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The Biological Effects of Trauma.

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ABSTRACT

In this paper, we sought to understand the effects of trauma through a biological lens so that we could better learn how all the different expressions of mental unwellness, as a result of trauma, affect our everyday lives. Previous research has predicted that the symptomatic consequences of trauma can be identified and affected by variables such as platelet serotonin concentrations, substance addiction, and cortisol levels. For our correlational study, we tested the strength of these relationships by examining naturalistic daily changes in their variables over a one-week period. We measured substance addiction by how many alcoholic drinks were consumed each day, inferred cortisol levels by levels of water retention of the wrist each day, serotonin concentrations by rating tiredness each day using a subjective scale, and inferred traumatic symptoms by heart rate each day. Data pooled across participants in our correlational study showed that alcohol intake, but not serotonin or cortisol levels, was significantly correlated with our physiological measurement of trauma levels. Though a minute finding, this information may be able to offer guidance and aid to future psychologists and healthcare providers in both the furthering of their research and in the betterment of treatment plans for those who have undergone trauma. These findings could also motivate councillors and therapists to inaugurate more resources for combatting addiction into their practices.

1. Introduction

1.1 Research Problem

The goal of this research paper was rooted in a shared interest in traumatic encounters as well as the strain they put on the livelihoods of the people that experience them, transitionally we also put focus on the various ways one can learn to adapt to the consequences of living through or being affected by traumatic events. Post-traumatic Stress Disorder affects a vast amount of people internationally and can materialize as a consequence of many different kinds of situations. In part, this paper was intended to shed light onto the ways this disorder, and others similar to it, symptomize and how such symptoms can be made more bearable. Intergenerational trauma affects thousands of people per year, particularly in minority communities. A better understanding of the underlying characteristics of trauma can help individuals living with intergenerational trauma and its direct effects. A wide range of people are affected by trauma every day and every year. Understanding the symptoms and limitations of stress and trauma can help individuals to overcome the difficulties associated with trauma. Research

on this topic is essential for those who have undergone trauma since not only does this information educate those who may be unaware of the internal contrivances of trauma, but it also aids in informing afflicted people of what to expect in the wake of a traumatic experience and how to deal with their feelings in a healthy way moving forward.

1.2 Literature Review

One biologically-based symptom commonly associated with Post-traumatic Stress Disorder is a fluctuation in platelet serotonin concentrations within the body. For example, in a correlational study executed by Grah et al. (2010), forty-six adults that had been diagnosed with Post-traumatic Stress Disorder and had underwent a suicide attempt, forty-one adults diagnosed with Post-traumatic Stress Disorder without a known suicide attempt and fifty phenotypical subjects had their blood drawn. This occurred on the second day of a patient's hospitalization, during standardized laboratory procedures. Samples were later tested for platelet serotonin concentrations by the competitive enzyme immunoassay in an enzyme-linked, immunosorbent assay test-ELISA test. Upon examination researchers found that, in subjects with Post-traumatic stress disorder, platelet serotonin levels were much lower in those that had attempted suicide. Further, regardless of whether or not a diagnosed patient had endured suicide attempt, both saw a statistically significant decrease in serotonin levels when compared to that of the average amount. Based on these results, the researchers concluded that platelet serotonin concentrations, while known to be lessened in those with Post-traumatic Stress Disorder, may very well also have a biological effect on the intensity of its suicidogenic symptoms.

Another element previously suggested to be associated with survivors of traumatic events is lower cortisol levels. For example, in a correlational study conducted by Yehuda et al. (2007), twenty-three adults of holocaust survivors with PTSD, and ten without, were collated with a control group of sixteen adults with no linkage to the holocaust. Each participant included in the study, had a catheter inserted. For a period of 24 hours, blood samples were obtained from each participant every thirty minutes. To control for major postprandial cortisol spikes, each participant received the same low-calorie meal at 9am, 12pm, and 6 pm respectively. Cortisol levels in plasma were measured using radioimmunoassay kits. Based on the data collected, researchers found that the mean cortisol levels of those with parental PTSD were comparatively lower than offspring without parental PTSD, and offspring without any connection to the holocaust.

A third biological factor associated with Post-Traumatic stress disorder is alcohol consumption. For example, a study was conducted on 250 adult college undergraduate students from a large urban university in the United States who were active alcohol drinkers for the past three months and had signs of PTSD by giving them online surveys and assessed with a modified version of the Daily Drinking Questionnaire (Tripp et al., 2015). The study examined six facets of emotion dysregulation as mediators between PTSD and alcohol intake by sex. Based on the data collected it was found that higher intake of alcohol leads to higher emotion dysregulation and higher PTSD symptoms and other mental health disorders. It was also suggested that gender-specific interventions targeting emotion

dysregulation may be effective in reducing alcohol-related consequences in individuals with PTSD.

1.3 Hypotheses

Based on the above literature review, we predicted the following hypotheses:
Hypothesis #1: If trauma increases then serotonin levels will decrease.
Hypothesis #2: If trauma increases then cortisol levels will decrease.
Hypothesis #3: If trauma increases then substance abuse will increase.

2. Methods

2.1 Participants

The three authors of this paper served as the participants in its studies. This included one male and two females, ranging from 19-21 years of age, with a calculated, average age of 20.66 years. The participants were all undergraduate students at Camosun College who completed this study as a research assignment for the course, PSYCH-215-001B (Biological Psychology), and were grouped together due to their mutual interest in the biological effects of trauma. One participant, being an indigenous person, had a family history of trauma, with regards to residential schools and their imposition on their immediate, and remote family. One of the female participants had been clinically diagnosed with Post-traumatic Stress Disorder two years prior to the conduction of this study.

2.2 Materials and Procedure

We performed a correlational study to test concurrently all of our hypotheses by examining naturalistic daily changes in their variables longitudinally. Each participant kept a study journal with them at all times over this study's one-week period in order to record self-observations of the following four variables: (1) serotonin levels, (2) cortisol levels, (3) addiction levels, and (4) trauma.

2.2.1 Serotonin Levels

Due to the directly immeasurable nature of serotonin concentration at this level of research practice, quantitative levels of serotonin throughout the body were measured using a subjective scale of tiredness. This was done, primarily, on account of serotonin's classification as a 'sleepiness-causing' neurotransmitter. All three participants were asked to complete a single, 'level of tiredness' questionnaire during the evening hours of 6pm-9pm, every day, over the span of one week. As was previously stated, this questionnaire worked as an ordinal scale in which participants could choose a number from 1-7 as a way of documenting their daily degrees of tiredness (1 = Incredibly tired, 2 = Pretty tired, 3 = I could use a cup of coffee, 4 = Reluctantly awake, 5 = Awake, 6 = Wide awake, 7 = I could run a marathon). This was done to provide us with an incremental, sensitive score that determined the correlation between an unaltered lifestyle and platelet serotonin concentrations. Let it also be known that this scale is meant to be interpreted inversely, whereby the higher one's tiredness score is, the less tired they are.

2.2.2 Cortisol Levels

Due to our inability to measure cortisol directly, another measure was used. Higher cortisol levels have been found to be linked with higher water retention levels, while lower levels are associated with lower water retention levels. Therefore, water retention was used as an indicator variable for cortisol levels. In order to measure water retention, each person measured their wrist

circumference between 8pm and 11pm each day.

2.2.3 Substance Addiction

Considering the factor that emotion dysregulation is associated with substance addiction. This will be done keeping in mind that substance addiction (alcohol intake) can lead to change in mood and behaviour. All the participants will be asked a question regarding their alcohol consumption for the day stating; how many drinks containing alcohol do you have in a day? The participants will be asked to answer a simple question about how many drinks they have had. This will indicate the level of mood fluctuations with alcohol consumption. The participants will be asked to note the amount of drinks they have had between 6pm to 9pm each day for a whole week. This will be done to determine the correlation between alcohol consumption and PTSD.

2.2.4 Trauma

In order to quantitatively measure trauma, our group elected to have participants record their normal, resting heart rate every day over the span of a week-long research conduction period. Participants were instructed to place two fingers on the apple of their wrist every night between the hours of 8pm-11pm for a total time of sixty seconds. Afterwards, they recorded the number of times they were able to count a heartbeat during the, aforementioned, one minute interval.

2.3 Planned Analyses

To assess the strength and statistical significance of associations between variables predicted by our three hypotheses, we performed Pearson product moment correlations of their predictor variables (trauma) with their outcome variables (serotonin, cortisol, and substance abuse). For testing Hypothesis #1, we correlated daily 'degrees of tiredness' with a participant's daily recorded heart rate. For testing Hypothesis #2, we correlated water retention in the wrist with heart rate. And for testing Hypothesis #3, we correlated the number of alcoholic drinks consumed by a participant throughout the day with the participant's heart rate. We performed all of the above correlations separately for each participant as well as using data pooled across all of the participants. For the correlations using pooled data, in addition to using the raw data, we also performed correlations after we had first transformed the data from each participant into *z*-scores in order to standardize differences in averages and variability seen between the participants in their data and thus make them more comparable. A correlation coefficient was considered statistically significant if the probability of its random occurrence (p) was $< .05$ (i.e., less than 5% of the time expected by chance alone).

3. Results

As is shown in Table 1, alcohol intake was significantly correlated with heart rate. Using both pooled raw data ($r = -.35$, $p = .12$, see Figure 1) and pooled standardized data ($r = .30$, $p = .19$, see Figure 2), water retention and heart rate were found to have a weak correlation that failed to reach the cut-off for statistical significance. Likewise, using both pooled raw data ($r = -.40$, $p = .07$, see Figure 3) and pooled standardized data ($r = -.30$, $p = .18$, see Figure 4), tiredness was not significantly correlated with heart rate. In contrast, using both pooled raw data ($r = .59$, $p = .004$, see Figure 5) and pooled standardized data ($r = .50$, $p = .02$, see Figure 6), alcohol intake was found to have a moderately significant correlation with heart rate. Based on a comparison of the correlation coefficients using both pooled

raw data and pooled standardized data, alcohol intake showed the strongest correlation with heart rate.

4. Discussion

4.1 Summary of Results

Hypothesis #1, which suspected that if trauma worsens then serotonin levels will decrease, was not supported by the results in a significant manner. Hypothesis #2, which supposed that if trauma increases then cortisol levels will decrease, was also not supported by the results in a significant manner. However, Hypothesis #3, which hypothesized that if trauma increases then substance abuse will increase, was supported by the results.

4.2 Relation of Results to Past Research

The results of this correlational study do not align with the conclusions made by Grah et al. (2010), in their correlational study of trauma and serotonin levels. A participant's 'level of tiredness', which was meant to be an indicator of serotonin concentrations, was not significantly correlated with the same participant's heart rate, which was meant to be an indicator of trauma levels. Meanwhile, the results of Grah et al.'s (2010) study supported the notion that a low concentration of serotonin in the bloodstream was correlated with the worsening of symptoms of trauma. In regards to our study, this contrast could be attributable to a lot of factors, including, though not exclusively, the inability of our 'tiredness' scale to accurately and specifically measure platelet serotonin concentrations. Our sample size was also much smaller than that of the study done by Grah et al. (2010), as we were only able to collect data from three participants, whereas their team had 137 subjects, in total, to acquire testable blood samples from. This could have contributed to a decline in the statistical significance of the results pertaining to this particular hypothesis.

Our correlational study failed to confirm the relationship between trauma and cortisol levels. Yehuda et al. (2007) found that cortisol levels measured using radioimmunoassay kits were lower in those that had survived traumatic encounters than those that had not. Conversely, cortisol levels did not seem to be as strongly correlated within our correlational study. The difference in methodologies between our study and Yehuda et al. (2007) may account for the disparity in the results. The most obvious difference in our methodology was our measurement of cortisol levels. Due to our inability to obtain radioimmunoassay kits, we instead used the measurement of the wrist as an indicator of cortisol levels. While wrist measurement may be indicative of cortisol levels, it is not nearly as accurate as a direct measurement of blood such as in the study conducted by Yehuda et al. Additionally, water retention, while indicating differences in cortisol, may also be a result of other things as well, such as excess insulin, or diet. Thus, our measurement of cortisol was likely less accurate. Future studies should attempt to control for sources of variance such as insulin and salt intake, or instead use a direct measurement of cortisol in blood. Additionally, future research should increase their sample size, as it would bring the measurements closer to the true mean and thus increase the validity of the results.

The results from this correlational study aligned with the results obtained by Tripp et al. (2015) in their correlational study done on alcohol consumption and symptoms of trauma. We, similarly, found high degrees of correlation between these two variables.

Participants' daily alcohol consumption was correlated with trauma using both pooled raw data and pooled standardized data.

4.3 Implications of Results

Hopefully, our results may be able to provide other researchers with an incentive to continue analysis on the correlations we found between substance abuse and trauma. With more research on the subject, we may be able to learn to better help and advocate for those struggling with the upkeep of their mental health and addictive behaviours. Parents and guardians could become further aware of the precursors, signs and symptoms of alcohol abuse in their children, or therapists could learn to be more promotive of rehabilitation facilities and substance-independence with clients effected by Post-traumatic stress disorder.

The topic of this study was proposed due to a shared interest in both the biological effects of trauma and the improvement of our systems of mental aid, whether it be for those with Post-traumatic stress disorder, intergenerational trauma, or otherwise. Our findings support the idea that a greater attention to substance abuse, in particular, may be beneficial in the revolution of how we talk, think and help those who have experienced trauma.

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Table 1

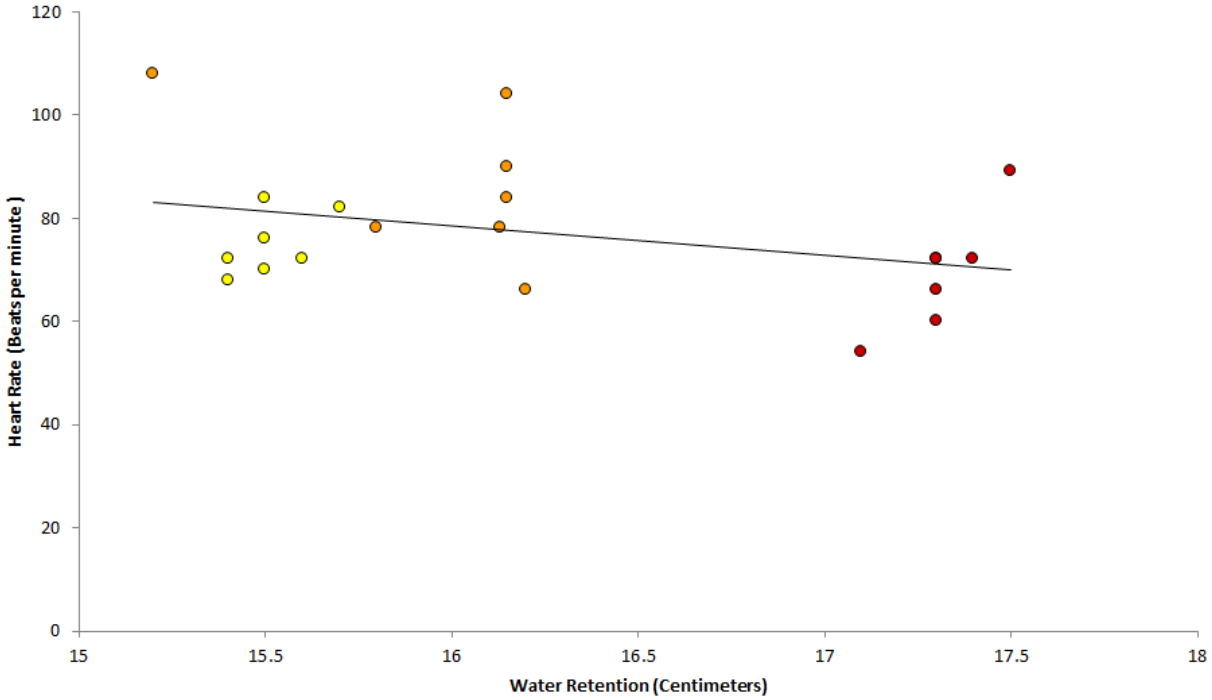
Correlations for Study Variables

Variables	Participant #1		Participant #2		Participant #3		Pooled raw data		Pooled standardized data	
	r	*n*	*r*	*n*	*r*	*n*	*r*	*n*	*r*	*n*
Water retention & heart rate	.90*	7	-.54	7	.54	7	-.35	21	.30	21
Tiredness & heart rate	-.40	7	-.35	7	-.16	7	-.40	21	-.30	21
Alcohol Intake & heart rate	.61	7	.71	7	.18	7	.59*	21	.50*	21

* $p < .05$.

Figure 1

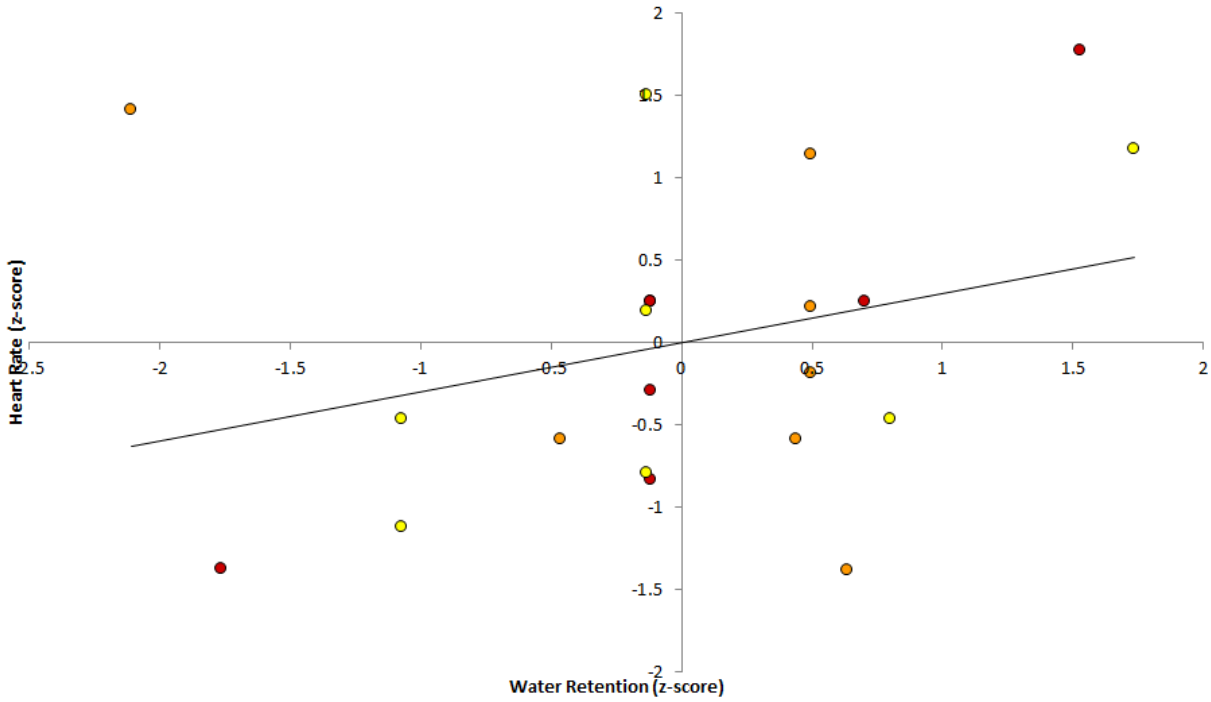
Association Between Water Retention and Heart Rate Using Pooled Raw Data



Notes. Marker colour differentiates participants: red = participant #1, orange = participant #2, and yellow = participant #3. Some data might not be visible in the figure due to overlapping markers.

Figure 2

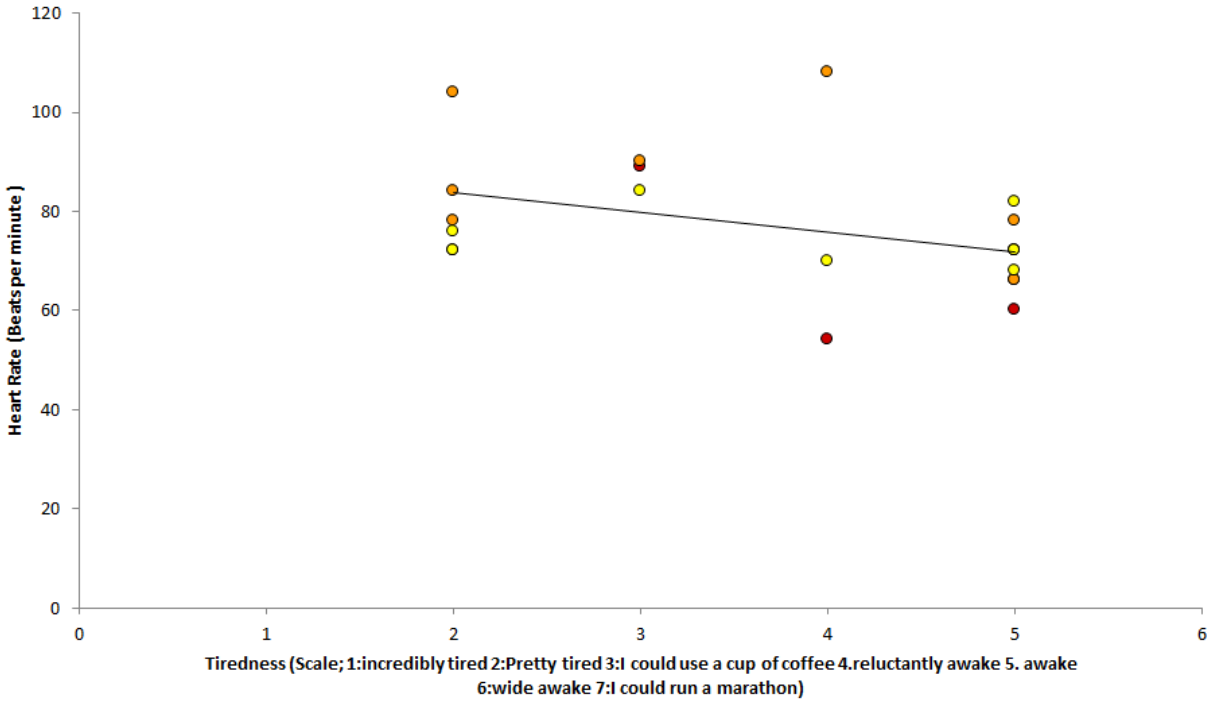
Association Between Water Retention and Heart Rate Using Pooled Standardized Data



Notes. Marker colour differentiates participants: red = participant #1, orange = participant #2, and yellow = participant #3. Some data might not be visible in the figure due to overlapping markers.

Figure 3

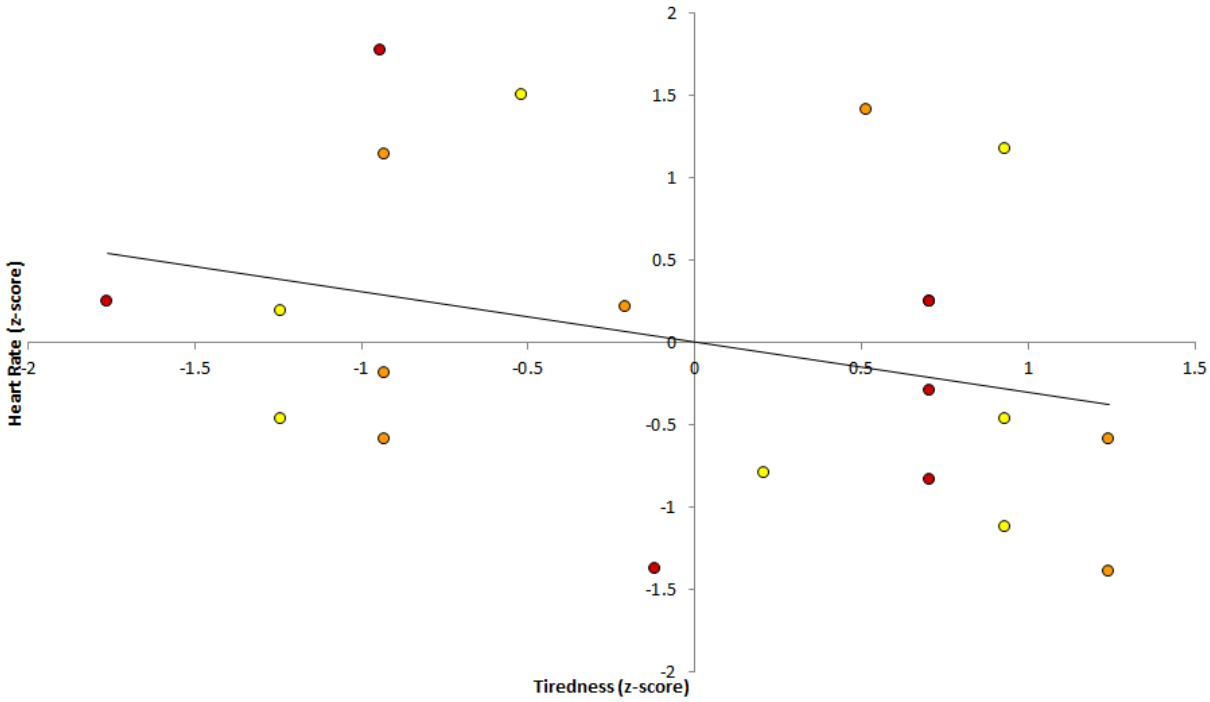
Association Between Tiredness and Heart rate Using Pooled Raw Data



Notes. Marker colour differentiates participants: red = participant #1, orange = participant #2, and yellow = participant #3. Some data might not be visible in the figure due to overlapping markers.

Figure 4

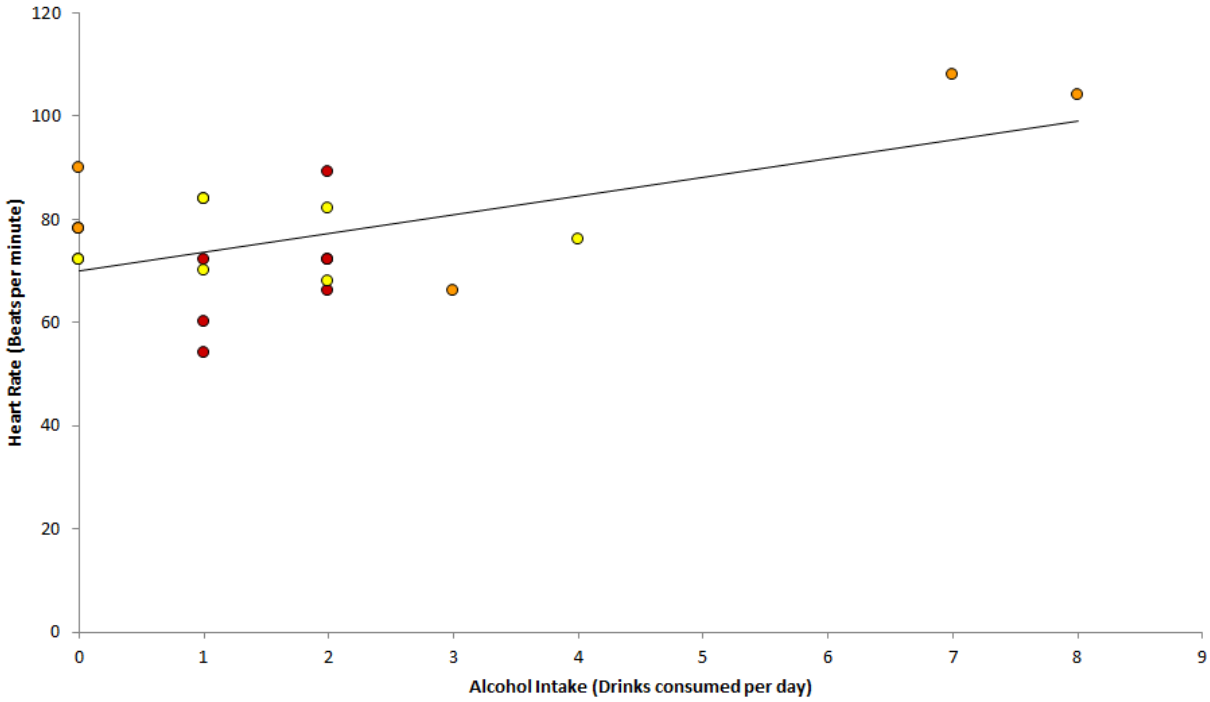
Association Between Tiredness and Heart Rate Using Pooled Standardized Data



Notes. Marker colour differentiates participants: red = participant #1, orange = participant #2, and yellow = participant #3. Some data might not be visible in the figure due to overlapping markers.

Figure 5

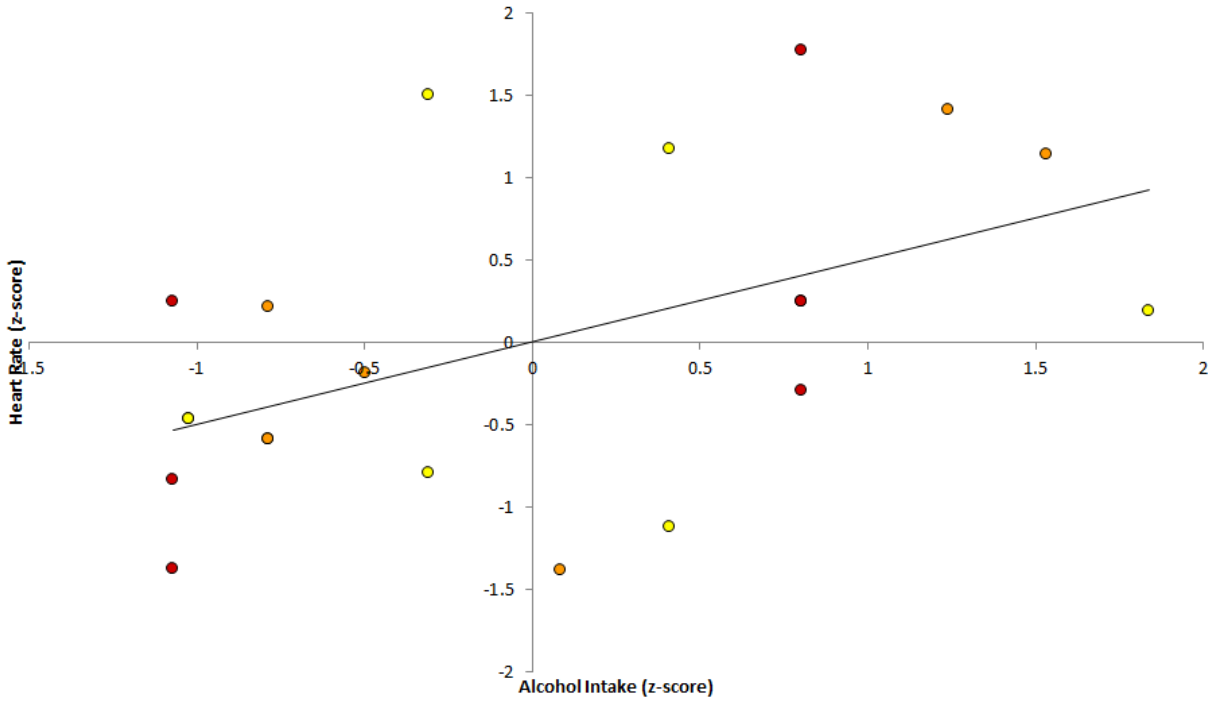
Association Between Alcohol Intake and Heart Rate Using Pooled Raw Data



Notes. Marker colour differentiates participants: red = participant #1, orange = participant #2, and yellow = participant #3. Some data might not be visible in the figure due to overlapping markers.

Figure 6

Association Between Alcohol Intake and Heart Rate Using Pooled Standardized Data



Notes. Marker colour differentiates participants: red = participant #1, orange = participant #2, and yellow = participant #3. Some data might not be visible in the figure due to overlapping markers.