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Effects of isotonic drinks on academic performance for university students in Singapore

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ABSTRACT

There are several factors that impact the academic performance of university students. The consumption of isotonic drinks is a factor that has not been explored enough to form a conclusive statement regarding its effects on academic performance. We will conduct an experiment in Singaporean universities to analyze the mean change in the scores of aptitude tests using a Paired Sample t-Test. We will also conduct a survey to compare how age, gender, study hours, sleep hours, smoking status, and exercise frequency correlate with measures of academic performance. Using regression analysis, we will determine which variables are associated with better levels of academic performance. Depending on the results, policies can be put in place to regulate isotonic drink consumption to ensure the health of the public is not compromised.

Keywords: isotonic drinks, academic performance, university students

CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

INTRODUCTION

Problem

A world of revitalizing hydration, where isotonic drinks meet refreshment and performance finds its perfect partner. It is known to many that isotonic drinks improve physical performance, as backed up by past research. In recent years, students have been consuming isotonic drinks more regularly, even when they are not exercising or performing physical activities. Sports drinks became the third fastest-growing drink category in the US, and sales by volume increased 17 percent between 2004 and 2008 (Healthy Eating Research, 2012). As isotonic drinks are commonly consumed and may affect many people, this raises the question of whether isotonic drinks can provide more benefits other than improved physical performance.

Background

It is evident that there have been countless studies on the factors that impact academic performance, and therefore, research has been done to alleviate negative factors. For example, a study shows a positive correlation between diet quality and academic performance (Florence et al., 2008). With the advances of digital marketing and marketing through social media, more and more students have become aware of isotonic drinks, and this has caused the sale of isotonic drinks to rise exponentially. Surveys listed in Broughton et al. (2016) show that there are many reasons as to why students consume isotonic drinks in general, with the majority claiming that it is to recover from physical activity and to improve focus and concentration during their day-to-day activities (Broughton et al., 2016).

With the increase in the consumption of isotonic drinks and the reasons as to why the students are consuming them, not much is known if consuming isotonic drinks has impacts on students other than to rehydrate and recover after exercise. There are studies that show the impact of isotonic drinks on athletic performance, but not much research has been done regarding the impact of isotonic drinks on academic performance. It is known that diet quality can affect academic performance, so that begs the question: do isotonic drinks affect a student's academic performance?

Significance of the Study

The current research on isotonic drinks is limited to a student's aerobic endurance, their physical performance, and their physical activity. As mentioned above, there are no current studies that delve into the impact of isotonic drinks on a student's academic performance, and with the current situation where there are more and more students consuming isotonic drinks regularly, as explained by the Healthy Eating Research (2012) research review, research needs to be done to determine if the isotonic drinks are healthy for the students to consume not for physical performance but to increase their focus and concentration and improve their academic performance.

This study will be the first research conducted on the impact of specifically isotonic drinks on academic performance and will help determine if isotonic drinks can be promoted to students as a means of improving their academics. Participants will undergo an experiment where they will take an aptitude test twice, thirty minutes apart. Participants will be separated into a control group and a treatment group, where the treatment group will be given isotonic drinks to consume in between the tests. The dependent variable for this study is the result of the

aptitude tests. The key independent variable is the consumption of isotonic drinks. The null hypothesis states that the consumption of isotonic drinks will have no impact on university students' academic performance, and the alternative hypothesis states that the consumption of isotonic drinks will have an impact on university students' academic performance. The results from the experiment will be analyzed using Paired Sample t-Test to determine if the consumption of isotonic drinks has an impact on university students' academic performance.

A survey will also be conducted among university students. The dependent variable for the survey is the student's CGPA, and the independent variable is the consumption of isotonic drinks. The control variables in this study include the number of hours students spend studying, the number of hours they sleep, the students' smoking status, and the amount of exercise they get in a week. The results from the survey as well as the experiment will be analyzed using regression analysis to determine the direction and magnitude of impact for each independent variable on the dependent variable.

This study aims to determine if isotonic drinks can benefit university students' academic performance and if these benefits can be advertised and promoted to the students to help them achieve better grades in their education.

LITERATURE REVIEW

There have been a multitude of studies done to understand the association between isotonic drinks and physical health benefits and the association between physical health and academic performance. However, there is limited research addressing the impact of isotonic drink consumption on academic performance.

In previous research, Sepriani and Sepriadi (2022) studied the effects of isotonic drinks on students' aerobic endurance through the quasi-experimental method, where they specifically selected a sample size of 20 participants who were fit for the research. This research was conducted in 2017 on students of the Faculty of Sport Science at Universitas Negeri Padang. The test was carried out by measuring the participants' VO₂ max before and after consuming isotonic drinks. The results from the time-series data show that there is a significant increase in the majority of the participants' VO₂ max after consuming isotonic drinks. This suggests that isotonic drinks have a positive impact on students' aerobic endurance.

There are studies that test the relationship between energy drink consumption and academic performance, so a comparison between isotonic drinks and energy drinks has to be made. Isotonic drinks and energy drinks are largely similar in terms of their high levels of sugar and nutritional content. However, isotonic drinks contain nutrients that rehydrate the body, while energy drinks contain stimulants for a boost of energy (Callahan, 2014). Hafeez et al. (2016) conducted a study on the effects of energy drinks on students' perceived stress and academic performance through cross-sectional survey questionnaires, where they used convenience sampling to collect data from different institutions in two different categories, namely, normal universities and medical universities. The result of the study shows an inverse relationship between perceived stress and academic performance and a positive correlation between energy

drinks and academic performance. This suggests that students under stress can negatively affect their academic performance, and they will consume energy drinks to boost their concentration level in hopes of improving their academic performance. However, this is disputed by research conducted by Kim et al. (2017), which found that increased consumption of energy drinks causes high stress levels, abnormal sleeping patterns, and reduced academic performance. With similar contents found in energy and isotonic drinks, further research needs to be conducted to find out whether isotonic drinks have an effect on a student's academic performance.

Academic performance may also be dependent on other behaviors such as diet, sleep pattern, alcohol consumption, and smoking. A study conducted by Ong et al. (2021) analyzes the association between such health-risk behaviors and academic performance through a cross-sectional survey involving 1543 university students collected in 2019. According to this study, it was found that students engaged in higher health-risk behaviors tend to achieve a lower GPA score. This is supported by research conducted by Florence et al. (2008), which found that there is a positive association between a good-quality diet and academic performance, although it should be noted that diets vary drastically around the world.

Isotonic drinks are mainly consumed by people who are physically active to replenish the fluids lost in the process. Xin and Qi (2022) conducted a study to find out the effects of physical fitness and sports intensity on academic performance. Their findings state that an increase in physical education participation can improve academic performance and that exercises with different intensities have different benefits for academic performance. Market research conducted by Cruz-Muñoz et al. (2020) found that students generally drink sports drinks or energy drinks to get an energy boost, improve concentration, and rehydrate during sports sessions.

In theory, based on previous research, there is a positive relationship between physical exercise and academic performance and the consumption of isotonic drinks and aerobic endurance. However, the link between isotonic drinks and academic results is unclear. Moreover, the previous studies also had small samples to research, making them less representative of the population. This study aims to examine the direct impact on academic performance of university students in relation to isotonic drinks, specifically.

RESEARCH QUESTION

The main objective of this study is to investigate and determine the positive academic benefits of consuming isotonic beverages, as there is growing demand and popularity, and to determine if the benefits of these beverages are only limited to physical performance. This study will focus on university students, as they are more likely to engage in physically demanding activities while balancing their studies. Hence, what are the effects of isotonic drinks on academic performance for university students in Singapore?

THEORETICAL FRAMEWORK

The theoretical framework for this study will focus on the nutrients, minerals, and electrolytes in isotonic beverages. The main benefit of an isotonic beverage is its ability to rehydrate the human body very efficiently. The main components of isotonic drinks are glucose, sodium chloride, potassium, and other minerals that help an individual recover energy. Sodium is crucial for the transmission of nerve impulses, the transport of protein and carbohydrates to tissues, and the acid-base balance in the body with potassium. Nickel is also present in isotonic beverages, and when taken in the correct amounts, it can help improve cardiovascular health for an individual (Styburski et al., 2020).

Noting that sodium helps improve the transport of protein and carbohydrates around the body, the energy level of an individual will increase with the proteins and carbohydrates being able to circulate more efficiently around the body. Nickel improves cardiovascular health as it helps the heart pump blood more efficiently around the body and makes it easier for proteins and carbohydrates to be transported, once again improving the individual's energy levels. This study will investigate if the energy boost from isotonic beverages can help university students study better and attain better academic performance.

Key Independent Variable

The key independent variable for this study will be the consumption of isotonic beverages. It will be used to determine its effects on university students' academic performance in terms of their score on an aptitude test. The students want to improve their academic performance, and the consumption of isotonic beverages might be able to positively impact these students.

The consumption of isotonic beverages will be measured using the two groups that are being assessed in the experiment; one group will consume the isotonic beverage and the other group will not, and we will compare the two groups' changes in score for the aptitude test before and after the treatment.

Dependent Variable

For the experiment, the dependent variable will be the academic performance of university students, which will be measured using a timed aptitude test involving numeracy ability, basic mathematical knowledge, numerical reasoning ability, and inductive logical thinking. The participants will be split into two groups: the control group and the treatment group. The control group will not consume the isotonic beverage, and the treatment group will consume the isotonic beverage to compare the changes in results between the two groups.

Control Variables

The control variables for this study are the number of hours students spend studying, the number of hours they sleep, the students' smoking status, and the amount of exercise they get in

a week. The number of hours a student spends studying can greatly determine the student's academic performance and will need to be measured in our study. This is the same for the number of hours of sleep a student gets daily. Sleep is one of the most important factors when it comes to energy levels and impacts the concentration and focus levels of students greatly. The smoking status of students needs to be measured, as smoking affects the general cognitive performance of humans and can affect the student's academic performance as well. The amount of exercise a student gets done in a week will also need to be measured, as a study indicated that students who exercise regularly have better academic performances compared to students who do not regularly exercise (Xin & Qi, 2022). These variables will be measured and accounted for when conducting the supplementary survey along with the experiment and during the analysis of the data.

HYPOTHESIS

The null hypothesis (H_0) states that there will be no impact on university students' academic performance due to the consumption of isotonic drinks, and the alternative hypothesis (H_1) states that there will be an impact on university students' academic performance due to the consumption of isotonic drinks. A two-tailed test will be applied to evaluate the hypothesis in this study and find out if there is a positive or negative impact of the consumption of isotonic drinks on university students' academic performance.

H_0 : There will be no impact of the consumption of isotonic drinks on university students' academic performance.

H₁: There will be an impact of the consumption of isotonic drinks on university students' academic performance.

CHAPTER 2

RESEARCH METHODOLOGY AND ANALYSIS REPORT

STUDY DESIGN

Research Question

This research intends to find out if the consumption of isotonic beverages has any impact on university students' academic performance. To be able to determine that, we will need to control the amount of isotonic beverage consumed as well as the type of participants, and this will be included in our scope. Another variable to control would be the brand of isotonic beverage, as different brands contain different ingredients as well as different nutritional content. To solve this issue, we have decided to use only the most well-known brand of isotonic beverage in Singapore, 100PLUS, which has partnerships with the Singapore Swimming Association (SSA), the Singapore Badminton Association (SBA), and the Singapore Table Tennis Association (STTA), among others (100PLUS, n.d.).

Currently, there has been no research done on the impact of isotonic beverages on the academic performance of university students. Therefore, our target group will be university students, and the research question for this study, considering the above-stated factors, is: What are the effects of isotonic drinks on academic performance for university students in Singapore?

Hypotheses

The hypotheses were formulated by considering the different variables and factors that affect academic performance. The study will be conducted through a two-tailed test as we are determining any effect, positive or negative, isotonic beverages have on university students' academic performance.

Null Hypothesis (H_0): There will be no impact of the consumption of isotonic drinks on university students' academic performance.

Alternative Hypothesis (H_1): There will be an impact of the consumption of isotonic drinks on university students' academic performance.

Type of Study and Data

A panel study will be conducted to measure the performance of the university students through the grades obtained from a timed aptitude test involving numeracy ability, basic mathematical knowledge, numerical reasoning ability, and inductive logical thinking. We are using the aptitude test as a measure of their academic performance as we need to control the individual intelligence of students, and using this method, we can compare the performance of the student before and after consuming isotonic beverages. According to Macklem (1990), aptitude tests involving verbal or numerical skills are good indicators of academic performance and achievement. The test will be conducted twice on a single day: before the consumption of isotonic drinks and thirty minutes after the consumption of isotonic drinks. As mentioned in one of the studies, there was a significant increase in VO₂ max thirty minutes after consumption of isotonic drinks (Sepriani & Sepriadi, 2020). This shows that rehydration takes place within thirty minutes, and from the aptitude test result, it can be determined if isotonic drinks affect student academic performance. In the same research by Sepriani & Sepriadi (2020), a 350-ml pack of isotonic drink was given to the participants as it has a similar electrolyte composition to human bodily fluids. As such, the participants will be given the same amount of 350 ml to remain constant. The type of data collected in the form of an experiment will be panel data. Cross-sectional data will also be collected through a survey to account for other variables such as age,

gender, hours of study, hours of sleep, smoking status, etc. to determine if there are other factors affecting their academic performance. The participants will be university students.

Data Collection and Analysis

This study revolves around the consumption of isotonic drinks, specifically 100PLUS. This will be done in partnership with the 100PLUS Research and Development team, as they would want to know if their drinks can give benefits to students so that they can alter their marketing strategies to advertise their drinks to students, highlighting the benefits. To entice students to volunteer in the experiment, a goodie bag consisting of 1 drawstring bag, 1 shaker bottle, 1 500-ml bottle of 100PLUS, 1 protein bar, and a towel will be given to the participants. This goodie bag initiative works in conjunction with the 100PLUS Research and Development team.

As the research requires human experimentation, it must be reviewed and approved by the Institutional Review Board (IRB) of the relevant educational institutes before it can be implemented. The data collected from the experiment will be analyzed using a t-test to determine any difference in the results collected for the two separate aptitude tests before and after consuming a specified amount of 100PLUS between the control group and the treatment group. The t-test will be used to determine if the consumption of isotonic beverages has any effect on the academic performance of university students. The data collected through the survey will be analyzed using regression analysis to find out if there are any variables affecting academic performance.

POPULATION AND SAMPLE

The population of this study is made up of university students in general. As the number of university students is very large, this study will use a sample size of 400 university students to better represent the population (Sage Knowledge, n.d.). As this research is conducted in Singapore, five local universities were chosen: Nanyang Technological University (NTU), National University of Singapore (NUS), Singapore Institute of Technology (SIT), Singapore Management University (SMU), and Singapore University of Social Sciences (SUSS). The yearly intakes of students in 2022 are 31,786, 32,335, 8,500, 12,385, and 1,000, respectively. We have chosen the five local universities in Singapore as they are the most common institutes that most students will enter for their studies, and the population of students in the five universities is substantial enough for our study.

Disproportionate stratified random sampling will be performed to gather 80 university students from each local university. This is to ensure that we have an adequate number of samples, even at the smaller local universities. The results of this study will be able to be generalized to university students in general, and it does not have a direct representation of university students in a particular educational institute. In addition, volunteer sampling will also be conducted, such that the students will have to understand the conditions of the experiment and voluntarily participate in it. Participants must not have any pre-existing medical conditions or allergies to ensure that there will not be any health hazards as a result of the experiment.

VARIABLES AND MEASURES

In the experiment, the dependent variable will be the results of the aptitude tests. According to Macklem (1990), aptitude tests involving verbal or numerical skills are good

indicators of academic performance and achievement. As the participants receive a fixed number of questions, their performance will be measured by the number of correct answers per minute on average before and after the consumption of isotonic drinks. After which, the difference in results between the two tests will be factored in to determine whether isotonic drinks have an impact on performance. As such, for this study, the key independent variable is the consumption of isotonic drinks. The isotonic drinks provided to the participants will be fully controlled, as each participant will have to consume 350 ml of 100PLUS during the experiment. The control variables include age, gender, university, degree program, smoking status, the amount of rest in between aptitude tests, and the fact that answers will not be revealed to the participants after the end of the first test.

Lastly, the independent variables will be the amount of 100PLUS each participant consumes on a regular basis (in ml/week), the duration of exercise (in hours/week), sleep pattern, the duration of study (in hours/week), and their perceived stress level. These independent variables will be collected in the form of a survey completed by each participant. The participant's CGPA will also be collected and converted into a percentage, as different schools have differing grade scales.

All these variables will be analyzed to determine if there is a significant difference in academic performance associated with the consumption of isotonic drinks.

DATA COLLECTION METHODS

The experiment must be reviewed and approved by the Institutional Review Board (IRB) of the relevant educational institutes before its commencement. In each of the relevant educational institutes, approval must be sought for the experiment to be hosted in an available

computer laboratory. This is to ensure that the participants are in a controlled environment with minimal disturbance. The experiment can also be conducted in batches as long as all the factors remain constant throughout.

A panel study will be conducted through an experiment involving 400 volunteer participants over a period of 1 hour. The study will measure academic performance by comparing their aptitude test results before and after consuming isotonic drinks. All 400 participants will be invited to complete a series of timed aptitude tests. Participants will be tested on numeracy ability (<https://www.pilotest.com/en/tests/numeracy>), basic mathematical knowledge and numerical reasoning ability (<https://www.pilotest.com/en/tests/mathematics>), and inductive logical thinking (https://www.pilotest.com/en/tests/inductive_thinking). All participants will be given 30 questions for each section to answer as fast as possible. Taking the test directly from the website will result in different questions for different participants. To ensure that all participants receive the same questions, the test questions will be randomly selected from a pool of questions from the websites, which is also listed in the appendix, and the same questions will be presented to all participants. A mathematical formula sheet and a calculator will be provided to the participants. The results will be measured by the number of correct answers per minute for both tests. After the initial test, the results will be recorded and will not be known to the participants to ensure that they do not affect the results of the second test.

After the first test, the participants will be split into two groups. The first group of 200 participants will be the control group, which will not be given isotonic drinks. The second group of 200 participants will be the treatment group, which will be given 350 ml of 100PLUS isotonic drink to consume to ensure that their intake is fully controlled during the experiment.

Thirty minutes after the consumption of the isotonic drinks in the second group, all participants will undergo another set of aptitude tests. Similarly, the questions will be the same for all participants. To prevent participants from answering the same questions from the initial test, a different set of questions will be selected from the question bank and presented to the participants. As the questions are selected from the same website, the difficulty level and concept of the questions will be similar. A mathematical formula sheet and a calculator will also be provided to the participants. The results from both tests will be compared and analyzed using a t-test and regression analysis to determine whether the consumption of isotonic drinks has an impact on performance, as well as the direction and magnitude of the impact.

At the end of the experiment, all participants will receive a goodie bag consisting of 1 drawstring bag, 1 shaker bottle, 1 500-ml bottle of 100PLUS, 1 protein bar, and a towel sponsored by the 100PLUS Research and Development team.

In addition, cross-sectional data will also be collected to account for other variables such as age, gender, hours of study, hours of sleep, smoking status, etc. to determine if there are other factors affecting their academic performance. As such, all the participants of the experiment will be handed a survey to complete after the first aptitude test, as well as university students through convenience sampling. The list of survey questions is stated in the appendix section below.

DATA ANALYSIS METHODS

Paired Sample t-Test

Given that the main experiment aims to test the differences between the improvement of aptitude test results in the control group and the treatment group, a t-test will be used. The impact that isotonic drinks have on academic performance will require a comparison of the means of

two samples. The first sample will consist of the improvement in aptitude test results of the first group that did not consume isotonic drinks. The second sample will consist of the improvement in aptitude test results of the second group that consumed isotonic drinks. The Paired Sample t-Test will allow the analysis of the average of two samples to see whether there are any differences in the improvement of aptitude test results between both groups.

This study assumes a significance level of 5%. By conducting a Paired Sample t-Test, the p-value will be the deciding factor based on the significance level of whether to reject the null hypothesis. This will then enable conclusions regarding the effects of academic drinks on academic performance to be drawn at the 5% significance level.

Regression Analysis

Data collected by the survey can be analyzed using regression analysis, which can provide the degree to which the independent and dependent variables are correlated. In this case, the regression analysis will present a relationship between the key independent variable, isotonic drink consumption, other independent variables, and CGPA.

The estimated equation will be as follows:

$$\begin{aligned}
 DEPVAR = & \alpha + \beta_1 CONSUMPTION + \beta_2 QUANTITY + \beta_3 AGE + \beta_4 GENDER \\
 & + \beta_5 UNIVERSITY + \beta_6 DEGPROG + \beta_7 EXERCISE DURATION \\
 & + \beta_8 SLEEP PATTERN + \beta_9 STUDY DURATION + \beta_{10} STRESS LEVEL \\
 & + \beta_{11} SMOKING + \varepsilon_i
 \end{aligned}$$

In the equation, α is a constant, and ε_i is the error term. *DEPVAR* represents the one of the dependent variables: CGPA and Difference in Aptitude Test Results. *CONSUMPTION* is a dummy key independent variable that equals one if the participant belongs to the treatment group that consumed isotonic drinks or zero otherwise. *QUANTITY* is the key independent variable in this regression analysis that represents the amount of isotonic drink that the student consumes in ml per week. *AGE* is an independent variable that represents the student's age in years. *GENDER* is an independent variable that represents the student's gender as indicated in the survey. *UNIVERSITY* is an independent variable that represents the university that the student studies at. *DEGPROG* is an independent variable that represents the degree program that the student is taking. *EXERCISE DURATION* is an independent variable that represents the number of hours that the student spends exercising per week. *SLEEP PATTERN* is a dummy variable that equals one if the student gets at least 7 hours of sleep every day or zero otherwise. *STUDY DURATION* is an independent variable that represents the number of hours that the student spends studying per week. *STRESS LEVEL* is an independent variable that represents the student's perceived stress level as indicated in the survey. *SMOKING* is a dummy variable that equals one if the student is a smoker or zero otherwise.

By interpreting the adjusted R-square and p-value of each independent variable, it is possible to determine if an independent variable has a significant impact on the dependent variable. The co-efficient that precedes the independent variables determines the magnitude of change in the dependent variable.

It should be noted that the survey was not strictly controlled, hence why the results of the analysis should be used as a supplement for the t-test. The analysis will allow results from the t-test to be cross-checked to draw a well-substantiated conclusion.

CONCLUSION

While there are several factors that impact a university student's academic performance, the study aims to isolate the components of what a person consumes. Specifically, the effects of consuming isotonic drinks on academic performance were investigated through an experiment. Hence, the key independent and dependent variables are isotonic drink consumption and academic performance, respectively.

The experiment is designed to be able to compare the changes in the aptitude test scores of those who consume isotonic drinks and those who do not before and after the consumption of 100PLUS. Both the control and treatment groups will take an aptitude test twice, with the difference being that the treatment group will consume isotonic drinks in between the two tests. This method creates a definitive understanding of how isotonic drinks impact test scores.

As mentioned above, there are many variables to consider when discussing academic performance. For this reason, it is key that the environment and experiment be as controlled as possible. For instance, the length and difficulty of the test will be constant. The time in between tests will be fixed to allow the control group to decompress and then prepare themselves and to allow enough time for the isotonic drinks to take effect on the treatment group.

The experiment will provide data that will be analyzed with a t-test, which compares the means of two different groups (control and treatment). With the variables that will be controlled, the analysis will provide the necessary results to understand the effects of isotonic drinks on the academic performance of university students.

Besides the experiment, a survey will also be conducted to examine other independent variables that may affect university students' academic performance based on their current

CGPA results. The results of this survey will be analyzed and cross-checked with the experiment results to draw a well-substantiated conclusion.

LIMITATIONS

This investigation aims to provide accurate information regarding the effects that isotonic drinks have on academic performance.

Although past research shows that aptitude tests such as those that assess verbal and numerical reasoning are good indicators of academic performance, it remains difficult to apply the implications of the test results across all subjects as each subject requires different types of skillsets and critical thinking. Hence, the results of a particular aptitude test may not accurately reflect an individual's potential performance in specific subjects.

As the study deals with solely isotonic drinks from 100PLUS, the observed effects cannot be fully generalized to all isotonic drinks from other firms. Each company needs a unique selling point for its products, which suggests that other isotonic drink companies likely include different ingredients (to a moderate extent), with which the combination created may create different effects compared to 100PLUS.

Everyone is different, especially when considering metabolism. During the break between the tests, it is likely that the effects of the isotonic drinks will take different amounts of time to take effect, potentially altering an individual's test performance and, therefore, results. This could lead to inaccuracies in models derived from the results.

Lastly, taking tests overall is a fatiguing task. Regardless of how well-rested an individual is, taking an aptitude test will have an impact on energy levels. As a result, it is likely that the results of the second test will be affected by this across the board, inherently altering the results.

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APPENDIX

Survey questions for 150 volunteer university participants:

- 1) What is your age? (Fill in the blanks)
- 2) What is your gender? (Male, Female, Non-binary/Third gender, Prefer not to say)
- 3) Which University do you go to? (NTU, NUS, SIT, SMU, SUSS)
- 4) What is your degree program? (Fill in the blanks)
- 5) Do you consume isotonic drinks? (Pocari Sweat, 100 Plus, H-Two-O, Etc.) (Yes / No)
- 6) If “Yes” to Q4, how much do you consume per week (in ml)? (Fill in the blanks)
- 7) If “Yes” to Q4, why do you consume isotonic drinks? (Physical activity, Taste, Improve focus)
- 8) Do you consume caffeinated drinks? (Coffee, Tea, Energy drinks, Soda, Chocolate) (Yes / No)
- 9) If “Yes to Q7, how much do you consume per week (in ml)? (Fill in the blanks)
- 10) How many hours of exercise do you partake in per week (In Hours)? (On a scale of 0 to 20)
- 11) Do you get at least 7 hours of sleep every day? (Yes / No)
- 12) How many hours do you study per week outside of school (in hours)? (On a scale of 0 to 50)
- 13) What is your perceived stress level? (On a scale of 0 to 100)
- 14) Smoking status? (Smoker / Non-smoker)
- 15) Which GPA scale does your university use? (Max GPA of 4.0 / Max GPA of 5.0)
- 16) If “Max GPA of 4.0” to Q12, which CGPA group do you fall under? (On a scale of 0 to 4)

17) If “Max GPA of 5.0” to Q12, which CGPA group do you fall under? (On a scale of 0 to 5)

Aptitude test questions will be extracted from the following websites:

1) Numeracy ability: <https://www.pilotest.com/en/tests/numeracy>

2) Basic mathematical knowledge and numerical reasoning ability:

<https://www.pilotest.com/en/tests/mathematics>

3) Inductive logical thinking: https://www.pilotest.com/en/tests/inductive_thinking