Sucrose Intake Effects as Potential Ergogenic Aid on the Physical Performance of Non-Athlete Students

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Abstract - Exercise is a form of physical activity to move the body to maintain physical health. Lack of exercise affects physical performance such as cardiovascular endurance, strength, power, and speed. Several studies have shown that liquid carbohydrate can be a source of energy to improve physical performance. Sucrose or commonly known as table sugar often encounter in our daily lives in the manufacture of food and drinks. Sucrose is a disaccharide consisting of glucose and fructose. This research aims to determine the effect of sucrose intake on the physical performance of non-athlete students as measured by the Cooper test method of running 2,4 km. The study using experimental method with a pretest-posttest group design. The population of this research were 30 non-athlete male students. Physical assessment such as pulse rate, body temperature, systolic and diastolic pressure, blood glucose levels were measured before, during and after the test. The VO_2Max was also measured with categories. The running times from the 2.4 km Cooper test on the first day (control) were compared with the running times on the third day after a 72-hour recovery period (experimental). The t-test analysis yielded a *p-value* of *0.0022* ($p < 0.05$). These findings indicated a significant effect of sucrose intake, used as potential ergogenic aid, on the physical performance of non-athlete students as measured by the 2.4 km Cooper test.

Keywords: *physical performance, sucrose, ergogenic aid, Cooper test method 2.4 km run*

I. INTRODUCTION

In recent years, exercise has become a common pursuit not only among athletes but also within the general population, as more people recognize its benefits. Regular physical activity is essential for maintaining fitness, which reflects the body's ability to perform daily tasks and exercise efficiently (Centers for Disease Control and Prevention, 2023). Physical performance varies greatly among individuals, influenced by factors such as fitness level, training, and specific physical abilities. Although responses to regular exercise differ from person to person, higher intensity and greater amounts of physical activity are generally associated with improved performance (Bondarev et al., 2021). To optimize and maximize physical performance, many individuals use ergogenic aids, substances or techniques designed to enhance exercise outcomes and capabilities (William et al., 2017). Previous findings have indicated that liquid carbohydrate (glucose) intake significantly influences the physical performance of non-athlete students. Building on this, this study seeks to investigate whether another type of simple liquid carbohydrate, sucrose, has a similar effect. Using the Cooper 2.4 km run test, this research aims to evaluate the effect of sucrose intake as an ergogenic aid on the physical performance of non-athlete male students through a pretest–posttest group research design.

II. LITERATURE REVIEW

The type of fuel the body relies on during physical activity is influenced by several factors. Carbohydrates, fats, and proteins can all serve as energy sources to support physical activity and muscle contractions (Nakrani et al., 2023). Consuming carbohydrates before, during, and after exercise plays a critical role in sustaining performance and recovery (U.S. Anti-Doping Agency, 2023). Sucrose—commonly known as table sugar—is a disaccharide composed of two simple sugars: glucose and fructose (Gropper & Smith, 2021). Once consumed, sucrose is broken down in the digestive system into glucose and fructose, which serve as rapid energy sources, replenish muscle glycogen stores, and help maintain blood glucose levels during physical activity. Because of these properties, sucrose is commonly included in sports drinks and energy gels as an ergogenic aid, particularly for endurance sports (Alsunni, 2015). Sucrose is administered at a 6% concentration, which matches the osmolarity of body fluids. Aligning the carbohydrate solution's osmolarity with that of body fluids (280–303 mOsm/L) is essential for optimal gastric emptying and efficient absorption (Jentjens et al., 2006). Ergogenic aids encompass performance-enhancing substances, nutritional supplements, and various techniques designed to improve an athlete's exercise capacity (Ketterly, 2022). Broadly, an ergogenic aid refers to any substance, device, or practice that enhances energy production, utilization, or recovery, thereby improving physical performance during training, competition, or other physical activities (National Institute of Health, 2024). One common form is liquid carbohydrate supplementation, a well-established strategy for boosting exercise performance particularly in endurance sports. Consuming carbohydrate-rich beverages during activity helps sustain blood glucose levels and restore muscle glycogen, which can delay fatigue and enhance endurance (Amawi et al., 2024). A physical fitness test is designed to assess an individual's physical capabilities and overall fitness level (Wilder et al., 2026). Such tests are applied in various settings, including sports, healthcare, physical therapy, and fitness training (Quinn, 2023). Among these, running tests specifically evaluate physical performance, offering valuable insights into speed, endurance, and running mechanics (Boullosa et al., 2020). One widely used example is the Cooper 2.4 km run test also known as the 1.5-mile run test—developed by Kenneth H. Cooper in 1968 for the U.S. Military (Cooper Aerobic, 2009). The goal is to complete the 2.4 km distance as quickly as possible, making it easy to administer since the distance is fixed and performance is measured by finishing time (American College of Sports Medicine, 2021). According to the School of Medicine, University of Virginia (2025), maximal oxygen uptake (VO_2max) is a key indicator of cardiorespiratory fitness and a dependable predictor of physical performance, particularly in endurance activities. It represents the maximum amount of oxygen the body can utilize during intense or maximal exercise and is widely recognized as one of the most accurate measures of cardiovascular fitness and aerobic endurance.

III. MATERIALS AND METHODS

The following are Materials and Methods of this study:

1. **Research Design**: This study employed a pretest-posttest group research design, which is a widely used experimental approach. In this design, subjects were measured on a specific variable before receiving a treatment or intervention, and then measured again afterward. The main objective is to evaluate the effect of the treatment by comparing the results from the pretest and posttest assessments.

2. **Participants/Data Sources**: The study involved 30 randomly selected male college students who were non-athletes, aged between 19 and 23 years. All subjects were in apparent good health, had not consumed energy drinks or similar substances before or during the test, and refrained from engaging in strenuous physical activity prior to testing. Each subject must wear exercise attire and proper running shoes (canvas shoes).

3. **Tools and Instruments**: The tools used in this study include: *informed consent* forms for subject participants, an infrared thermometer (*Thermogun*, *Vin Med, Japan*), a sphygmomanometer (*Riester*, 1 mmHg precision) and a stethoscope (*Littmann*), a bathroom weighing scale (*Camry*, 0.1 kg precision), Glucometer (*Accu-check Performa)*, a digital stopwatch (mobile phone), a whistle as the start signal, writing materials (pen and paper), and a 400-meter running track. The treatment materials were 6% sucrose solution made of 36 grams of pure sucrose powder or crystals which were dissolved in 600 milliliters of distilled water.

4. **Procedures**: *The Prelimina*ry**:** The completion of the informed consent form for the subjects to know and understand the purpose of the study. During the study, subjects were asked to refrain from developing new habits, including smoking, and engaging in physical activity or strenuous exercise. Prior to the treatment, body weight, height and body mass index (BMI) of the subject were measured. *Experiment One (no sucrose intake)*: On the first day of the test, subjects were not given any food (after fasting overnight approximately 8 hours). Subjects' pulse rate, body temperature, blood pressure, and blood glucose levels, were checked before running test. Afterwards, subjects headed to the running track to complete a 2.4 km run test (6 laps). *The Recovery Stage:* The subjects underwent a 72 hours recovery period, during which they were prohibited from performing any strenuous physical activities. This duration was aimed at providing sufficient time for the body to restore energy reserves and repair muscle tissue damage (Luki, 2024). *Experiment Two* (*with sucrose intake)*: On the third day, prior to starting the running test, subjects' pulse rate, body temperature, blood pressure, and blood glucose level were measured. The subjects drink a 6% sucrose solution prepared by dissolving 36 grams of pure sucrose powder in 600 ml of water. After completing the 30 minutes rest, the subjects had their blood glucose levels checked then headed to the running track to perform a 2.4 km run test (6 laps). The time was recorded after completing the 2.4 km run test. The subjects then underwent a pulse rate, body temperature, blood pressure, and blood glucose level check at the end of the test. Upon completion, maximal oxygen uptake (VO_2max) was calculated.

5. **Analysis Techniques**: The collected data were analyzed using a *t-test* in *Microsoft Excel*, with a significance level set at $p = 0.05$. This statistical test was applied to assess differences in running time, pulse rate, body temperature, systolic and diastolic pressure, and blood glucose levels in the subjects before and after sucrose intake and calculating and categorizing the VO_2max using the following formula:

$$VO_2max = 85,95 - [3,079 \times running\ time\ (minute)]$$

IV. RESULTS AND DISCUSSION

The physical characteristics of the subjects include age (years), body weight (kg), height (cm), body mass index (BMI in kg/m²) presents in table 1.

Table 1. Physical characteristic of the subjects

Variabel	Average	Std.Dev
Age (year)	20.90	0.76
Body Weight (kg)	71.40	15.80
Height (meter)	1.70	0.05
Body Mass Index (BMI)	24.50	4.98

Table 1 shows that the average of year of the subjects was *20.90 ± 0.76* years, body weight *71.40 ± 15.80* kilograms, body height *1.70 ± 0.05* meter and body mass index (BMI) *24.50 ± 4.98.* Subjects were categorized as youth with normal BMI category.

Table 2. Comparison of pretest between experiment one and experiment two

	Pretest (Control-No-Sucrose)		Pretest (experimental-Sucrose)		
	Mean	Std.Dev	Mean	Std.Dev	*P Value*
Pulse Rate (bpm)	76,30	12,93	77.81	9.40	0.2075
Body Temperature (Celsius)	35.30	0.33	35.20	0.16	0.1034
Systole	126.60	11.45	125.70	13.16	0.3393
Diastole	84.60	12.07	83.30	12.68	0.2444
Blood Glucose (mg/dL)					
Fast	91.60	10.32	88.10	10.73	0,0324
Postprandial	-	-	120.90	16.15	
	-	-	-	-	

Table 2 shows that the mean value of the pretest pulse rate before running without sucrose intake was *76.30 ± 12.93 bpm*, while the pretest pulse rate before running with sucrose intake was *77.81 ± 9.40 bpm*. The *p-value* obtained was *0.2075*, which is greater than *0.05* indicating there was no significant difference between the pre-treatment pulse rates of the control and experimental groups. The average body temperature for control was *35.3 ± 0.33°C* and for the experimental was *35.2 ± 0.16°C*. The t-test yielded a *p-value* of *0.1034*, which is greater than *0.05*, indicating there was no significant difference in body temperature between the control experimental group. The mean value of fasting systolic blood pressure of the control was *126.60 ± 11.45 mmHg* while in experimental group was *125.7 ± 13.16 mmHg*. The t-test yielded a *p-value* of *0.3393*, which is greater than *0.05*, indicating that there was no significant difference in systolic blood pressure between the two groups before treatment. Similarly, for diastolic blood pressure, the mean value of the pre-treatment control group was *84.60 ± 12.07 mmHg*, while the pre-treatment experimental group had a mean of *83.30 ± 12.68 mmHg*. The t-test showed the *p-value* of *0.2444*, also greater than *0.05*. This indicated there was no significant difference in diastolic blood pressure between the control and experimental groups prior to treatment. Meanwhile, fasting blood glucose measurements showed a mean value of *91.60 ± 10.32 mg/dL* in the pre-treatment control group and *88.1 ± 10.73 mg/dL* in the pre-treatment experimental group. Although the difference in means might appear notable, the t-test produced a *p-value* of *0.2075*. As this value exceeds *0.05*, indicating there was no significant difference in fasting blood glucose levels between the two groups prior to treatment. The data shows that there was no significant difference between pulse rate, body temperature, blood pressure (systole and diastole), and blood glucose level between the pretest (control) without sucrose intake before the Cooper test method of running 2.4 km and the pretest (experimental) with sucrose intake before ongoing Cooper test method of running 2.4 km.

Table 5. Comparison of posttest between experiment one and experiment two

	Posttest (Control-No-Sucrose)		Posttest (Experiment-Sucrose)		
	Mean	Std.Dev	Mean	Std.Dev	*P Value*
Pulse Rate (bpm)	105,10	16,65	121,10	13,74	*0,0000*
Body Temperature (Celsius)	35,70	0,41	35,60	0,30	0,0967
Systole	128.40	17.68	145.91	19.97	*0.0000*
Diastole	83.20	10.89	79.90	10.85	0.0739
Blood Glucose (mg/dL)					
After the Treatment	102.31	20.68	99.01	18.99	0.2096

Table 5 shows the average pulse rate following the control treatment was *105.10 ± 16.65 bpm*, while after the experimental treatment it increased to *121.10 ± 13.74 bpm*. A t-test conducted with a significance level of $\alpha = 0.05$ resulted in a *p-value of 0.0000*. The p-value is less than *0.05* indicating there was a significant change in pulse rate before and after the experimental 2.4 km run. This increase is attributed to the physical activity performed, as heart rate rises rapidly once the subject begins running. The response occurs because the body's demand for oxygen—transported by the blood, intensifies, prompting the heart to pump more frequently (Boyette and Manna, 2023). Body temperature following the control treatment was *35.70 ± 0.4°C*, while after the experimental treatment it was *35.60 ± 0.30°C*. The t-test yielded a p-value of *0.0967*, which is greater than *0.05* indicating there was no significant difference in temperature between the control and experimental group. The mean value of systolic blood pressure of the control group was *128.40 ± 17.68 mmHg* and *145.91 ± 19.67 mmHg* in the experimental group. The t-test yielded a *p-value of 0.0000*, which is less than *0.05* indicating there was a significant difference in systolic blood pressure between the control and experimental groups after the treatment. Meanwhile, for diastolic blood pressure, the mean value for the control group was *83.20 ± 10.89 mmHg* and *79.90 ± 10.85 mmHg* for the experimental group, with a *p-value* of *0.0739*. The p-value was greater than *0.05*, indicating that there was no significant difference in diastolic blood pressure between the two groups. Physical activity is known to increase heart rate and elevate the body's energy demands at the cellular, tissue, and organ levels. This, in turn, may enhance respiratory activity and venous return, resulting in increased stroke volume and cardiac output, which can lead to a moderate rise in blood pressure (Patel et al. 2024). During cardiovascular exercise, systolic pressure may rise substantially, reaching values near or even exceeding 200 mmHg as exercise intensity increases. However, diastolic pressure, tends to remain relatively stable during both exercise and daily activities. In some cases, particularly during cardiovascular exercise, diastolic pressure may even show a slight decrease (UC Davis Health Sport Medicine, 2025). Mean value of blood glucose level of the control group was *102.31 ± 20.68 mg/dL* in the and *99.01 ± 18.99 mg/dL* in the experimental group. The t-test yielded a *p-value* of *0.2096*. This value exceeds *0.05* indicating there was no significant difference in post-treatment blood glucose levels between the control and experimental groups. The data shows that there was no significant difference between, body temperature, blood pressure (diastole), and blood glucose level between the posttest (control) without sucrose intake before the Cooper test method of running 2.4 km and the posttest (experimental) with sucrose intake before ongoing Cooper test method of running 2.4 km. On the other hand, both pulse rate and systolic pressure indicated a significant difference. There was an increase of pulse rate and systolic pressure after before ongoing Cooper test method of running 2.4 km with sucrose administration. During and after exercise, both pulse rate and systolic blood pressure increase as a normal physiological response to meet the heightened oxygen demand of active muscles. As exercise intensity rises, the heart pumps more forcefully and rapidly, resulting in an elevated heart rate (pulse rate) and increased systolic blood pressure. Typically, these increases are temporary, with values returning to baseline within a few hours post-exercise (Vandergriendt, 2025; Weber, 2025).

Table 6. Comparison of running time

	Experiment One (no sucrose)		Experiment Two (sucrose)		
	Mean	Std.Dev	Mean	Std.Dev	*P Value*
Running Time	904,81	189,20	870,62	167,79	0,0022

Table 6 shows the running times before and after sucrose administration. To assess the effect of sucrose on running time, a t-test was performed with a significance level of $p < 0.05$. The analysis yielded a *p-value* of *0.0022*, which is less than 0.05 indicating that there was a significant reduction in running time following sucrose administration. This suggests that subjects completed the 2.4 km distance faster after sucrose intake, with times decreasing from *904.80 ± 189.20* seconds to *870.6 ± 167.79* seconds. The data indicate a reduction in running time during the second experiment following the administration of a glucose solution. This suggests that the subjects ran faster and completed the distance in less time compared to the first experiment, without sucrose solution. This improvement is attributed to the increased availability of energy sources essential for running. The findings of this study demonstrate that consuming sucrose solution prior to exercise positively influences physical performance. These results align with the study by Walis and Wittekind (2013) which stated that sucrose appears to be as effective as other highly metabolizable carbohydrates (glucose, glucose polymers) in providing fuel source during endurance exercise, and improving physical performance.

Table 7. Comparison of VO_2Max between experiment one and experiment two

Category	Experiment One		Experiment Two	
	Absolute	Percent (%)	Absolute	Percent (%)
Excellent	0	0	0	0
Very Good	0	0	0	0
Good	2	6.67%	2	6.67%
Moderate	7	23.33%	10	33.33%
Poor	13	43.33%	12	40.00%
Very Poor	8	26.67%	6	20.00%
Total	30	100%	30	100%

Data shows that in experiment one with no-sucrose intake, from the total of 30 subjects, there is no one categorized as "excellent" (*0%*) and "very good" (*0%*), there were two subjects categorized as "good" (*6.67*), seven subjects categorized as "moderate" (*23.33%*), thirteen subjects categorized as "poor' (*43.33%*), and eight as "very poor" (*26.67%*). Meanwhile, in experiment two with sucrose intake, none of the 30 subjects categorized as "excellent" (*0%*) nor as "very good" (*0%*). two subjects are categorized as "good" (*6.67%*), ten subjects categorized as "moderate" (*33.33%*), twelve subjects categorized as "poor" (*40.00%*), and six categorized as "very poor" (*20.00%*). VO_2max measures an individual's capacity to utilize oxygen during maximal physical exertion. The values of VO_2max can differ widely among individuals due to factors such as genetics, environmental conditions, and overall physical fitness (Myers, 2022). In this study, each subject showed an increase in their VO_2max category, likely due to the provision of an additional energy source that supplied sufficient fuel for running, thereby enhancing strength and endurance. The relationship between endurance and VO_2max is that a higher VO_2max indicates greater efficiency in oxygen utilization during exercise, enabling a person to sustain physical activity for longer durations. Simply put, a higher VO_2max corresponds to improved endurance during high-intensity exercise. According to UC Davis Health Sport Medicine (2025), VO_2max serves as a predictor of athletic performance, though its correlation with success in endurance sports is only around 30–40%. Other important factors—such as an individual's sustainable lactate threshold, motivation, and training—also significantly influence performance. Overall, a higher VO_2max generally reflects greater potential for success in aerobic endurance events.

V. CONCLUSION

Based on the results and discussion regarding the effect of sucrose intake on the physical performance of non-athlete students, this study concludes that sucrose administration improves physical performance by reducing running time and improving VO_2max of non-athlete students.Further research is recommended with a larger sample size to strengthen these findings. Additionally, studies involving female non-athlete students are needed to determine whether sucrose intake similarly affects their physical performance

Authors' contributions

The first author was responsible for conceptualizing the research, while the second author contributed by gathering data and working directly with the subjects during the experimental phase. Both authors collaborated in analyzing the data and writing the manuscript. Additionally, the first author took part in editing and revising the paper.

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