

# EXAM ANXIETY AND ITS EFFECTS ON COLLEGE STUDENTS' PERCEIVED AND PHYSIOLOGICAL STRESS

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*Students at the University of Wisconsin-Superior participated in this study on exam anxiety and stress. The goal of this research was to look at how exams affect students' perceived and physiological stress and whether college students can recognize their level of stress by correlating it to their physiological stress. Participants at UW-Superior were asked to complete surveys to quantify their perceived stress levels and an electrocardiogram to determine their physiological stress 3 days pre-exam, the day of an exam, and 3 days post-exam. The data was then analyzed and subdivided by gender to look for trends among participants. Results indicated that participants have higher levels of physiological and perceived stress on the day of the exam compared to either pre-exam or post-exam stress levels. While participants identified many factors that influenced their stress levels on all three days, course exams clearly contributed to the perceived and physiological stress that they were feeling as indicated by the significant changes seen between exam and post-exam testing days.*

## **Introduction**

College is known to be a stressful time in students' lives. Academic stressors, including exam anxiety, can lead to chronic stress beyond their time in college. This study investigated University of Wisconsin-Superior students' physiological and perceived stress, to see if college exams have an impact on students' stress levels. Continued research on this topic is so important due to the increased incidence of people facing anxiety, depression, cardiovascular issues, and suicide rates. This study investigated potential stressors to make students more aware of what is causing their stress as a means of helping them work on stress reduction strategies moving forward. It will also spread awareness on how essential combating stress is, to peoples' overall health.

## **Literature Review**

College students struggle daily with stress, e.g., classwork, tests, quizzes, and even external factors such as work, relationships, and extracurricular activities. The stress from these various aspects of life can be detrimental to a person's overall health. Baghurst & Kelley's (2014) study showed that college students are at high risk of declining mental health, due to issues of chronic stress. One thing that

is known to bring about a massive amount of stress is exam anxiety; students often have heightened anxiety during exam times because of the pressure to perform well (Melillo et al., 2011). Stress can lead to many different psychological and physiological effects on students, including mental health disorders, cardiovascular issues, heart attack, strokes, and even suicide. However, there are ways to reduce these harmful effects, such as less time on the internet, exercise, enough sleep, and even time management (Garett et al., 2017). This research is specifically examining students' perceived stress versus physiological stress. Along with looking at how exams affect students' perceived stress and physiological stress, the differences of perceived stress between genders were also considered. Raising more awareness towards this issue can help diminish the amount of stress students are facing every day.

## **Stressors**

Stress is an unavoidable emotional tension that comes with being a college student. When students enter college, they are beginning a very important, developmental period of their lives (Baghurst & Kelley, 2014). Along with this collegiate transition there are many changes and big decisions to be made, and overwhelming challenges that students are faced with. One major stressor for students that comes from school is stress from college exams (Melillo et al., 2011). Results from a study done by Adnan et al. (2012) found that students had more stress at the end of the semester compared to the beginning of the semester, probably due to the amount of university exams that students have at the end of the semester. These exams are usually worth a large portion of the course grade and therefore can either help the grade or hinder it. Having all this pressure on one hour worth of being tested on a specific material is very stressful. Another stressor, going along with exams, is the pressure for perfection. Students that are pursuing high performance majors, such as in the STEM fields have a lot of pressure put on them (Rice et al., 2015). This pressure to achieve good grades and be the best versions of themselves leads to a lot of stress and mental exhaustion. However, the students who strive for perfection often do better than students who do not, but the cost is often students' mental health (Rice et al., 2015).

### ***Perceived Stress***

Perceived stress is something that is easily measurable and is defined as the feelings or thoughts that a person has about the amount of stress that they are currently under (Baghurst & Kelley, 2014). This perceived stress is used to analyze how difficult or uncontrollable people find their lives, and therefore how stressed out they are because of this (Ahuja & Banga, 2014). Naceanceno et al. (2021) found that there was a significant difference in anxiety levels and stress perception among females and males. According to a study, “Female students reported experiencing more stress and reactions to stressors than did male students” (Misra, 2000, pg. 12). This difference of females having higher perceptions of stress is because females rate their experiences as more stressful, which therefore leads to a higher score. The research by Misra et al. (2000) found that “Higher scores on self-imposed stress among females than males indicated that females liked to compete, be noticed, loved, and worry for others, sometimes seeking perfect solutions that lead to higher anxiety and stress” (Discussion section, para. 3). Additionally, females might aspire to achieve more and do several activities at once, including taking care of family, achieving academic excellence, working, and maintaining a social life (Misra et al., 2000). This high achieving desire of females might be what increases their perceived stress levels and causes them to have more stressors and react more to stress.

### ***Stress Effecting Overall Health***

Stress can have both psychological and physiological detrimental effects on a student and impact their overall mental health. Khosrowabadi et al. (2011), found that, “chronic mental stress can influence the brain activity in various mental states” (p. 5). Through the use of a Brain-Computer Interface, they found that the connectivity between brain regions can be used as a biomarker for signs of chronic mental stress. One psychological effect that stress has on a person is mental health disorders. Two of the most commonly diagnosed mental health disorders are depression and anxiety; according to the American College Health Association (2019), 66% of students reported having high, overbearing anxiety in the 2019 spring school semester. There is an “unbelievably high” number of cases of students committing suicide between 15 to 29 years of age (Ahuja & Banga, 2014). Sano et al. (2018) found that one tenth of the college students, out of the approximately 47,000 student sample they were examining, had a plan for suicide with the most common reason behind suicides being a psychological issue, such as depression or anxiety. These

psychological issues can stem from stress and cause a person’s mental health to decline. Cardiovascular disease is a major physiological effect that can be caused by stress (Melillo et al., 2011). Heart disease is the number one leading cause of deaths in the United States, which makes this a very serious issue. Stress can also increase the chance of a heart attack and a stroke (Ahuja & Banga, 2014), and it lowers human performance, even on simple tasks such as a person driving a car or cooking a meal (Melillo et al., 2011). Stress, therefore, affects a person’s overall health and can have major detrimental impacts.

### ***Stress Reducing Strategies***

Stress can be alleviated through different stress reduction strategies, including changing daily tasks and study habits. One example is by changing internet habits; spending less time on the internet has been shown to lower stress (Ahuja & Banga, 2014). The internet is known to be a very time-consuming place for people, and this can interfere with time that could be spent on academics, therefore, leading to increased stress for students (Garett et al., 2017). Another way academic stress can be controlled and managed is through using effective study techniques and having time management (Misra et al., 2000). Students are known to have increased stress around exams, often due to a lack of time management. Participants who were perceived to be in control of their own time had more satisfaction and therefore less stress compared to participants that were not in control of their own time (Misra et al., 2000). Exercise has also been proven to aid in relieving stress (Garett et al., 2017). Adding movement to one’s daily routine can help improve brain function, mood, and physical health. Sleep is another activity that can help ease stress. Getting enough hours of sleep is very important to memory consolidation, which can inadvertently lower stress levels.

In summary, stress can negatively impact a person’s health if the right precautions are not taken, and it becomes too much to handle. Several things can lead to increased stress levels, one of them being college exams (Melillo et al., 2011). However, there are many ways to improve stress levels such as coping strategies and getting a better quality of sleep (Garett et al., 2017). The goal of this current study is to analyze the differences between perceived and physiological stress of students, to look at the correlation of exams and stress, and to spread awareness to how grave of an issue chronic stress can be.

### ***Research Questions***

For this study, I asked three questions:

1. Do college exams have an impact on students’

- perceived stress?
2. Do college exams have an impact on students' physiological stress?
  3. Can college students perceive their level of stress by correlating it to their physiological stress?

This study also explored the differences of stress perception and physiological stress between genders.

### **Hypotheses**

For this research I have developed the following hypotheses: Participants will have a higher perceived stress result on the exam day survey versus the non-exam day surveys. Participants' physiological stress will be higher on the exam day ECG compared to the post-exam day ECG. However, the pre-exam day ECG physiological stress might also be higher due to the stress of doing an ECG for the first time/first time being involved in a research study. Participants perceived stress scores will go up on the exam day in correlation with what their physiological stress shows. Finally, due to trends in past research, females will have overall higher perceived stress than males.

## **Methods**

### **Participants**

The sample included ten students' total: five students from the BIOL 405: Neurobiology class, four students from the CHEM 321: Organic Chemistry II class, and one student from the SO W 325: Crisis Intervention class. Initially there were two different majors chosen: Biology representing the natural science major and Human Behavior, Justice, and Diversity (HBJD) representing the social science major. However, due to a lack of participants, students were recruited from the CHEM 321: Organic Chemistry II class as well. These three classes were used to get a decent sample size and to get enough data on students from both genders. Due to the gender differences of stress perception described above, both females and males were used in the study to analyze if there was variation.

For this study, there was specific inclusion and exclusion study criteria. The inclusion criterion is what the participants must be, while the exclusion criterion is what the participants must not be (Creswell & Creswell, 2018). Inclusion criterion for the sample was that the participant must be an on-campus student at University of Wisconsin-Superior (UW-Superior), due to the physiological measurements that were taken as described below and must be from one of the upper-level classes that were chosen. Upper-level classes are defined as

being 300- or 400-level, according to UW-Superior and are usually junior or senior level classes. The class difficulty was kept at the same level between the three classes, so there wouldn't be a factor influencing the amount of stress for the exams. The criteria for participants to be UW-Superior on-campus students and the need to keep the class difficulty the same ensure the results are as accurate as possible with the least number of variables due to the small sample size.

### **Surveys**

Qualtrics based surveys were used in this study to collect the quantitative data, as well as some qualitative data related to participant perceived stress. The surveys were modified from the Perceived Stress Scale (PSS), included in Appendix A, because "it is the most widely used psychological instrument for measuring the perception of stress" (Cohen, 1988). The PSS is a very well-known survey on perceived stress that has been used by many authors who have tested its accuracy. An article by Baghurst & Kelley (2014) stated that, "good reliability for the PSS (0.85) has been found in previous research and validity was established" (Measures section, para. 3). The PSS is a survey with ten questions; however, a shorter version can be made from four specific questions. The study utilized four out of the ten questions from the PSS scale, and one unique question, for a total of five questions, which can be viewed in Appendix B. The unique question is open ended, rather than a rating, and asks, "In the last week, what are the top two things that are contributing to your stress?" This question allowed for more specific information to evaluate if there are external factors affecting their other PSS survey answers.

The surveys were administered through Qualtrics, an online survey product, and were sent out via email to the participants. This online survey technique is the preferred method, because of the convenience and efficiency of it, but also to decrease personal interaction due to the current pandemic. The surveys were submitted virtually, and the data was collected on a spreadsheet through Microsoft Excel. The surveys were brief (five questions in length) and sent out to the participants via email. They were then completed online and submitted virtually. Participants completed the survey several times over the course of two weeks. They took the surveys three different days right before the start of their class, and on the same day as the ECG tests. They did the first survey three days before the exam day, one on the day of the exam, and then the last survey three days following the exam. Once all the surveys were completed and submitted, the answers were inputted into a spreadsheet where they were

converted into numerical values.

The survey uses a five-point Likert 0-4 scale which can be evaluated using the numerical score (0 = never, 1 = almost never, 2 = sometimes, 3 = fairly often, and 4 = very often). The numerical scores are then added together to get an overall result of the level of perceived stress. Questions #2 and #3 from the survey are reversed, so the number added is inverted (ex: if the participant put 1 as their answer for question #2, it would be inverted to be 3). The composite score is then found by adding up the values from each question. The ratings from this survey are computed to a composite score, where the higher the score, the greater the perceived stress the individual is indicating (Cohen, 1988). Perceived Stress Results for this study ranged from 2-13 for the participants. As for the short answer question, the answers from the participants were coded to fit into one of the three following groups; stress about the exam (if they stated: “organic chemistry exam” or “the exam”), other academic stress (if they said: “finals week” or “assignments for other classes”), and non-academic stress (if they stated: “work” or “the future” or anything else that wasn’t academic related. The students’ perceived stress and top stressors were collected through the brief surveys and then the results were calculated as described above. Then the data was analyzed and averaged using Microsoft Excel, and some significance was found from the performed t-tests.

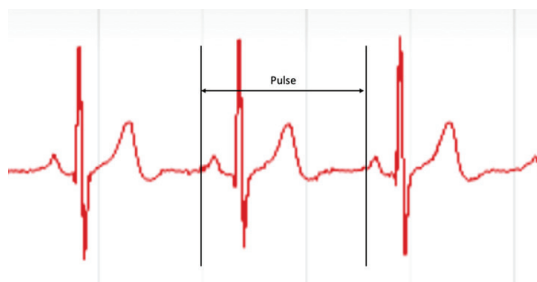
### **Electrocardiograms**

Electrocardiograms (ECGs) are another tool that was used in this study to collect quantitative data. ECGs are tests that record the electrical signals of the heart and were used to look at heart rate variability based on changes in interval frequency (Figure 1a and 1b) and wave amplitude (Figure 1c). The pulse was automatically given from the online software, Kura cloud, when a specific heartbeat was selected. The T-P interval was quantified by using two markers to distinguish the desired area, and then the software calculated the value (as seen in Figure 1b). The R wave amplitude was quantified by estimating the height of the wave by using the scale (not shown) to the left of the ECG reading (Figure 1c).

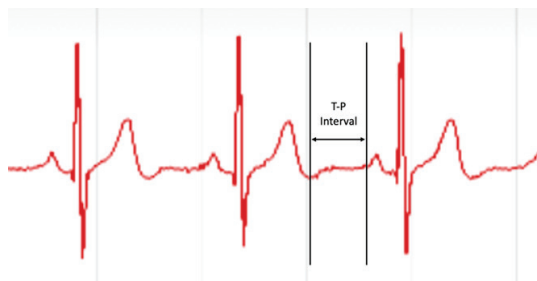
The ECG readings were taken in the biology lab of Barstow Hall on the UW-Superior campus. The participants came in on three different days to do the ECG readings. The first ECG was a baseline ECG completed three days before the scheduled exam to get the participants ECG data when they are not stressed about their exam (pre-exam). The second ECG was taken on the day of the exam (exam). And the third ECG was completed three days after the exam (post-exam). A 3-lead electrocardiogram test

was completed on each student, and all three readings were completed in under 10 minutes. Then, three separate heart beats of each person’s individual ECG were analyzed, and the data was collected, averaged out and numerical values were calculated.

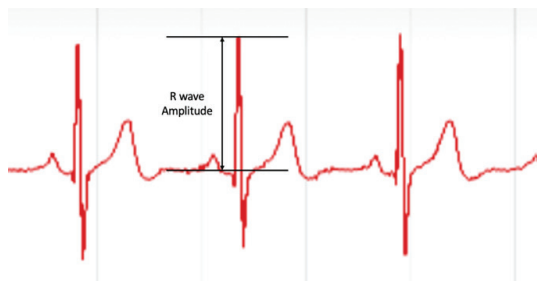
Once the ECG data was collected, the recordings were deleted, and the data was analyzed anonymously. This was done by removing participants’ names from the data which was then associated with random numbers rather than identifiable student information, and everything was evaluated blindly with no association of the individual data to a particular participant. The numerical values collected from the ECG data was compared to the survey question answers and everything was evaluated together on Microsoft Excel. All the data was also averaged, and significance was found using t-tests.



**Figure 1a**  
*ECG Reading showing calculation for Pulse*



**Figure 1b**  
*ECG Reading showing calculation for T-P Interval*



**Figure 1c**  
*ECG Reading showing calculation for R wave Amplitude*



## Results

### *Perceived Stress*

Perceived stress was calculated using the surveys, which identifies a person's perception of their stress, as described above. The results show that participants' average perceived stress levels did go up on the day of the exam, compared to the pre-exam and post-exam days (Figure 2, dark blue bars). When examining the differences in perceived stress between genders, female participants had lower average Perceived Stress Results (PSR) compared to male participants on the pre-exam and post-exam days, and a similar perceived stress average on the exam day (Figure 2, comparing turquoise and light blue bars).

### *Stressors*

The stressors were found through the surveys, the open-ended question #5, "In the last week, what are the top two things that are contributing to your stress?" The results from Figure 3 show that overall, participants did have the most stress about the exam on the day of the exam, along with academic and non-academic stress. When examining the differences of top stressors between genders, male participants reported the exam being a top stressor on exam day more than female participants did (Figure 3, comparing the grey bars for males and females under the exam stressor).

### *Pulse*

The pulse was calculated through the Kura cloud software, by highlighting the specific heartbeat that is being evaluated, and the software automatically calculates it. As seen in Figure 4, the results show that participants' average pulse did go up on the day of the exam, compared to both the pre-exam and post-exam days (dark green bars). Looking specifically at differences in the pulse between genders, there was a trend that female participants had lower average pulse compared to males on the exam and post-exam days, and a similar pulse on the pre-exam day (Figure 4, medium green and light green bars).

### *T-P Interval*

The T-P interval was calculated using the Kura cloud software, by measuring the distance between heart beats on the ECG reading, as seen in Figure 5. The graph shows that the participants' average T-P interval did get smaller, indicating a faster heart rate, on the day of the exam, compared to the pre-exam and post-exam days (Figure 5, brown bars). When looking at the differences in T-P intervals between genders, males had longer average T-P intervals compared to females on the pre-exam day (Figure

5, bright yellow and pale-yellow bars). However, females had longer average T-P intervals compared to males on the exam and post-exam days (Figure 5, pale yellow and bright yellow bars). Significance was found for total participants between pre-exam day and exam day, along with between exam day and post-exam day.

### *R wave*

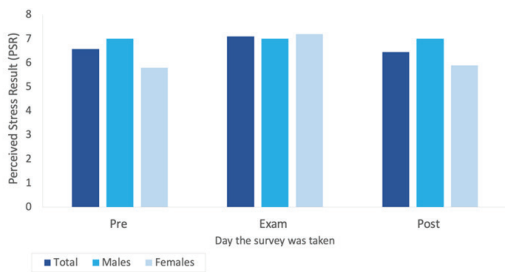
The R wave was calculated with the Kura cloud software, based off the amplitude of the R wave peak. The R wave amplitude signifies the heart's strength of contraction. The results from Figure 6, show that the participants' average R wave amplitude was higher on the pre-exam day ECG, compared to the exam and post-exam day ECGs (dark red bars). When looking at the differences in R wave amplitude between genders, male participants had a higher average R wave amplitude on pre-exam, exam, and post-exam days than female participants (Figure 6, bright red and pale pink bars).

### *Correlations of Perceived Stress Levels versus Physiological Stress*

To explore if there are correlations between perceived stress and physiological stress, we used Excel to create a scatterplot to visualize any comparisons. Figure 7 below, shows the correlations between perceived stress and the physiological value pulse. The other figures comparing the correlations between perceived stress and T-P interval and R wave amplitude are not shown.

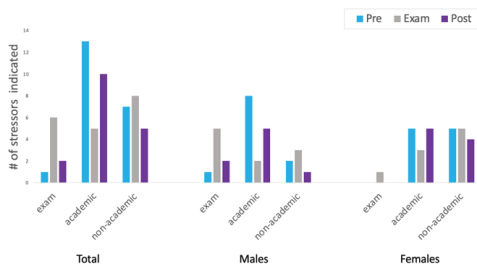
For perceived stress versus pulse, Figure 7 shows that there is, in fact, a correlation between them. The female participants' data points showing the correlation between the perceived stress result and pulse, more closely followed the trend line, compared to the male participants' data points. However, the trend line for female participants does show a downward trend, which indicates that the higher the perceived stress result, the lower the pulse was. This counters the original hypothesis that predicted the higher the perceived stress result, the higher the pulse.

For perceived stress versus T-P interval, there isn't a correlation between this data, along with perceived stress versus R wave amplitude (Data not shown).



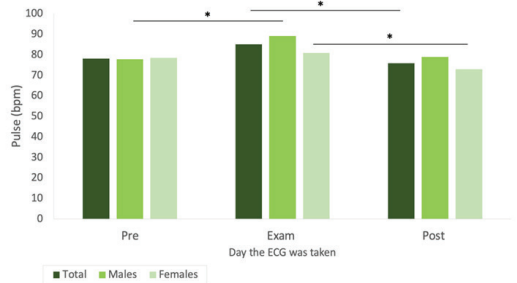
**Figure 2**  
**Perceived Stress Levels for Undergraduate Students around Exam Day**

*Note.* Undergraduate students were asked to complete surveys evaluating their stress level 3 days prior to a scheduled course exam (pre-exam), on the day of the scheduled exam (exam) and 3 days following the scheduled exam (post-exam). The Perceived Stress Result (PSR) was calculated based on the survey answers and an average score on each survey day was calculated (total). Participants were also subdivided by gender to determine if there were differences in PSR between males and females. The data was analyzed and averaged using Microsoft Excel, and no significance was found from the paired t-tests.

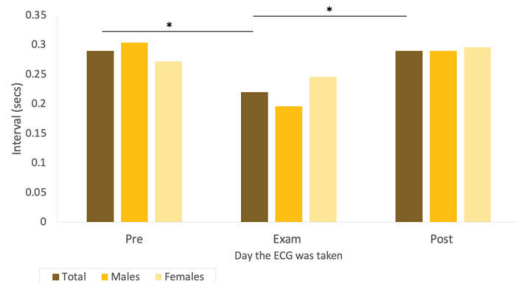


**Figure 3**  
**Stressors Contributing to the Stress of Undergraduate Students**

*Note.* Undergraduate students were asked to complete surveys evaluating their stress level 3 days prior to a scheduled course exam (pre-exam), on the day of the scheduled exam (exam) and 3 days following the scheduled exam (post-exam). The stressors indicated by the participants were an open-ended answer to question #5 on the survey. Participants were also subdivided by gender to determine if there were differences in exam versus academic versus non-academic stressors between males and females. The data was analyzed, and a figure was created using Microsoft Excel.

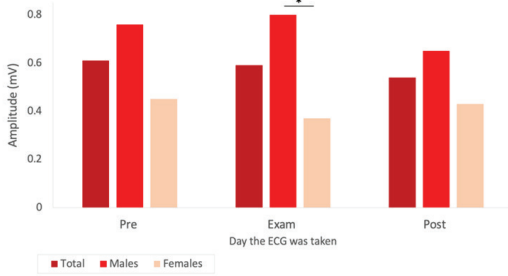


**Figure 4**  
**Pulse for Undergraduate Students around Exam Day**  
*Note.* Electrocardiograms (ECGs) were conducted on undergraduate students to evaluate their physiological stress. The pulse was calculated using the Kura cloud ECG software and an average pulse on each ECG Day was calculated (total). Participants were also subdivided into groups by gender to determine if there were differences in pulse between males and females. The data was analyzed and averaged using Microsoft Excel, and significance was found between the exam and post-exam day for total participants, between the pre-exam and exam day for males, and between the exam and post exam day for females. The significance was found using the paired t-tests, and all had significance below 0.05.



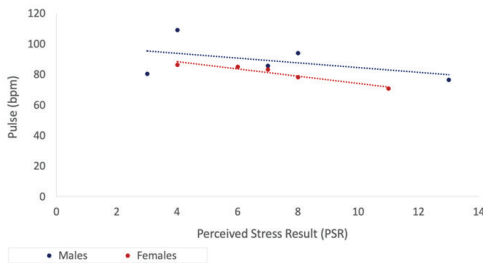
**Figure 5**  
**T-P Intervals for Undergraduate Students around Exam Day**

*Note.* Electrocardiograms (ECGs) were conducted on undergraduate students to evaluate their physiological stress. The T-P intervals were calculated using the Kura cloud ECG software and an average T-P interval on each ECG Day was calculated (total). Participants were also subdivided by gender to determine if there were differences in T-P interval between males and females. The data was analyzed and averaged using Microsoft Excel, and significance was found between pre-exam and exam days, and between exam and post-exam days for total participants. This significance was found by using paired t-tests.



**Figure 6**  
**R wave Amplitude for Undergraduate Students around Exam Day**

*Note.* Electrocardiograms (ECGs) were conducted on undergraduate students to evaluate their physiological stress. The R wave amplitude was calculated using the Kura cloud ECG software and an average R wave amplitude on each ECG day was calculated (total). Participants were also subdivided by gender to determine if there were differences in R wave amplitude between males and females. The data was analyzed and averaged using Microsoft Excel, and significance was found between males and females on exam day from the t-tests.



**Figure 7**  
**Correlation of Perceived Stress Levels and Pulse for Undergraduate Students around Exam Day**

*Note.* Undergraduate students were asked to complete surveys evaluating their stress level on the day of an exam. The Perceived Stress Result (PSR) was calculated based on the survey answers and an average score on the exam day survey was calculated for male and female groups. On the same day, an ECG was conducted to find the physiological stress of the participants. The data was then analyzed to explore if there was any correlation between perceived stress and pulse of the participants. The R squared value for males is  $R^2 = 0.222$  and females is  $R^2 = 0.9291$ .

## Discussion

When examining the perceived stress levels of students, results that were found, verify the original hypothesis of exams effecting students' stress levels. As seen in Figure 2, the conclusion can be

drawn that, exams do heighten students' stress levels based on their Perceived Stress Result (PSR). Figure 2 shows that the total participants' average PSR was higher on exam day compared to the pre-exam and post-exam day. The participants are most likely feeling stress related to their exams as their values are higher on exam day than non-exam days. Therefore, their stress levels are being influenced by the exams. Furthermore, we can conclude that females might have lower perceived stress than males on non-exam days, based off the results shown in Figure 2. However, the results of this study contradict past research done on this topic of stress and exam anxiety, which all state findings that females have a higher perception of stress than males. This could be due to the small sample size and an inaccurate representation of genders, or males in classes such as neurobiology and organic chemistry are more confident with speaking about their stress levels. When focusing specifically on the top stressors contributing to the stress of the students, there were some interesting trends between genders. Males say academic stressors are more pressing and were by far more stressed by exams while females largely had non-academic stressors and every female indicated non-academic stressors for pre-exam and exam day surveys, and four out of 5 females on the post-exam day survey. Therefore, it appears that the females were more worried about stressors outside of school, while males were focused more on academic stressors. This could be because females worry about many different things such as relationships or work, rather than focusing on one stressor.

When examining the physiological measures of stress, results showed that exams do affect the stress levels of students. These physiological data was the pulse, T-P interval, and R wave amplitude (Figures 1a, 1b, and 1c). When a participants pulse increases, the heart is beating faster which is a sign of increased stress. This is the same for when the participants T-P interval decreases, the heart is beating faster because the length of time between heartbeats is shorter. When a participants R wave amplitude increases, this means that the participants' heart is contracting stronger, which is also a sign of increased stress. We can draw the conclusion that exams do increase students' physiological stress, specifically by increasing pulse, based on the ECGs conducted. Figure 4 shows that the total participants' average pulse was higher on exam day compared to the pre-exam and post-exam days, indicating that participants experienced higher physiological stress on the day of the exam. We can also conclude that exams do increase students' physiological stress, specifically by decreasing the T-P interval, based on

the ECGs conducted. The decrease in T-P interval, is the shortening of the length of time between heart beats. When looking at Figure 5, the total participants' average T-P interval was shorter on exam day compared to the pre-exam and post-exam day, suggesting that students had more physiological stress on the day of the exam. As seen in Figure 6 showing R wave amplitude, no specific conclusions can be drawn. The results of the total participants' average R wave amplitude being higher on pre-exam compared to the exam day, trends differently than expected. This could be because it might have been stressful for a participant to have an ECG conducted on them for the first time, or their first interaction with me, or their first time being involved in a research study.

Based off Figures 7, showing the correlation between perceived and physiological stress, no specific conclusions can be drawn. The graph has data points outside of the trend line, and there are no trends in the data. This contradicts the original hypotheses that the physiological data would correlate with the perceived stress data on exam day. They were all inconclusive, which could be due to the small sample size.

## Conclusion

The purpose of this research project was to gather information and data on how exams affect students' perceived and physiological stress levels. Exams appear to increase the perceived stress levels (Figure 2) along with the physiological stress (Figures 4, 5, and 6) when survey and physiological data is compared to non-exam days. Furthermore, female participants showed less perceived stress than male participants on non-exam days, contrary to past research, which found that females typically have more perceived stress than males. This could be due to a small sample size and outliers skewing the data. Also, Figure 3 shows that males had more stress about exams than females did, on exam day. Males also stressed more about academics, overall, compared to females. This shows that males indicated more stress on academics than females did, which could've led to more perceived stress. Along with the gender trends, we also explored different age groups (Group 1: ages 18-20 and Group 2: ages 21-23) to see if we could find any correlations between the data. We originally hypothesized that Group 2 with the older students would have higher stress because they are closer to graduation and could have more stress about the future. However, no conclusive results were found, and the data was insignificant.

## Limitations

There were multiple limitations with this research project. One major limitation was the relatively small sample size. This study consisted of 10 participants total, making it very difficult to get significant data. More participants would provide greater data to analyze and the possibility of significant results.

Another limitation was the timing of the data collection for this project. The data was collected over this past spring semester of 2021, during the COVID-19 pandemic, and classes were held mostly online. This led to a very difficult process of recruiting students to partake in this study.

## Future Directions

Some modifications that could be made to the methods are having students take the surveys at the exact same time as the electrocardiogram. For the current study, the students had to take the survey on the same day, but they could be taken hours apart. Having the participants take them both at the same time would help to have more accurate data for the correlations between perceived stress and physiological stress. Another thing that could be done differently next time, is having the student wait 10 minutes in the room without talking or moving before conducting the ECG, to get more accurate readings. This is important because students could have been showing physiological stress due to outside factors, which would influence the ECG reading. Some students were in a rush because they were running late, and their heart rates were high due to increased physical activity to get to the lab where the test was conducted. If this could have been avoided, the results might have been different and more accurate.

As for future research, it would be interesting to follow up on perceived and physiological stress differences in genders. There were trends in both perceived and physiological stress in my study, between males and females. But my sample size wasn't big enough to have many significant results showing these differences. Additionally, future research could be done on exploring perceived stress in students in different majors. I had originally wanted to look into this but couldn't because of the small sample size. However, it would be interesting to see if students in different majors have differing amounts of stress. I believe that students in life science majors might have more perceived stress compared to students in social science majors, because social sciences can be up to interpretation while life sciences are more concrete. But it would be compelling to see if this hypothesis is true or if other majors also show different levels of stress



perception.

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