
3	Above average	47-51	6	30%	0	0%
4	Average	42-46	10	50%	0	0%
5	Below average	37-41	4	20%	0	0%
6	Not Fit	30-36	0	0%	0	0%
7	Very Unfit	<30	0	0%	0	0%
	Amount		20	100%	20	100%

From the research results listed in table 3 above, it can be seen that from the pre-test data there are 4 people (20%) samples who have a cardiorespiratory endurance level below the average (VO₂ Max = 37-41

ml/ kg/min), 10 samples (50%) had an average cardiorespiratory endurance level (VO_2 Max = 42-46 ml/kg/min), and 6 (30%) samples had above average cardiorespiratory resistance (VO_2 Max = 47-51 ml/kg/min). Meanwhile, from the data from the post-test results, it is known that there are 16 people (80%) in the sample who are declared fit (VO_2 Max = 52-60 ml/kg/min) and 4 people (20%) samples who are declared very fit (VO_2 Max => 60 ml/kg/min).



Figure 3. Data Results

From the data in table 3, it can also be seen that there is an increase and decrease in the number of each category from the pretest and posttest results. For the greatest increase was in the very fit category, with an increase of 16 children at posttest who initially did not exist at all at pretest. While the largest decrease was in the average category, which was 10 children, this is because their ability to endure in the average category changes to be very fit and fit. From this data it can be seen that there is a positive change from the pretest to posttest results. The graph of increasing and decreasing can be seen in Figure 4.

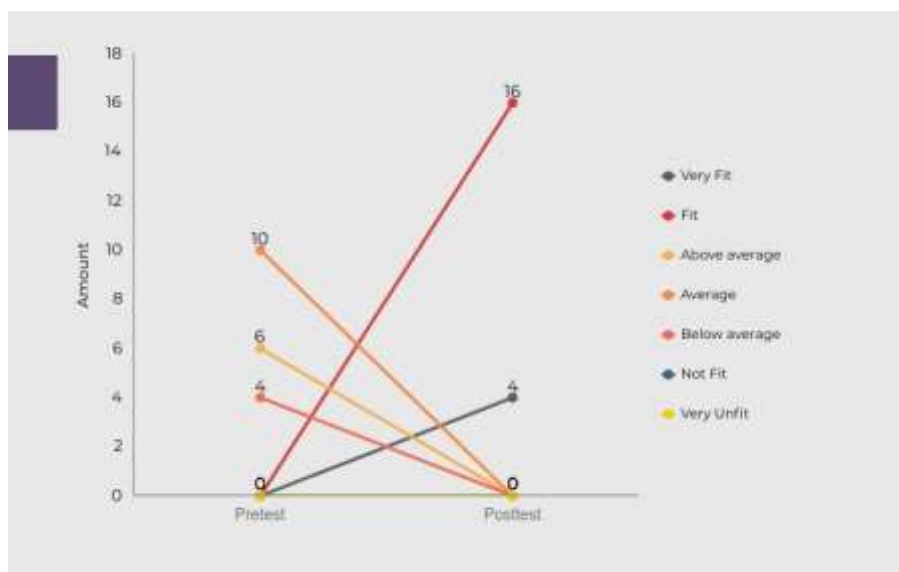


Figure 4. Graph of increasing and decreasing test results

Table 4. Difference Table Increase in physical fitness levels

Research variables	Mean Pretest	Mean Post-test	Difference	Percentage
High Intensity Interval Training (HIIT)	43.5	60.3	16.8	39.69%
Oregon Circuit Training	42.2	58.6	16.4	39.28%

The table 4 above shows the difference in the increase in physical fitness levels which can be seen from the difference between the average pretest and posttest in the two groups. The difference in the High-Intensity Interval Training (HIIT) group was obtained from the pretest average of 43.5 and the posttest average of 60.3 having a difference of 16.8 and the percentage being 39.69%. Whereas in the Oregon circuit Training group, the difference was obtained from an average pretest of 42.2 and posttest of 58.6 having a difference of 16.4 and a percentage of 39.28%. So it can be concluded that the group that was given High-Intensity Interval Training (HIIT) training had a greater increase in physical fitness levels compared to the Oregon Circuit Training group.

DISCUSSION

The results of the statistical analysis of the study for the increase in the physical fitness level of the athletes in the High-Intensity Interval Training (HIIT) group with a total sample of 10 people obtained the minimum value of pretest = 6 and posttest = 9, the maximum value of pretest = 13 and posttest = 16. (mean) pretest = 9.60 and posttest = 11.80. Then the standard deviation of the High-Intensity Interval Training (HIIT) group pretest = 2.066 and posttest = 2.348.

These data were then tested with Paired t-test and obtained t-test results with the value of Sig. The pretest and posttest (2-tailed) High-Intensity Interval Training (HIIT) groups were 0.001. So from these results, it can be seen that the Sig. smaller than 0.05 or 0.001 <0.05, this means that High-Intensity Interval Training (HIIT) training has a significant effect on increasing the physical fitness levels of Soedirman VII Expedition Athletes

This is in line with several previous studies including research from Batacan et al (2017) who said that High-Intensity Interval Training (HIIT) could increase VO_2 Max (SMD 0.83, 95% CI 0.56 to 1.10; $p < 0.00001$) with a large effect on the normal weight trial sample. Meanwhile, Astorino et al (2017) concluded that in a young sample, 20 periodic HIIT sessions led to a significant increase in VO_2 Max accompanied by an increase in SV and maximal CO. The data suggest that the increase in VO_2 Max as a result of HIIT is due to an increase in central O₂ delivery as is often reported.

Another study from [Wen et al \(2019\)](#) mentioned that HIIT is effective for increasing VO_2 Max in healthy adults, overweight/obese, and athletes. With several variations of HIIT, the short work interval HIIT (≤ 30 seconds of work/session), low-volume HIIT (≤ 5 minutes of work/session), and short-term HIIT (≤ 4 weeks) are effective and efficient ways to increase physical fitness level enhancement. For better results in increasing VO_2 Max, several HIIT training programs are recommended including long-interval (≥ 2 minutes / submaximal intensity), high-volume (≥ 15

minutes/session) and moderate to long-term (≥ 4 –12. Sunday).

Based on the description above, it can be concluded that High-Intensity Interval Training (HIIT) is defined as an exercise consisting of several cycles of short or medium duration and high intensity, and each cycle is interspersed with rest periods in the form of light-intensity exercise. Various types of exercises that can be done using HIIT include walking, running, cycling, climbing stairs, and swimming. HIIT consists of 3 stages, namely warm-up, maximum intensity exercise, and cooling down. Heating is done for 3 minutes, followed by 6 cycles. Each cycle consists of a maximum intensity exercise for 2 minutes with an intensity of 80 - 90% reserve heart rate and moderate-intensity exercise for one minute with an intensity of 50 - 60% reserve heart rate (Nugraha & Berawi, 2017). Therefore, By doing HIIT, the increase in a person's physical fitness level can be better and it is possible to carry out physical activities for a longer duration.

The results of the statistical analysis of the study for the increase in the physical fitness level of the athletes in the Oregon Circuit Training exercise method group had a total sample size of 10 people, the minimum value of pretest = 6 and posttest = 9, the maximum value of pretest = 13 and posttest = 16. = 9.60 and posttest = 11.80. Then the standard deviation of the High-Intensity Interval Training (HIIT) group pretest = 2.066 and posttest = 2.348.

These data were then tested with Paired t-test and obtained t-test results with the value of Sig. The pretest and posttest (2-tailed) High-Intensity Interval Training (HIIT) groups were 0.001. So from these results, it can be seen that the Sig. smaller than 0.05 or 0.001 < 0.05 , this means that High-Intensity Interval Training (HIIT) training has a significant effect on increasing the physical fitness levels of Soedirman VII Expedition Athletes

These results are in line with several previous studies including research from Reza Agus Hariyanto & I Ketut Yoda (2018) who concluded that the Oregon circuit training method affected increasing the maximum

oxygen volume with a significance value of 0.000 at the sig (α) 0.05 level. Apart from that research from [Almy & Sukadiyanto \(2014\)](#) states that the Oregon Circuit Training method is effective at increasing the VO₂ Max of athletes, but Oregon Circuit Training is more effective at increasing VO₂ Max for soccer players who have a high BMI. Research results from [Triansyah & Haetami \(2015\)](#) shows that respondents in the Oregon circuit group increased body resistance (VO₂ Max) by an average pretest of 36.84, and a post-test of 37.01 with a value of $p = 0.012$.

Based on the description above, it can be concluded that Oregon Circuit Training is a form of exercise that is very good for developing endurance in almost all sports, especially sports that require endurance, one of which is mountain climbing. The Oregon Circuit Training combines aerobic demands with continuous motion at interval speed, the Oregon Circuit Training method is a very enjoyable exercise aimed at increasing the athlete's strength and aerobic capacity. Oregon Circuit Training can affect cardiovascular endurance, because Oregon Circuit Training strengthens the respiratory muscles so that it provides benefits for maintaining heart-lung fitness, with increasing lung volume will accelerate the process of gas exchange (diffusion).

So for the independent t-test outcomes are Sig. (2-tailed) High-Intensity Interval Training (HIIT) and Oregon Circuit Training are capable 0.840. As result so both assemblies birth a Sig esteem > 0.05 , and it can be took that thither is no significant departure in the effect of High-Intensity Interval Training (HIIT) and Oregon Circuit Training on the improvement of the strong-arm stamens of Soedirman VII Expedition athletes.

This is as the two exercises (treatment) both mold the growth in the physical survival of the athletes of the Soedirman VII Jaunt The difference was in the difference between the signify (mean) of the two groups, videlicet the High-Intensity Interval Training (HIIT) grouping got the pre-test = 43.5 and the post-test = 60.3, patch the Oregon Circuit Training grouping intermediate videlicet pre-test = 42.2 and post-test = 58.6. Supported on these outcomes it can be compared the difference in

influence in another path videlicet sounding at table 9 supra almost the departure in the increase in the two groups, the difference in the High-Intensity Interval Training (HIIT) grouping was obtained from the pretest intermediate of 43.5 and the posttest intermediate of 60.3 has a difference of 16.8 and the percentage is 39.69%, The results of this cognate essay that it rotates outside that High-Intensity Interval training (HIIT) and Oregon Circuit Training buoy add to the improvement of the strong-arm stamens of Soedirman VII Expedition athletes.

CONCLUSION

The results of the study, concluded that there is an effect of giving High Intensity Interval Training and Oregon Circuit Training methods on the ability of cardiorespiratory endurance. In addition, when viewed from the difference in mean values, the High Intensity Interval Training training method has a better effect than Oregon Circuit Training. From these results, the HIIT training method or Oregon Circuit Training can be an alternative exercise to increase VO₂ Max. This study has limitations, which only counts one of several components of physical fitness, namely cardiorespiratory endurance which is seen from the VO₂ Max level, further research can examine other physical components with the same or different variables.

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