ORIGINAL ARTICLE

The Effectiveness of Vestibular Stimulation in Reducing Academic Stress among Student Nurses in School X

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ABSTRACT

Background. Vestibular stimulation, particularly through rhythmic swinging, has been associated with relaxation, stress reduction, and improved psychological well-being by modulating physiological and emotional responses. Academic stress is highly prevalent among nursing students due to demanding workloads, clinical placements, and examinations, negatively affecting their physical health, mental well-being, and academic performance. Despite existing coping strategies, the potential of vestibular stimulation as a stress management intervention among student nurses remains underexplored.

Objective. This study aimed to determine the effect of vestibular stimulation, specifically swinging, in reducing academic stress among student nurses, evaluating its effectiveness across year levels and assessing variations in duration and position. Grounded in Ulrich's Stress Reduction Theory, it investigated the physiological and psychological mechanisms through which vestibular stimulation may alleviate stress.

Methods. A quasi-experimental design was used with 78 student nurses from School X in Baguio City, stratified by year level. Participants were 18 years and above and physically capable of performing the intervention. Those with medical conditions, musculoskeletal issues, orthostatic intolerance, mental health treatment, recent stress interventions, and weighing over 100 kg were excluded. Participants were randomly assigned to intervention and control groups. The intervention group received vestibular stimulation in lying and sitting positions for five and ten minutes, while the control group followed their usual routines. Stress levels were measured using the Perceived Academic Stress Scale (PASS). A two-way ANOVA tested the effects of position and duration on stress levels, with Bonferroni post hoc tests at $p < 0.05$.

Results. The intervention group showed a significant reduction in academic stress compared with the control group. Differences in stress reduction were noted based on duration and body position.

Conclusion. Vestibular stimulation effectively reduces academic stress among student nurses by triggering physiological responses linked to relaxation. Integrating this intervention into nursing education is recommended, including creating campus spaces that support its use.

Keywords: vestibular stimulation, academic stress, student nurses

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INTRODUCTION

Vestibular stimulation has emerged as a promising tool for relaxation, heightened focus and attention, pain relief, sleep promotion, stress management, and cognitive improvement.[1] Beyond maintaining balance and equilibrium, the vestibular system interacts with multiple brain areas, regulating various body mechanisms.[2] It also modulates heart rate, blood pressure, and stress responses via vagal activity and inhibition of the hypothalamic-pituitary-adrenal and sympathetic-adreno-medullary axes.[3] Various approaches exist, including caloric, galvanic, electrical, vibration-induced, and mechanical stimulation. Among these, mechanical stimulation through rhythmic swinging effectively engages the vestibular system, eliciting sensory and emotional responses.[4] It also shows value in therapeutic interventions for sensory processing disorders and facilitates relaxation.[5,6] It also has effects on balance in quadriplegic cerebral palsy, with improvements in behavior, emotions, psychology, and interactive learning.[7]

Academic stress remains a significant concern, particularly for nursing students, arising from heavy workloads, clinical placements, and examination pressures.[8-10] Stress adversely affects physical and mental health, causing fatigue, pain, reduced immunity, and contributing to illnesses such as hypertension, heart disease, and immunodeficiency disorders.[11,12] It also impairs concentration, memory, skill development, academic performance, self-esteem, and self-efficacy. Given these effects, interventions are crucial, as academic stress is linked to anxiety, depression, and unhealthy lifestyle habits.[13,14]

While numerous coping strategies exist, interventions targeting vestibular stimulation, especially mechanical methods like swinging, remain underexplored, particularly in the Philippines. This study aims to investigate the effect of vestibular stimulation on academic stress among student nurses, offering a potential avenue for novel interventions and contributing valuable insights to stress management strategies in academia.

Theoretical Framework

The current study was supported by the Stress Reduction theory, which suggests that exposure to natural environments or elements can elicit positive physiological and psychological responses that counteract stress.[15] This theory emphasizes constructs, such as stress, stressors, natural environment, biophilia, recovery, or restoration. Stress arises when an individual encounters a challenge or threat affecting their psychological, physiological, or behavioral well-being. Environmental stressors, including crowding, noise, or pollution, can exacerbate stress, whereas natural stimuli tap into humans' inherent biophilic connection, promoting relaxation, restoration, and improved functioning.

In this study, stress is defined as the natural response to a stressor, with academic stress specifically referring to stress experienced by student nurses due to workload and clinical placements. Student nurses often report higher stress levels than peers in other healthcare disciplines, with clinical training being particularly demanding. Responses to academic stress may include emotional, cognitive, and physiological reactions such as anxiety, tension, and fatigue.

Vestibular stimulation, specifically through swinging, was examined as a mechanism for stress recovery. The rhythmic motion activates the vestibular system, inducing balance, spatial orientation, and calmness, which support relaxation and reduce negative affect. The theory highlights the importance of environmental and sensory factors in facilitating stress reduction, supporting the potential of swinging as a practical intervention to alleviate academic stress among student nurses.

Significance of the Study

The study on vestibular stimulation explores its potential to reduce stress and improve well-being, which is particularly important for student nurses facing demanding academic and clinical responsibilities. By providing non-pharmacological tools for stress management, vestibular stimulation may enhance mental health and academic performance. Furthermore, its application extends to healthcare settings, where nurses can incorporate vestibular techniques into holistic care plans to mitigate stress-related health issues and promote patient wellness. Implementing vestibular activities in educational institutions or communal spaces, such as swings in recreational areas, offers accessible opportunities for relaxation, sensory engagement, and social interaction. These interventions not only support individual stress reduction but also foster a conducive environment for learning, resilience, and overall community well-being.

OBJECTIVES

The study aimed to identify the effect of vestibular stimulation on the level of academic stress among student nurses. Specifically, it aimed to answer the following questions: (1) What is the effect of vestibular stimulation in reducing academic stress levels among student nurses according to year level? (2) Is there a significant difference in the academic stress among student nurses when the vestibular stimulation is divided according to duration (a) 5 minutes and (b) 10 minutes, and position (a) lying and (b) sitting.

MATERIALS AND METHODS

Study Design

This quantitative study used a quasi-experimental design, involving manipulation and randomization, but lacks control. The manipulation is the vestibular stimulation using the hammock at different durations and positions.

Locale and Population

The study was conducted from March 2024 to May 2024 in Baguio City, with intervention sessions held at participants' homes to reflect natural and restorative environments, consistent with Ulrich's Stress Reduction Theory. This approach aimed to reflect real-life conditions, acknowledging variations in environmental factors such as noise and visual stimuli. A total of 80 nursing students from levels I to IV of School X, aged 18 and above and physically capable of performing the tasks, were selected using stratified random sampling, with 20 participants per year level requested from Department Heads and pre-screened for eligibility. Exclusion criteria included weight over 100 kg, medical conditions, ongoing stress or mental disorder treatments, joint or muscular problems, orthostatic intolerance, or recent participation in stress-reducing interventions. Additional selections were requested as needed to meet the target sample size. Sample size was based on Gay's formula, recommending a minimum of 15 participants per group, with extra participants included to account for potential withdrawals.

Participants were randomly assigned via the fishbowl method into an intervention group (n = 60) and a control group (n = 20), with a larger intervention group to improve precision in estimating effects, as supported by Batistatou et al.[16] Two participants from the intervention group withdrew, leaving 78 participants.

Data Gathering Tool

The Perception of Academic Stress Scale (PASS) by Bedewy and Gabriel in 2015 was used as a pre-test and post-test measure.[17] The 18-item Likert scale evaluates stress levels as low (18 to 41), moderate (42 to 66), or high (67 to 90). Reversed scoring was applied to items 1 to 5 to reduce response bias. The instrument demonstrated strong internal consistency, reliability, content, and convergent validity, with a Cronbach's alpha coefficient of 0.7, indicating strong item relationships. In the Philippines, a study utilized this tool to assess academic stress, achieving a higher CVI score.[18] The PAS scale had a Cronbach's alpha of 0.89 in the study, compared to 0.7.[17]

Data Collection

Participants were recruited via coordination with Department Heads and divided into four subgroups based on year level. Orientation sessions were conducted to explain the study, obtain informed consent, administer the PASS pre-test, and provide intervention materials. Random allocation into intervention and control groups was performed using the fishbowl method, with five participants per year level assigned to the control group and the remainder to the intervention group. Blinding was not feasible due to the nature of the intervention, but standardized instructions and schedules were applied to minimize bias.

Participants received unique codes and access to personal Google Drive folders to submit weekly post-test results and supporting documentation. Weekly reminders were sent via Messenger and email. Researchers review submissions, compute post-test results, and systematically recorded data in a Google Sheet for monitoring and analysis.

Materials

The materials utilized in this study included a hammock and a nylon/polypropylene rope. The hammock is a portable cotton rope with a length of 75 inches, a width of 60 inches, and a maximum support weight of 450 pounds or 204 kilograms. Each hammock has 2 Nylon/Polypropylene ropes with a diameter of 8 millimeters and a length of 1 meter or an estimated 3 ft for each side of the hammock for hanging.

Protocol

The institutional procedure involved sending a letter to the Department Heads of each year level in the Bachelor of Science in Nursing program at School X for their assistance in identifying participants by utilizing stratified random sampling. The selected participants were recruited into assigned groups (intervention and control) by the researchers through the use of the fishbowl method with no involvement from the promoters. Afterwards, the researchers proceeded to the protocol of the research, wherein it is divided into three phases: the Preparation phase, the Experimental phase, and the Post-Experimentation phase. Detailed procedures are provided in the Appendix Figure 1.

Safety of Research Subjects/Participants

The researchers performed a safety test of the hammock to test its strength and durability to ensure that there was no physical harm to the participants during the research. Furthermore, the researchers instructed and demonstrated how to install, tie, and secure a hammock. A return demonstration was conducted to test the participants' knowledge. Due to the participants' refusal to allow site visits and strict dormitory rules, the researchers' site visits were not done. Instead, the researchers asked the participants to upload photos of the hammock set up as well as close-up photos of the tied knot to ensure proper and safe setting of the hammock.

Data Analysis

To address the first objective, mean stress levels per year were calculated, and descriptive statistics, including percentages, were used to assess the effect of vestibular stimulation on the stress levels of student nurses across year levels.

For the second objective, a two-way ANOVA tested the effects of position, duration, and their combination on academic stress levels. Although the two-way ANOVA identified overall differences among the variables, it did not pinpoint where those specific differences lay. Bonferroni post-hoc tests were performed to identify significant differences among intervention groups, with $p < 0.05$ considered significant. All analyses were conducted using Google Sheets.

The individual participant was the unit of analysis and assignment, so no multilevel adjustments were required. With two participants withdrawing (final n = 78), an intention-to-treat approach was applied to preserve validity. Missing post-test data were handled using "hot deck" imputation, replacing missing values with scores from participants with similar baseline characteristics.

Ethical Considerations

The study received ethical clearance from the Saint Louis University Research Ethics Committee (SLU-REC 2024-018), with final approval on February 27, 2024, and an amendment for intervention schedule adjustments approved on March 22, 2024.

Participants were provided with informed consent and were assured of voluntary participation. Data were coded to protect privacy, with digital files stored in password-protected Google Drive and printed files kept in a locked cabinet accessible only to researchers. Randomization minimized bias, and each participant received a hammock, including those who withdrew.

Safety measures included using cushions under the hammocks to prevent injury, and potential risks such as dizziness or motion sickness were acknowledged. The intervention offered potential benefits, including stress reduction and improved well-being. Two participants withdrew due to health and time constraints but retained their hammocks.

Table 1. Baseline Demographic and Clinical Characteristics of Participants by Study Group

Characteristic	Intervention (n = 58)	Control (n = 20)
Age, mean ± SD (years)	19.8 ± 0.304	19.8 ± 0.565
Sex, n (%)		
Male	25 (43%)	9 (45%)
Female	33 (57%)	11 (55%)
Year Level, n (%)		
First-year	15 (26%)	5 (25%)
Second-year	15 (26%)	5 (25%)
Third-year	15 (26%)	5 (25%)
Fourth-year	13 (22%)	5 (25%)
Baseline Academic Stress Score, mean ± SD	57.9 ± 1.056	59.5 ± 0.433

RESULTS

The results obtained from 58 student nurses of school X, comprising 15 first-year, 15 second-year, 15 third-year, and 13 fourth-year students, will be presented in three sections. The first section describes the baseline demographic and clinical characteristics of participants in the intervention and control groups, showing that the groups were comparable in age, sex, and baseline stress levels. The second section discusses the effectiveness of vestibular stimulation in reducing academic stress, while the third section examines the numeric difference in academic stress reduction to vestibular stimulation based on duration and position.

Table 1 shows the baseline demographic and clinical characteristics of participants in the intervention and control groups. The mean age was similar between groups, with participants in the intervention group averaging and those in the control group. The sex distribution between the intervention and control groups was closely aligned, with only slight differences in the proportions of male and female participants. Participants were evenly distributed across year levels in both groups. Baseline academic stress scores were slightly lower in the intervention group compared to the control group, indicating that the groups were generally similar prior to the intervention.

Table 2 presents the pre-test and post-test mean PASS scores of student nurses across year levels. Each year level showed a significant decrease from pre- test to post-test scores, indicating that vestibular stimulation consistently lowered perceived academic stress. Thus, the hypothesis that vestibular stimulation has no significant effect on reducing academic stress levels among student nurses according to year level is not substantiated.

Table 3 shows the significant difference in academic stress among student nurses according to duration and position of vestibular stimulation. The results show a reduction in academic stress levels following all intervention conditions, with varying degrees of improvement.

Prolonged exposure to the intervention resulted in greater stress reduction, and the lying position had a greater effect on stress relief than the sitting position. Overall, these results suggest that both longer duration and lying position

Table 2. Effect of Vestibular Stimulation in Reducing Academic Stress Level among Student Nurses according to Year Level

Level	Pre-Test Mean Score	Interpretation	Post-Test Mean Score	Interpretation	Numeric Difference (%)
1	56.33	M	52.63	M	-3.70 (6.57%)
2	56.33	M	50.70	M	-5.63 (9.99%)
3	57.47	M	48.88	M	-8.59 (14.9%)
4	62.08	M	53.27	M	-8.81 (14.19%)

Interpretation:
18-41: Low Academic Stress Level (L)
42-66: Moderate Academic Stress Level (M)
67-90: High Academic Stress Level (H)

Table 3. Difference of Academic Stress According to Duration and Position

Pre-Test Mean Score		Post Test Mean Score	Interpretation	Difference	SD
57.9137931	5 Minutes Sitting	56.72413793	M	-1.18965517	10.25
	5 Minutes Lying	49.94827586	M	-7.96551724	9.62
	10 Minutes Sitting	53.20689655	M	-4.70689655	9.74
	10 Minutes Lying	45.34482759	M	-12.56896551	10.21

Duration p-value = 0.002344879943
Position p-value = 0.00000008028754916

Interpretation:
if the p-value is <0.05, then there is a significant difference
if the p-value is >0.05, then there is no significant difference

produced more pronounced decreases in stress levels among participants.

A two-way ANOVA was conducted to examine the effects of duration and position on the measured variables. The analysis revealed a significant main effect of duration, $F(1,228) = 9.47$, $p = 0.002$, with a small effect size (partial $\eta^2 = 0.040$, 95% CI [0.010, 0.089]), indicating that the duration of vestibular stimulation had a statistically significant impact on stress scores. Additionally, a significant main effect of position was observed, $F(1,228) = 30.77$, $p < 0.001$, with moderate effect size (partial $\eta^2 = 0.119$, 95% CI [0.063, 0.181]), suggesting that the position also significantly influenced the outcome variable.

The interaction between duration and position, however, was not significant, $F(1, 228) = 0.17$, $p = 0.681$, partial $\eta^2 = 0.001$, 95% CI [0.000, 0.010], indicating that the effect of duration did not depend on position. Descriptive statistics showed that 10-minute and seated conditions had the highest mean scores, while those in the 5-minute and lying conditions had the lowest. These results indicate that duration and position independently influence the outcome variable, but there is no combined effect.

Furthermore, a post hoc analysis using Bonferroni correction was conducted to compare the mean differences between different experimental conditions. The significance level was adjusted to 0.00833 to account for multiple comparisons.

There was a significant difference when 5 minutes of sitting was compared with both 5 minutes of lying and 10 minutes of lying. Similarly, 10 minutes of lying showed a significant difference when compared with 5 minutes of lying and 10 minutes of sitting. In contrast, there was no significant difference between the two sitting durations, nor between 10 minutes of sitting and 5 minutes of lying.

The decrease in stress levels is higher when vestibular stimulation is extended to 10 minutes compared to 5 minutes, and also higher when vestibular stimulation is done in a lying position compared to a sitting position. This suggests that a longer duration of vestibular stimulation may have a more beneficial effect in reducing academic stress among student nurses, and lying down may have a more pronounced effect in reducing academic stress than sitting.

No adverse or unintended effects were observed in any of the study conditions. Participants tolerated all vestibular stimulation protocols well, and no incidents of dizziness, nausea, or discomfort were reported. Hence, no effect size or confidence interval was computed for adverse effects.

DISCUSSION

Effectiveness of Vestibular Stimulation in Reducing Academic Stress

The reduction in stress levels may be attributed to the calming rhythmic movement produced by vestibular stimulation. Swinging activates the vestibular system, triggering the release of serotonin and dopamine, which are neurotransmitters linked to relaxation and improved mood. This is consistent with findings that vestibular stimulation activates the midbrain structures, particularly the periaqueductal gray, promoting serotonin release and inhibiting anxiety-related brain regions.[19] Similarly, activation of the dopamine reward system has been shown to counteract negative emotions and reduce stress. [20]

Beyond neurotransmitters, vestibular stimulation may also influence cortisol regulation. Decreasing cortisol signals the attenuation of the stress response, leading to decreased physiological arousal and increased relaxation. Prior studies confirm that swinging can reduce cortisol levels, likely through modulation of the HPA axis, GABA release, and hippocampal activation.[21] This aligns with reports that vestibular input influences prefrontal cortex activity, which plays a key role in modulating emotional responses and stress regulation.[22]

Higher pre-test stress levels among senior students may be due to increased academic expectations, heavier clinical responsibilities, and pressure associated with graduation.[23-25] These findings parallel literature describing heightened stress in upper-year student nurses, especially those nearing program completion. The greater reduction in stress among higher-year levels suggests that vestibular stimulation may serve as an effective additional coping strategy. This corresponds with evidence that older or more experienced student nurses demonstrate greater resilience, making them potentially more responsive to interventions like vestibular stimulation.[26]

These outcomes are consistent with Ulrich's Stress Reduction Theory, which proposes that exposure to soothing environmental stimuli can elicit positive physiological and psychological responses.[15] The consistently decreased stress levels observed in this study support the theory's assertion that restorative stimuli, such as rhythmic motion, promote relaxation and recovery from stress. Thus, the hypothesis that vestibular stimulation has no significant effect on academic stress is not supported.

Vestibular Stimulation according to Duration

The significant decrease in stress levels observed with 10 minutes of vestibular stimulation compared to 5 minutes suggests that a longer duration of stimulation is more effective in alleviating academic stress among student nurses. This finding aligns with Ulrich's Stress Reduction Theory, which emphasizes the restorative effects of natural stimuli, such as rhythmic motion, on physiological and psychological relaxation.[15] Although prior studies largely examine galvanic vestibular stimulation (nGVS), they consistently show that extended stimulation produces stronger physiological effects, such as improved postural stability and enhanced adaptive responses in perception and reflex activity.[27,28]

Research also indicates that low-intensity vestibular stimulation applied over longer intervals can be more effective than shorter, high-intensity sessions, reinforcing the finding that a 10-minute swinging period may provide optimal stress relief.[29] Similar evidence shows that long-term vestibular interventions yield cumulative benefits, with stress levels decreasing further after several months of continued stimulation.[30]

Vestibular Stimulation according to Position

The greater reduction in stress among participants in the lying position. Compared to the sitting position highlights the importance of posture in modulating relaxation. Existing literature aligns with this pattern, like yaw rotation in a supine orientation has been associated with increased comfort,[3] while yoga practices emphasize the restorative effects of lying positions, which promote deep breathing, muscle relaxation, improved venous return, and reduced cardiac workload.[31,32] Shavasana, for example, lowers cardiovascular resistance and hydrostatic pressure, supporting a parasympathetic state conducive to stress reduction.[33] Qualitative findings also show that lying down fosters bodily awareness and calmness, consistent with Polyvagal Theory, which links comfortable, low-effort positions to activation of the parasympathetic branch of the vagus nerve.[34,35] Moreover, these results align with Ulrich's Stress Reduction Theory, which posits that environments or positions promoting natural, restful states, similar to lying down in a relaxed posture, enhance physiological and psychological recovery, supporting stress reduction among student nurses.[15]

Limitations

While this study provides valuable insights into the effectiveness of vestibular stimulation as a stress management intervention among student nurses, several limitations should be acknowledged. The sample size and the focus on a specific group of student nurses from a single institution may limit the generalizability of findings to broader populations of student nurses, as characteristics such as age, gender, baseline stress levels, or educational context could influence intervention outcomes and hinder the ability to extrapolate the results to a more diverse population. Additionally, the study's focus on a specific duration and intensity of vestibular stimulation may restrict the exploration of dose-response relationships and optimal intervention parameters. Examining a broader range of stimulation durations and intensities could offer valuable insights into how varying levels of stimulation impact stress reduction outcomes. The short duration of the intervention may also not fully capture the long-term effects of vestibular stimulation on stress reduction. Furthermore, the study design limits the exploration of vestibular stimulation's effectiveness by implementing it only three times per week, potentially leaving key aspects of its benefits underexplored. Potential moderating or mediating factors, such as individual differences in coping styles, personality traits, or prior experiences with stress management techniques, were not examined, which could have influenced the outcomes of vestibular stimulation interventions. Although the study included post hoc analysis using Bonferroni correction and tested for interaction effects, the nonsignificant interaction term suggests that combined effects of duration and position may not have been fully captured. Lastly, as the study relied on self-reported stress scores, potential response bias and minor imprecision in measurement tools could influence the precision of the findings.

In addition to these limitations, the fidelity of the vestibular stimulation intervention was maintained throughout the study. Each participant was instructed to upload weekly videos of their vestibular stimulation sessions, which the researchers reviewed to confirm adherence to the assigned duration and position. Weekly reminders were also sent to ensure consistency and compliance. However, since sessions were not directly supervised, full control over adherence could not be guaranteed, and minor variations in how participants performed the intervention may have occurred. Despite this, the overall consistency in documentation suggests acceptable fidelity in implementation.

CONCLUSION

The study demonstrates that vestibular stimulation effectively reduces academic stress among student nurses, with a 10-minute duration and a lying position producing the most significant effects.

These findings highlight the value of integrating vestibular stimulation into nursing education as a practical

stress-management strategy. Nursing programs may establish recreational spaces with swings and incorporate these techniques into wellness initiatives to promote resilience and self-care.

Psychiatric nursing instructors can also adapt vestibular stimulation as an additional tool for managing psychological distress. Future research is encouraged to explore extended durations and the specific influence of lying positions to assess the potential and optimal outcomes of the intervention.

Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

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APPENDIX

Detailed Procedural Protocol for Vestibular Stimulation Intervention

Phase 1 – Preparation Phase

The preparation phase involved the necessary steps taken by the researchers and participants before implementing the intervention.

Researchers

During the preparation phase of the study, the researchers identified the participants through the help of the Department Heads, and opted to get their schedule. The necessary materials, including the informed consent form, hammock, ropes, and PASS tool questionnaire was also prepared. The materials for the study were bought online through a shopping application. To ensure the hammock's proper setup, the researchers identified two sturdy poles or structures suitable for supporting the hammock. The ropes were then securely attached to each side of the hammock and was hung on each pole or structure achieved by tying a two-half hitches knot. Following the setup, a safety test was conducted by placing a 100 kg sack of rice on the hammock to evaluate its strength and load-bearing capacity. The safety test was done on each hammock to ensure the safety of the participants.

Intervention Group

The intervention group attended a face-to-face orientation conducted by the researchers, during which the purpose and procedures of the study were explained, informed consent was obtained, and pretest was also done. Responses were collected, checked for completeness, and was returned if incomplete. Participants were then informed of their assigned groups and provided with a personal Google drive link via their email for uploading evidence and post tests. Each participant received one hammock and two nylon ropes. A checklist and an instructional video created by the researchers were provided, demonstrating the proper knot-tying technique and safe hammock installation. Verbal instructions emphasized selecting a suitable and stable area in their homes with two sturdy structures capable of supporting their weight. Participants were instructed to use the two-half hitches knot, adjust the sag to approximately 0.6 meters (2 feet), and place a cushion or pillow underneath for safety and comfort.

Due to the researchers' inability to conduct home visits for the 60 intervention participants, they were asked to submit photographs or videos showing the knot-tying and setup process to verify correct installation. Once their submissions were reviewed and approved by the researchers, participants proceeded to the experimental phase, where vestibular stimulation was performed.

Control Group

The control group also underwent a face-to-face orientation conducted by the researchers, during which the purpose and procedures of the study were explained, informed consent was obtained, and pretest was also done. The control group identified the specific coping mechanisms that they were using for stress management. The researchers advised them to continue with their specific coping mechanisms for stress management. Similarly, the control group was also provided with a personal Google drive link via their email to upload their post tests every week. An explanation of the PASS tool and instructions for answering the questionnaire were done. Responses were collected, checked for completeness, and was returned if incomplete. Those who completed the questionnaire were then dismissed.

Phase 2 – Experimental Phase

This phase involved the implementation of the intervention, in which the intervention group used a swing for vestibular stimulation, while the control group continued with their usual routines. The intervention and control groups were not gathered together during this phase, as the

intervention was conducted individually in the participants' respective homes. The vestibular stimulation was administered to the intervention group three times per week for four weeks: five minutes in a sitting position during week 1, five minutes in a lying position during week 2, ten minutes in a sitting position during week 3, and ten minutes in a lying position during week 4.

Since the intervention was conducted in the participants' respective homes without direct supervision, there was a potential for noncompliance or reporting bias. To minimize this, participants were required to submit photographic or video evidence of each session which were uploaded in their personal Google Drive folder and received regular reminders from the researchers through Messenger or Google Mail.

The participants then placed themselves on the swing as directed, without assuming a seated position for back-to-front movement and a lying down position for side-to-side motion, each for a predetermined duration. Before getting on the hammock, the participants placed a cushion or pillow underneath the hammock and confirmed its secureness and stability of the setup thoroughly. Upon ensuring its security, the participants set the timer in their phone activating the alarm system to time the performance of doing the intervention. The participants positioned themselves on the hammock's edge, with their feet touching the ground. This minimizes the center of gravity and enhances stability. The participants employed their hands to grasp the hammock's sides, ensuring stability and security. Upon achieving a gentle swinging rhythm, the participants timed their swinging in the hammock.

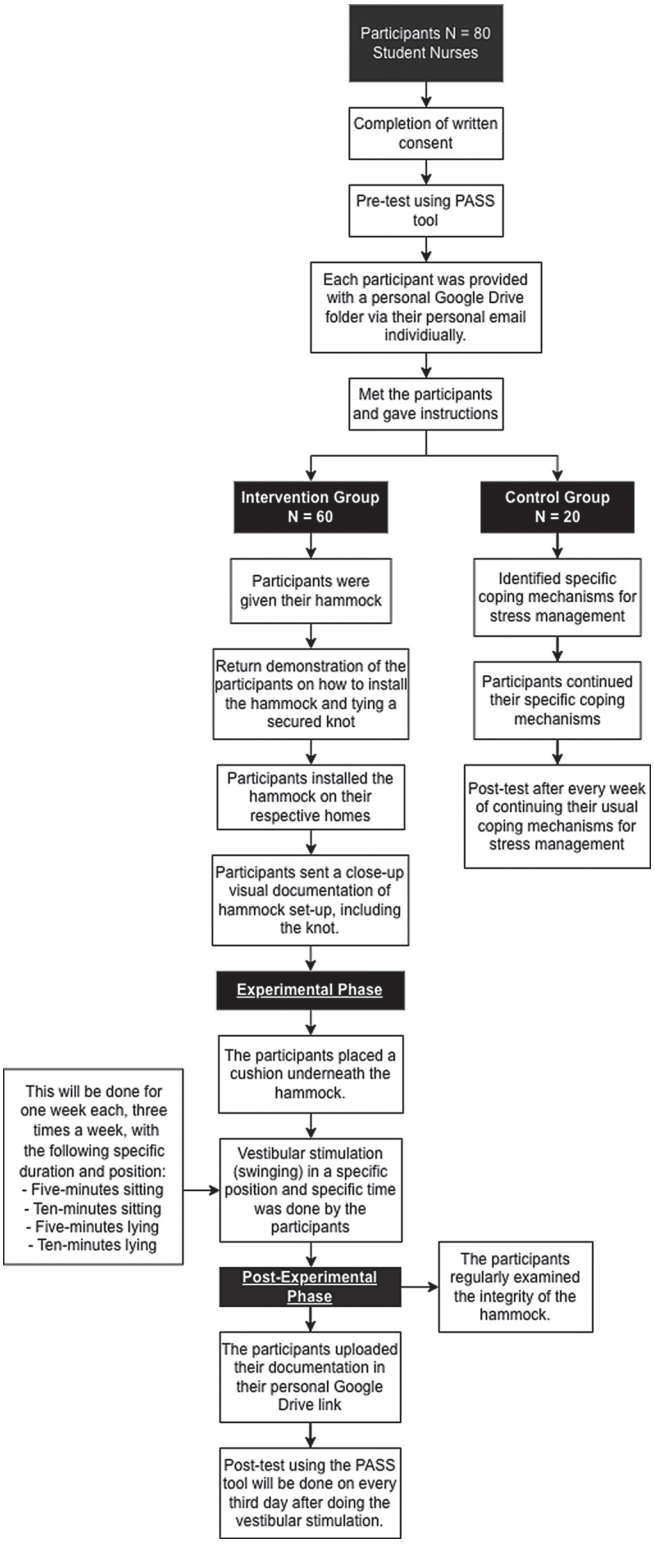
Phase 3 – Post-experimental Phase

This phase involves monitoring patient safety and compliance, ensuring proper use of the hammock, and assessing the effects of the vestibular stimulation.

After the alarm system sets off, the participants reduced the motion, sat cautiously, and stood gradually. The participants also exercised vigilance when entering and exiting the hammock. After the participants got out of the swing, they did some gentle stretching to loosen up their muscles and avoid any stiffness, then proceeded to do their usual activities. After the intervention, the participants regularly examined the hammock to identify any indications of wear and tear and confirmed the security of the knots, ropes, or straps. The participants uploaded their photos and/or videos as evidence in their personal Google Drive folder.

After the third day of doing the vestibular stimulation in a specific duration and position, the participants answered the Perceived Academic Stress Scale as a post-test after doing the intervention. Then, the researchers gathered the post tests' data via face to face and/or by accessing the uploaded data of the participants through their personal google drive folder provided by the researchers. The participants moved to the next specific position and duration after the three-day intervention.

For the control group, the participants had a post through PASS on every week after continuing their usual coping mechanisms for stress management.



Appendix Figure 1. Diagram of Research Protocol.