

# BMJ Open Exploring the relationship between different modes of transportation and levels of physical activity among senior high school students of the University of Santo Tomas: a cross-sectional study protocol

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## ABSTRACT

**Introduction** Rapid changes in technology, communication and transportation prompted challenges in achieving the recommended level of physical activity. Although the students are returning for in-campus classes to promote more interaction and socialisation, the youth still fall short of living up to the desired level of physical activity. The mode of transportation plays a pivotal role in physical activity, yet its relationship is poorly elucidated. The aim of the study is to explore the relationship between the types of transportation and the level of physical activity among senior high school students aged 16–18 from the University of Santo Tomas.

**Methods and analysis** This will be an observational, cross-sectional, analytical study design. Participants' demographics and anthropometric measurements such as height, weight and hip and waist circumferences will be collected. To measure the variables of interest, the International Physical Activity Questionnaire and Global Physical Activity Questionnaire will be used. Descriptive statistics will be used to characterise the samples using frequency, mean, median and SD, while inferential statistics such as analysis of variance for comparison and Pearson's and Spearman for correlation will be used. All analysis will be done using IBM Statistical Packages for Social Sciences V.23 with the significant level set at alpha 0.05.

**Ethics and dissemination** Ethical approval was obtained from the University of Santo Tomas—College of Rehabilitation Sciences Ethics Review Committee with the protocol number SI-2023–029. The study will comply with the principles of the Declaration of Helsinki, Ethical Guidelines on Health-Related Social Research of the Philippine Health Research Ethics Board and the Data Privacy Act 2012. All results, regardless of outcome, whether positive or negative, will be accessible through publication and by reporting to the participant through email and other relevant authorities.

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The study is of a low-risk nature in several aspects such as psychological, social, economic, privacy/confidentiality and legal.
- ⇒ The methods and tools that will be used in the study are standardised and supported by literature to be valid and reliable.
- ⇒ The study will be conducted solely within Metro Manila, which may limit the generalisability of the findings to other regions in the country with different geographical, seasonal, socioeconomic or cultural contexts.
- ⇒ The study focuses exclusively on senior high school students from the University of Santo Tomas, which may not fully represent the variability in other populations.
- ⇒ The study will not account for other factors that could influence physical activity and the mode of transportation, such as infrastructures, access to transportation, neighbourhood, seasonal and weather variability, screen time, diet and socioeconomic factors.

## INTRODUCTION

### Background

As of 2022, the WHO reports that more than 80% of teenagers fail to meet the required physical activity standards.<sup>1</sup> The significant level of inactivity is partly attributed to sedentary lifestyles at school and home and inactivity during leisure.<sup>2</sup> Moreover, in a publication by Yeung and Johnston, specific attention has been drawn to the countries in Asia, namely the Philippines, Malaysia, Singapore, Japan, South Korea, India, Pakistan and several Pacific nations, which exhibit the highest proportions of inactive populations

in the region.<sup>3</sup> In the local setting, the Food and Nutrition Research Institute states that 84.5% of Filipino youth aged 10–17 fall short of meeting the recommended level of physical activity (PA).<sup>4</sup>

WHO defines physical activity as body movements driven by skeletal muscles necessitating energy expenditure.<sup>1</sup> On the other hand, an active lifestyle is characterised by regular PA, while sedentary behaviour is associated with low energy expenditure, such as television viewing.<sup>5,6</sup> The enhancement of one's PA depends on the consideration of both invariable and modifiable factors. Invariable factors include age, gender, race and ethnicity. According to the Kretschmer *et al* study, boys have a higher moderate to vigorous PA than girls, and this is supported by Espada *et al* which also reports that women have lower levels of PA than men.<sup>7,8</sup> In addition, a study conducted by Goel *et al* mentions that females are more likely to walk and use public transport while males tend to use bicycles instead.<sup>9</sup> Likewise, a study by Lejsková *et al* states that men would often use cars as drivers, trains, buses and bicycles while women tend to use cars as passengers, public transport and walking.<sup>10</sup> Conversely, modifiable elements include environmental circumstances, community settings and one's behavioural and personality characteristics.<sup>11</sup> Delving further, a 2022 assessment regarding the PA of children and adolescents in the Philippines encompassed 10 indicators of PA, namely overall physical activity, organised sport and physical activity, active play, active transportation, sedentary behaviours, physical fitness, family and peers, school, community and environment and government.<sup>4</sup> Evidently, a study by Khan *et al* elucidates a positive correlation between active school transport and PA in adolescents, concurrent with a decrease in sedentary behaviour. With this, it can be concluded that one's mode of transportation contributes to determining an individual's level of PA.<sup>12</sup>

An active mode of transport is defined as a way of travelling that entails energy expenditure, with walking and cycling as prominent examples. In contrast, passive transport is attributed to using motorised transportation, such as cars, buses and trains, requiring no physical exertion or energy expenditure.<sup>13</sup> When both modes are employed in combination, it is referred to as mixed transport. Considering such, recent studies have investigated the factors contributing to the choice of transportation mode. In a student setting, an increase in active transport has been associated with the proximity of house to school, social support from peers, parental active transport and access to services.<sup>14</sup> In the Philippines, the Asian Development Bank reports that urban transportation has been dominated by public utility vehicles such as jeepneys, taxis, tricycles and pedicabs.<sup>15</sup> Given its extensive usage, passive transportation can be inferred to be the most common transport mode in the country. Correspondingly, Cagas *et al* document that only 29.5% of Filipino schoolchildren use active transportation to school at least 5 days a week.<sup>4</sup>

To advance the use of active transportation in adolescents, physical therapists play an imperative role in

primary health promotion and in addressing the sedentary lifestyle of individuals, starting with assessment. In rehabilitation, the level of PA is evaluated through functional assessment using outcome measure tools called the International Physical Activity Questionnaire (IPAQ) and Global Physical Activity Questionnaire (GPAQ). The IPAQ is primarily intended for adult population surveillance, as it has been created and tested for use by those aged 15–69. Furthermore, the questionnaire evaluates PA across various domains, including leisure, domestic and gardening activities, and work-related and transportation-related activities.<sup>16</sup> On the other hand, the GPAQ assesses PA about occupation, transport and leisure.<sup>17</sup> In a study conducted by Herrmann *et al*, the GPAQ V. 2 validity has shown low to moderately high validity ( $r=0.25–0.63$ ) against measures of physical fitness, body composition and objective (accelerometer, pedometer) and subjective measures of PA (IPAQ). The questionnaire has shown overall strong reliability. It was presented that GPAQ, including its domains such as occupation, transportation and leisure, provided acceptable short-term reliability (all  $>0.80$ ). However, the long-term reliability of reporting moderate-intensity activity for recreation, work and travel was low ( $<0.70$ ). In their summary, they also mentioned that GPAQ has also 'showed acceptable evidence of short- and long-term test-retest reliability by activity category and modest validity evidence'.<sup>18</sup>

Another significant contribution that physical therapy offers within the domain of transport and health is the emerging discipline of environmental physiotherapy (EPT), an expansion in the profession with inherent benefits for both the patients and the environment. This evolving domain, propelled by the increased number of consumers and the consequential depletion of natural resources, confronts the ensuing adverse environmental impacts.<sup>19</sup> With this, the study will also introduce EPT by promoting active transportation. If EPT is widely practised in the country, then it could increase the number of teenage groups that would opt for active transportation. This not only encourages people to go for active transportation, but it will also help improve the condition of the environment, specifically reducing gas emissions. In addition, practising active transport contributes to the pursuit of Sustainable Development Goals (SDG) 3 (Good Health), 11 (Sustainable Cities and Communities) and 13 (Climate Action).

The University of Santo Tomas Senior High School (UST SHS) was established in 2016 and houses six strands namely: Science, Technology, Engineering and Mathematics Strand, Accountancy and Business Management Strand, General Academic Strand–Health-Allied, Humanities and Social Sciences Strand, Music, Arts and Design Strand and the Physical Education and Sports Track. The study on the topic is to be piloted at the UST SHS as it fits the age criteria of the population and is accessible to the researchers due to their affiliation with the university.<sup>20</sup>

## Knowledge gap

The continuous decline in PA levels among school-going adolescents<sup>21</sup> has underscored the need for further investigation into the relationship between modes of transport and PA levels. Active transport has shown promise in increasing PA levels due to its easy integration into daily routines,<sup>22</sup> though its relationship remains inconclusive as it relies solely on cross-sectional data.<sup>23</sup> This limitation warrants attention for the current study. Additionally, in exploring the relationship between mode of transport and PA levels, the roles of passive and mixed transports remain understudied compared with active transportation. Other notable gaps include the absence of input from physical therapists and limited research conducted in the Philippine context, which fails to consider environmental differences influencing transport choices and, consequently, PA levels. Evans *et al* suggest that multiple factors, including individual, social and environmental aspects, should be taken into account when monitoring PA levels to maximise effectiveness.<sup>24</sup> Given the differences in geographic locations and environmental conditions, data from the current study is likely to differ from previous findings, considering the routes taken by UST SHS students in Manila to which Leather *et al* note that regions beyond the Central Business Districts in Manila lack sufficient facilities for pedestrians and cyclists to travel safely.<sup>25</sup> Addressing infrastructure disparities is vital in the exploration of the relationship between the modes of transportation and PA levels of UST SHS students.

## Objective

The primary aim of this study is to explore the relationship between the types of transport and the physical activity levels of senior high school students from UST. To achieve the primary objective, the following are the secondary aims of the study:

1. To determine the level of physical activity of UST SHS students.
2. To compare the level of physical activity to the modes of transportation.
3. To correlate the level of physical activity to the modes of transportation.
4. To correlate the level of physical activity to the anthropometric measurements of UST SHS students.

## Significance

The study's findings hold significant importance in public health as they can raise awareness about the impact of transportation on PA, enabling targeted health interventions for primary care. The study may also promote PA within educational institutions, fostering healthier student environments. Moreover, the study can provide empirical evidence to inform policy decisions related to PA. This paves the way for future research into health, environment and SDGs, offering a comprehensive understanding of transportation's effects on individuals and the community.

## Delimitation

Based on the study's objective, an observational cross-sectional study design will be implemented in the academic year 2024–2025. The study will highlight UST SHS students' PA based on their transportation mode, and participants will include UST SHS students aged 16–18 years old. The study will examine the following factors influencing students' PA: active, passive and mixed transportation. The study will not include other PA factors, such as screen time and physical/social environments.

## METHODS

### Design

This research will use an observational, cross-sectional analytic study design to explore the relationship between active, passive and mixed modes of transportation and physical activity. Moreover, this study will be reported by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.<sup>26</sup>

### Participants

Participants in the study are students recruited from UST SHS and officially enrolled in all strands of the 11th–12th grade aged 16–18 years old and above. However, people with mobility-related health issues, such as arthritis, osteoporosis, musculoskeletal disorders, neurological disorders, balance disorders, severe cardiopulmonary diseases and so forth, that might affect the mode of transportation or commute used, are ineligible to participate. Approximately 373 students will be invited to participate, as estimated from the current 148 classes of the academic year (A.Y.) 2023–2024 with approximately 38 students per class, calculated using Slovin's formula  $n = N / (1 + Ne^2)$  wherein  $n$  is the sample size,  $N$  is the population size, and  $e$  is the acceptable margin of error, with a confidence level of 2%. The registration form will be generated using Google Forms. The link to the forms and publication materials will be sent to the student council for dissemination to the class presidents of each class at UST SHS, who will share it with the rest of their classmates. To address non-response bias per strand, the strand societies will be informed about this study via email of important links and information for dissemination. To address non-response bias per year level, the researchers will ask the senior high school administration to reserve rooms on different floors of the Frassati building during the data collection to ensure accessibility of different year levels. Those who completed the applications and signed up, provided that they fit the inclusion criteria, will be eligible to participate in the study. Moreover, the study will employ stratified random sampling to recruit the students, wherein the participants will be stratified based on their strand. The percentage of their strand population to the total population will be determined. Following that, the sample per strand will be calculated. With this, the sample will represent the population concerning the different grade levels. Moreover, the characteristics of each stratum may also



be established separately.<sup>27</sup> The specific sampling frame cannot be obtained at the moment due to data privacy matters. However, the exact number of members in the population will be obtained once the enrolment period for A.Y. 2024–2025 concludes. To further clarify our recruitment criteria, similar to the recruitment criteria of Mendoza, participants in ‘The Walking School Bus and Children’s Physical Activity: A Pilot Cluster Randomized Controlled Trial’ were eligible if they were enrolled in fourth grade and had no health limitations that prevented them from walking to school.<sup>28</sup> This supports the study’s inclusion criteria, which state that only students enrolled in the 11th–12th grade of UST SHS and free of mobility-related health concerns are eligible to participate.

## Setting

The study will take place at the UST SHS and Blessed Giorgio Frassati Building from August 2025 to October 2025. Specifically, the data gathering will be implemented to further investigate the level of physical activity of students who use active, passive and mixed modes of transportation. To magnify the recruitment process, the team will execute an educational seminar following the data-gathering process.

## Tools

Two screening tools will be used to gather data regarding the participants’ physical activity levels: the IPAQ and the GPAQ. The IPAQ is a self-report, seven-item questionnaire that assesses the types and intensity of physical activity and sitting time that an individual does.<sup>29</sup> The questionnaire contains open-ended questions regarding one’s physical activity over the last 7 day and is proven to have good stability in test–retest reliability and high reliability ( $\alpha < 0.80$ ). Moreover, the screening tool was also tested valid in terms of predictive validity, concurrent validity, convergent validity, criterion validity and discriminant validity.

On the other hand, the GPAQ is a self-report questionnaire consisting of 16 items developed by the WHO for physical activity surveillance. It contains questions about physical activity participation in three domains, namely activity at work (occupational), travel to and from places (transport-related) and recreational activities (leisure time). The screening tool’s short- and long-term test–retest reliability is measured as good to very good, while its concurrent validity is poor to fair. Moreover, it is also important to note that the second version of the GPAQ will be used in this study as advised by the GPAQ Analysis Guide. The first version of GPAQ initially contains 19 questions. However, the WHO excluded three items due to redundancy, leaving 16 questions in the second version.<sup>17 30</sup>

Using the IPAQ and the GPAQ together offers significant strengths in assessing physical activity levels. Such that the high validity of both questionnaires ensures reliable cross-validation of results, while their coverage allows for a thorough understanding of activity across different

domains. Additionally, this combination is cost-effective, enabling large-scale assessments without the need for expensive equipment.

The Detecto eye-level mechanical weigh beam and its stadiometer will be used to measure the weight and height for precision and reliability.<sup>31</sup> Furthermore, the Detecto scale has both components established as the ‘gold standard’ for measuring height and weight: a standing scale and a stadiometer, respectively.<sup>32</sup> Correspondingly, standardised non-stretch body tape measures will be used to assess the waist and hip circumferences of the participants, following Casadei and Kiel’s recommendations.<sup>33</sup>

## Procedures

The data-gathering procedure will include two phases. Phase 1 involves obtaining approval from the Ethics Review Committee to ensure the study’s ethical foundation. This phase would also include strategic planning, budgeting and coordinating with the secretary general to be followed by the principal of the UST SHS department. Additionally, the group will organise a health promotion talk, conduct interest checks and promote the study through the posting of publication materials on social media. These materials will outline the study’s purpose, participation criteria and associated components, such that:

1. Interested students must complete an informed consent form before participating.
2. The activity will entail the collection of their demographic information and presence of regular athletic activities, taking off their anthropometric measurements and answering the IPAQ and GPAQ. Moreover, they will be asked to state their primary mode of transportation to and from school.
3. Participation will involve attending a talk on physical activity to educate participants about its importance.

Following Phase 2, participants will be recruited and asked to pre-register and fill out the informed consent forms (ICF) indicating their approval to participate in the study. The research group will be requesting UST SHS faculty members to serve as witnesses to the participant’s completion of the ICF. Participants under the age of 18 will fill out a separate ICF cosigned with a parent or guardian, unlike those aged 18. Participants will also be provided with a list of guidelines outlining expectations, such as the need to obtain their demographic information, strand and anthropometric measurements, which include hip and waist circumferences, height and weight, which will be taken individually in a typical classroom of the UST SHS building by the research team. Included in the instructions before the assessment is the necessity to wear appropriate attire. During the anthropometric measurement, participants will be asked to don cycling shorts and a fitting shirt, standing erect with weight evenly distributed on both feet. Height and weight will be measured using the Detecto eye-level mechanical weigh beam while the participants are barefoot. Moreover, waist circumference will be measured around the midpoint of

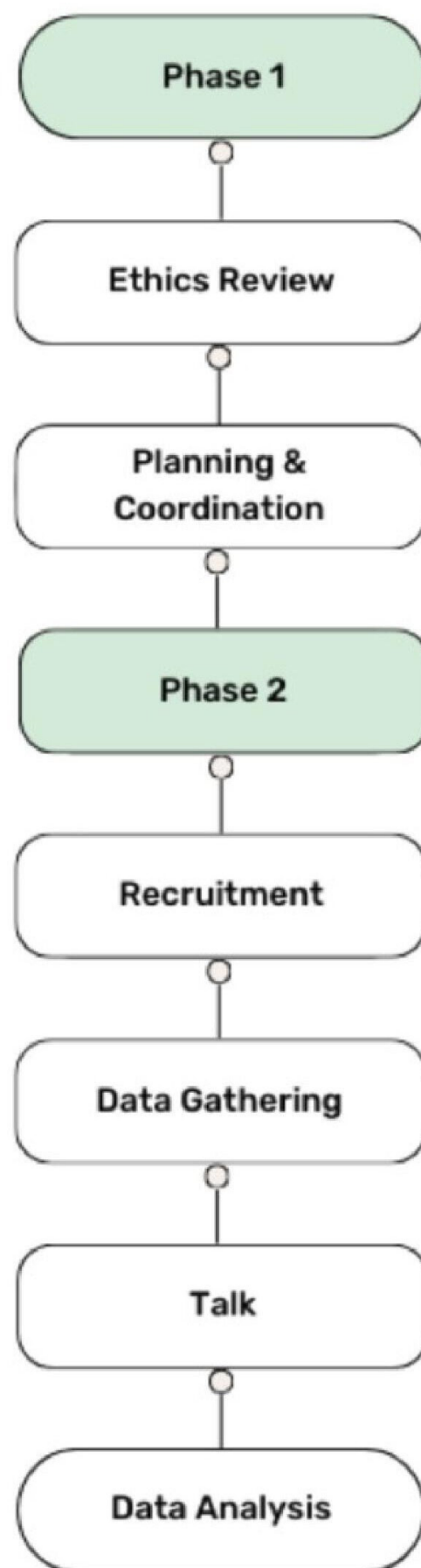
the lower ribs and iliac crest, while hip circumference will be assessed at the largest circumference around the buttocks using standardised tape measures.<sup>34</sup> The body mass index (BMI) and the waist-hip ratio will be calculated by the researchers afterwards. Specifically, the BMI will be computed by dividing the weight in kilograms by the square of the height in metres (weight/height),<sup>2</sup> and the waist-hip ratio will be computed by dividing the waist circumference by the hip circumference (waist circumference/hip circumference).<sup>35 36</sup>

To assess the participant's level of physical activity, the IPAQ and GPAQ will be used and physically distributed by the research team after the measurements. To mitigate the effects of confounding variables, additional information will be gathered, including the athletic activities of the participants, such as sports activities and gym memberships. Furthermore, to minimise potential selection bias, the team will be asking about the mode of transportation at the endmost part of the data collection. This approach will help ensure objectivity among researchers when collecting anthropometric measurements from participants, reducing the likelihood of disparities. The team will ensure that data confidentiality and security are upheld throughout the data collection.

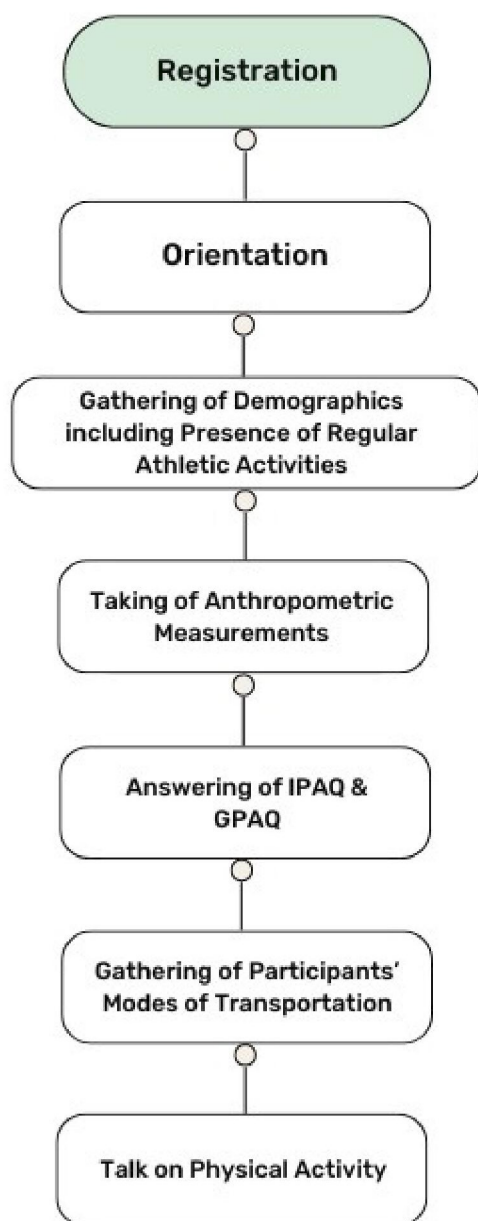
Subsequently, a 30-min talk will be conducted aimed at promoting and enhancing awareness of physical activity among the youth, designed to reinforce participants' knowledge. A licensed Physical Therapist will be present to supervise the whole process. Data analysis will follow thereafter. Figure 1 outlines the process of data gathering from phases 1 to 2 which will span from January 2024 to November 2024. Meanwhile, figure 2 outlines the timeline of implementation on the day of data collection, which includes the steps a participant may expect to take.

### Data analysis

Descriptive statistics will be used to describe the population using the frequency, proportion, mean, median and SD. This analysis will enable the categorisation of participants into their modes of transportation: active, passive and mixed transport groups. Furthermore, the participant's demographic information, anthropometric measures, programmes and levels of physical activity will also be characterised. Their physical activity levels will be determined through their computed responses to the IPAQ and GPAQ. The information on different modes of transportation and levels of physical activity will be analysed using Spearman's Rho, wherein Cohen's recommendation of interpretation of relationship is used, where  $|r| < 0.10$  is considered a weak relationship,  $0.30 |r| 0.50$  is considered a moderate relationship, and  $|r| > 0.50$  is considered a strong relationship. On the other hand, Kendall's tau is undertaken to determine the relationship between the different modes of transportation and anthropometrics. Statistical significance is accepted at  $p < 0.05$ . Should there be any missing data, a single imputation method will be used wherein a single estimated value will be used to fill in the missing data and standard statistical



**Figure 1** Data gathering procedure.



**Figure 2** Timeline of data gathering. GPAQ, Global Physical Activity Questionnaire; IPAQ, International Physical Activity Questionnaire.

methods will be applied to complete the resulting data.<sup>37</sup> Additionally, visual sensitivity analysis will be used to give a representation of the relationships between the dependent variable with each of the independent variables.<sup>38</sup> All analyses will be done using IBM Statistical Packages for Social Sciences V.23 with the significant level set at alpha 0.05.

#### Patient and public involvement statement

None.

#### ETHICS AND DISSEMINATION

Ethical approval has been granted by the University of Santo Tomas—College of Rehabilitation Sciences Ethics Review Committee (UST-CRS ERC) and will comply with

the principles of the Declaration of Helsinki, Ethical Guidelines on Health-Related Social Research of the Philippine Health Research Ethics Board and Data Privacy Act 2012. All data and information collected will be securely stored in a 10-character password-protected Google Drive folder, which will only be accessible to the researchers. Hard copies of the questionnaire will be safeguarded in the residence of the group's liaison officer. The data gathered will then be securely stored for the duration of the study, and it will be destroyed 10 years after publication of results by the rules and provisions of RA 10173 or the Data Privacy Act. The results of the study will be disseminated to the participants and fellow SHS students from UST. All results, regardless of outcome, whether positive or negative, will be accessible through publication or by reporting to the participant through email and other relevant authorities. A copy of the final manuscript will be submitted to the UST-CRS ERC. There are no conflicts of interest presumed to occur between researchers and participants of this study.

Participants will be asked to fill out the ICF distinct to their age group: 18-year-olds and 16- to below 18-year-olds. These documents will encompass information regarding their participation, including the scope of the study, expected procedures and their rights. The ICF for participants below 18 years old will primarily be addressed to their parents or legally authorised representatives (LAR). The document, signed by the parent/LAR and cosigned by the participant, will be collected to confirm their consent for participation.

The study is of a low-risk nature in terms of psychological, social, economic, loss of privacy/confidentiality and legal aspects drawn from the data-gathering of the participant's personal information and measurements, such that they may be effectively managed by the researchers. Meanwhile, the research will indirectly benefit the participants through knowledge transfer on the relationship between physical activity and mode of transport and through taking part in a study that will benefit various facets of society in terms of health awareness and promotion in facilitating lifestyle changes with regards to physical activity on a personal and societal scale. Despite the risks outweighing the benefits in number, such risks are modifiable and may be mitigated by the researchers. Managing the risks one by one would lead to a better methodology and assurance that the dignity and safety of the participants are prioritised. Thus, ultimately facilitating improvement in the quality of the study.

In response to the psychological risk of possible mental fatigue while answering the questionnaires, the researchers have given the participants the liberty to take breaks or withdraw their participation in the study at any moment. The researchers will also be the ones to privately take the participant's anthropometric measurements for concerns regarding body image. To address potential social risks, such as embarrassment about the participant's mode of transportation due to associated negative stigma, the researchers will strictly enforce privacy



and confidentiality at all times. All collected information will remain confidential and be shared only between the researchers and the participants. To address legal concerns, parents or guardians of underaged participants will be notified via short messaging services or email to ensure the authenticity of consent forms and prevent any forgery of signatures with regard to the participation of their child in the study. Additionally, prior to scheduling the data collection, a survey will be conducted to determine the participants' preferred time and date to minimise disruptions of daily routines.

To ensure confidentiality and privacy, the researchers will thoroughly explain the protection and disclosure policies in place to safeguard each participant's rights and privacy. Protection policies include measures to minimise harm and protect personal information, wherein soft copies containing such data will be securely stored in a password-protected Google Drive folder with only the researchers having access. Moreover, hard copies of the answered questionnaires will be securely stored in the residence of the group liaison officer. Coded identifiers will also be implemented to protect participants' identities and information. All collected data will be kept at the said locations for 10 years after the publication of the results and will be destroyed and deleted after the set duration to ensure that no misuse occurs. Meanwhile, disclosure policies address how and when data may be shared with others. The completed paper will be disseminated to the participants via email and publicly shared through publications or conferences, and they may gain access to their own information on request. To ensure data privacy, the names of the participants will not be included in the data gathered, and coded identifiers will be used. The records will be securely stored for 10 years and the privacy of all participants will be maintained throughout the study.

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**Contributors** DM introduced the research concept and, alongside ZMS, oversaw the drafting and revision of the proposal. AAE, NEIC, JD, DNL, IML and AYW conducted literature reviews, gathered references and collaborated on writing the proposal, with guidance and input from DM and ZMS. Guarantor is DM. AI was used to reference sources, edit minor grammatical errors and edit for cohesion.

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