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Influence of Exercise Environment on Stress and Affect in Sedentary Adults: A Comparison of Indoor and Natural Environments

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Abstract

The national need for increased physical activity, especially among sedentary populations, has been well documented. The need now is for fitness programs to be more effective at encouraging individuals to adopt and maintain a physically active lifestyle. This study investigated the relationship between exercise environment, stress, affect, and Nature Relatedness. Because stress reduction has been seen as a benefit of being exposed to nature, stress and affect were assessed in sedentary adults at the beginning and end of short walks in an outdoor and indoor environment in an effort to determine which environment had the greater ability to reduce stress. Stress and affect were measured using salivary cortisol concentration and alpha-amylase activity, as well as surveys and questionnaires. Additionally, the link between Nature Relatedness and environmental preference was assessed. Ultimately, our results indicated that this population expressed a preference for exercising in the outdoor environment over the indoor environment.

Influence of Exercise Environment on Stress and Affect in Sedentary Adults: A Comparison of Indoor and Natural Environments

Over a quarter of the US population over the age of 18 reports engaging in no physical activity (Pretty, Griffin, Sellens, & Pretty, 2003). Sixty percent of Americans are not regularly physically active ("Physical Activity and Health: A Report of the Surgeon General). Nearly one in twenty-five deaths worldwide can be attributed to lack of physical activity (Barton & Pretty, 2010). This is significant considering that physical activity plays a role in attenuating many of the chronic conditions plaguing America today including hypertension, obesity, and cardiovascular disease (Bibiloni, Pons, & Tur, 2013; Breckenkamp, Blettner, & Laaser, 2004; Mora, Lee, Buring, & Ridker, 2006; Nelson et al., 2018; Pretty et al., 2003).

As physical inactivity is increasing, so too are reports of psychological conditions such as chronic stress and depression (Franco Gianfabio P., Barros Alba L.B.L., Nogueira-Martins Luiz A., & Michel Jeanne L.M., 2003). In particular, developed countries with quickly changing cultures have experienced an uptick in reports of chronic stress (Kopp & Réthelyi, 2004). Chronically elevated cortisol levels are correlated with an increased risk of cardiovascular disease and a reduced quality of life (Kopp & Réthelyi, 2004). Research has begun to elucidate the connection between exposure to the natural environment and psychological conditions such as depression and chronic stress (Kondo, Jacoby, & South, 2018). When exposed to a natural, green environment for even a short period of time, individuals report experiencing decreased symptoms of stress (Hansmann, Hug, & Seeland, 2007). Physical activity alone tends to produce a similar reduction in stress (Focht, 2009). Recently, researchers have turned to focus on the potential synergistic effect that physical activity and the natural environment may have on affect and health (Hug, Hartig, Hansmann, Seeland, & Hornung, 2009).

Pretty et al. (2003) coined the term "Green Exercise," to refer to exercising in a natural environment. Green Exercise has attracted the interest of researchers from a variety of fields including psychiatry and psychology (Harvey, Hotopf, Øverland, & Mykletun, 2010; Mackay & Neill, 2010; Teychenne, Ball, & Salmon, 2008), environmental studies (Barton & Pretty, 2010; Hansmann et al., 2007; Thompson Coon et al., 2011; Triguero-Mas et al., 2015), and exercise science (Focht, 2009; Pretty, Peacock, Sellens, & Griffin, 2005). The fact that researchers from so many different disciplines are focusing on this topic is significant because researchers in each area are finding substance, and the potential for application, in the idea that exposure to the natural environment often provides a variety of psychological benefits to individuals.

Research on the topic of Green Exercise typically examines the effect of an indoor and an outdoor environment on certain markers ranging from headache level (Hansmann et al., 2007), to state anxiety (Mackay & Neill, 2010), to blood pressure (Pretty et al., 2005). Many studies done on Green Exercise have utilized subjective measures such as surveys to determine outcomes (Hansmann et al., 2007; Hug et al., 2009; Mackay & Neill, 2010; Triguero-Mas et al., 2015). Far fewer studies have utilized physiological measures, with the outcome that not much is known about the physiological changes that occur as a result of exercising in a green environment compared to an indoor one (Bowler, Buyung-Ali, Knight, & Pullin, 2010). The benefit to using physiological measures is that they can lead to a better understanding of the physiological changes that accompany an individual's actions. Pretty et al. (2005) used blood pressure as a measure and Harte and Effert (1995) used laboratory measures of catecholamines and cortisol to indicate emotional change. Salivary alpha-amylase can also be used as a physiological indicator of the effect that certain environments have on stress levels, as research has shown that salivary alpha-amylase levels are an effective indicator of stress (Koibuchi & Suzuki, 2014; Ligtenberg, Brand, van den Keijbus, & Veerman, 2015). In the present study, salivary cortisol and alpha-amylase were used as physiological measures of stress in order to add to the growing knowledge base on the physiological influences of exercising in a natural environment. Additionally, four different surveys were utilized to provide insight into the preferences and emotional states of the participants.

Aim of this Study

The aim of this study was to better understand the relationship between exercise environment and the associated psychological responses to exercise. In light of what we know about the benefits of exercise, and about the benefits of exposure to a natural, green environment, we hypothesized that the surveys and cortisol and alpha-amylase concentrations would indicate that outdoor physical activity attenuated stress to a greater degree than indoor physical activity. Secondarily, we hypothesized that those individuals who expressed a higher affinity for the natural environment would show a greater degree of stress reduction during the outdoor walk than those who did not express the same affinity.

Methods

Research Design

This study was cross sectional and utilized a crossover design (Figure 1). The crossover aspect was incorporated in order to control for the effects of fatigue and the potential training effect of participants between walking in the first environment and then the second. Participants were randomly divided into two groups of equal size who then walked at each location.

Participants and recruitment

Participants were recruited through voluntary response to either flyers posted around the UVM campus or an email which was circulated to UVM faculty and staff, both of which provided information about the study. Compensation in the form of a $25.00 Amazon gift card was offered to all participants. Inclusion criteria were as follows: be between the ages of 18 and 65 years, able to speak and read English, currently exercising less than 150 minutes per week, currently not a smoker, currently taking no medication that influences stress levels, and be available at the time of study.

The target population was sedentary adults. This population was chosen because this is the demographic most in need of increasing physical activity levels. The study offered minimal risk to the participants, as each group was supervised by two of the researchers at all times, and participants were not asked to perform any overly strenuous activities; walking pace was instructed to be enjoyable for each individual, regardless of the pace of other participants. In terms of safety and ethical considerations, any outcome of participation in the study would likely have had a positive impact on the participants.

Measurement Tools

Pre-participation screening. Participants went through a simple health screening process before participating in the study. The Physical Activity Readiness Questionnaire (PAR-Q) is a seven-question questionnaire for people aged 15 - 69 that has been shown to be effective at screening for risk factors before beginning an exercise program (Thomas, Reading, & Shephard, 1992). The PAR-Q was completed by each participant, and no participants were found to require medical clearance before participation.

To ensure that all participants fell into the target population category - sedentary adults - the International Physical Activity Questionnaire (IPAQ) was completed by each participant. The IPAQ collects information about the volume of light, moderate, and intense physical activity an individual has engaged in in the previous week. The survey is broken into categories based on environment including job-related physical activity, transportation, housework and caring for family, and recreational physical activity. Additionally, the amount of time spent sitting was collected through this survey. Ultimately, an individual can be categorized as having low, moderate, or high activity levels. This measure has been shown to be valid when assessing levels of physical activity in adults (Hagströmer, Oja, & Sjöström, 2006).

A demographics survey collected information about the participants' education level, average income, age, gender, and occupational status. Demographics were collected to potentially shed light on certain trends in the data such as whether one environment is more desirable to one age group or another. Additionally, the demographics survey helped to ensure all participants fell within the desired age range of 18 – 65 years old.

Affective response measures. Two surveys served as measures of affect during this study: The abbreviated Profile of Mood States (POMS) survey and the Positive and Negative Affect Schedule (PANAS). The POMS survey was used to assess changes in mood pre- to post-walk. The POMS is the most commonly used measure of mood in studies involving exercise and mood (Barton & Pretty, 2010) and has been shown to be valid and reliable for assessing long and short term changes in mood (Harte & Eifert, 1995). The survey presents a list of emotions that participants respond to using a five-point scale indicating to what degree they feel the emotion in the moment. These emotions are categorized into 7 subscales: tension, anger, fatigue, depression, esteem-related affect, vigor, and confusion. Total Mood Disturbance can then be calculated from the sum of the results.

The PANAS assesses positive and negative affect of individuals. Individuals go through a list of twenty emotions and rate each one using a five-point Likert scale ranging from "very slightly or not at all" to "extremely" based off of how much they feel the emotion in the moment.

This measure has been shown to be valid in assessing positive and negative affect (Watson, Clark, & Tellegen, 1988).

The Walking Environment Preference survey was created for this study for the purpose of providing a straightforward and specific subjective measure to indicate which environment was more enjoyable for the participants. It was simply and intuitively constructed, with eight statements regarding which environment was preferred. Participants rated the statements using a five-part Likert scale ranging from “strongly agree” to “strongly disagree.” This survey was used to determine the participants’ preferred walking environment, as well as their potential to walk in those locations in the future.

Physiological measures. Cortisol and alpha-amylase were collected simultaneously using a collection kit from Salimatrics. The concentrations of these measures were used as a proxy for the amount of psychological and physiological stress the participants experienced.

Nature Relatedness measure. The Nature Relatedness survey was used to determine the participants’ Nature Relatedness score, a measure of how deep one’s understanding and appreciation for nature is. Individuals responded to 21 statements about their perception of their relationship to nature and natural occurrences using a five point Likert scale ranging from “disagree strongly” to “agree strongly.” Responses were tallied and a Nature Relatedness score was ascribed to each participant. This measure has been shown to be valid in the assessment of Nature Relatedness (Nisbet, Zelenski, & Murphy, 2009). In the present study, Nature Relatedness scores were correlated with questions from the Environmental Preference Questionnaire in order to investigate the relationship between one’s Nature Relatedness score and their stated preference for exercising in the outdoors.

Procedure

Physiological data was collected in the form of saliva samples, and psychosocial data was collected through surveys and questionnaires. Participants were instructed to use passive transportation to travel to the initial meeting point at the University of Vermont (UVM) on the day of the study. Participants were randomly assigned to either group A or group B, with two researchers accompanying each group. The day's timeline was then explained to the participants. Group A was transported by van to an outdoor walking trail. Group B was transported to a local shopping center where an indoor walking path had been plotted. When each group had arrived at their destination, individual saliva samples were taken, along with the PANAS and POMS surveys.

The walks at each location lasted 20 minutes. One researcher walked in front of the fastest participant in each group, and the second researcher followed the walker with the slowest pace. This second researcher ensured that the participants were spaced apart from one another by instructing each individual to begin their walk 15 seconds after one another. The participants were told to make as little contact with one another as possible. Immediately following the walk, saliva samples were taken and additional POMS and PANAS questionnaires were completed by each individual. Once all materials were collected by the researchers, group A and group B were transported by vans to the opposite location. The same pre- and post- walk procedures were carried out at the new locations. When finished, both groups were transported back to the starting point at UVM and participants were debriefed and offered their gift-card compensation.

Physiological Data Capture. To collect the saliva samples, the Salimetrics brand saliva collection devices were used. Participants were instructed on how to properly use the saliva collecting devices. During the study, the samples were kept cool in an insulated container. The samples were sent to the Deming laboratory at UVM to be analyzed for alpha-amylase activity and cortisol concentrations.

Psychosocial Data Capture. The PAR-Q and IPAQ were used as screening tools to highlight any contraindications the participants may have had for participating in physical activity and for determining their current level of physical activity, respectively. Additionally, the POMS and PANAS surveys were used to assess the participants' emotions before and after each walk. The Nature Relatedness survey and the Walking Environment Preference survey were completed after both walks ended.

Statistical Analysis. To determine if any significant difference existed between pre-walk and post-walk survey scores, as well as between pre- and post-walk cortisol and amylase levels, two-tailed t-tests were performed. For the POMS survey, the averages of each emotion were calculated for before and after the walks in each environment. Each question in the Walking Environment Preference survey was organized by pre- or post- walk and by environment, and the rankings were averaged. Statistical analysis was performed with the Google Sheets application. With regard to the alpha-amylase data, a power calculation was performed by UVM professor Alan Howard that found that at least 41 participants would be necessary to determine a significant difference.

Results

The hypothesis that physical activity in an outdoor environment would improve mood and affect more so than in an indoor environment was supported by the psychosocial data. The surveys tended to indicate a greater affinity on average for the outdoor environment. However, the cortisol and alpha-amylase from the saliva samples did not increase pre- to post-walk as predicted.

Demographic Data

Table 1 displays the sociodemographic characteristics of the participants. There were eight participants (n = 8), all of whom identified as Non-Hispanic, and Caucasian. Sixty-three percent of the participants were female, 25% were male, and 13% were non-binary. The age range was broad, with the youngest participant being in the 18 - 24 year old range and the oldest participants in the 55 - 64 year old range.

Physiological Data

Salivary cortisol concentration decreased significantly pre- to post-walk (Figure 2). This was seen for both indoor and outdoor locations ($p = 0.004$; $p = 0.003$). The decrease in cortisol concentration was not significantly greater in one environment compared to the other ($p = 0.843$). This finding would lead us to reject the hypothesis that exercise in a natural environment would cause cortisol levels to change in a way that would indicate a decrease stress more than exercise in an indoor environment.

Though not statistically significant, alpha-amylase activity trended toward increasing from pre- to post-walk in each location ($p = 0.234$ indoors; $p = 0.064$ outdoors) (Figure 3). Alpha-amylase activity was expected to increase significantly in each environment, and to a greater degree in the indoor environment compared to the outdoor environment. Our findings would lead us to reject the hypothesis that alpha-amylase activity would indicate lower levels of stress in the outdoor environment compared to the indoor environment.

Psychosocial Data

The POMS survey indicated that the measure “tension” decreased significantly following the outdoor walk ($p = 0.029$) (Figure 4), whereas tension trended toward increasing following the indoor walk ($p = 0.409$) (Figure 5), though not statistically significantly. No additional measures changed significantly during the outdoor walk, though anger, depression, and confusion trended toward decreasing, while esteem related affect and vigor trended toward increasing. During the indoor walk, no measures changed significantly, though tension, anger, fatigue, depression trended toward increasing, while esteem related affect trended toward decreasing. Though many of these changes were not statistically significant, it is interesting to note that they trend in opposite directions, as this may indicate a potential for each environment having a different effect on mood. When comparing the magnitude that the measures changed during the indoor and outdoor environments respectively, there was no significant difference. However, the magnitude of decrease in tension and depression was marginally significantly greater during the outdoor walk (p-value = 0.099 and 0.089 respectively).

The PANAS survey indicated a significant increase in positive affect during the outdoor walk, whereas no significant change in positive affect was seen during the indoor walk. Negative affect decreased marginally significantly during the outdoor walk ($p = 0.064$). Negative affect did not change significantly during the indoor walk.

According to the Walking Environment Preference questionnaire, the participants generally preferred walking outside to walking inside (Figure 6). These findings support the hypothesis that the surveys would indicate a greater reduction in stress during the walk in the outdoor environment when compared to the indoor environment.

According to the Nature Relatedness questionnaire, all participants in this study had similar Nature Relatedness scores. NR scores ranged from 3.0 to 3.667. Figure 7 displays the correlation between NR score and the self-reported responses to “the walk outside was better for me” question from the Walking Environment Preference questionnaire. When comparing these two measures there is a non-significant correlation ($r = .384$). Due to the similarity in NR scores between participants, we are unable to confirm or reject the hypothesis that individuals who express a higher affinity for nature also prefer walking in an outdoor environment.

Discussion

In this study, we investigated exercise environment preference and the influence of walking in an indoor and an outdoor environment on emotion and on physiological measures of stress including salivary cortisol concentration and alpha-amylase activity. Overall, individuals preferred walking in the outdoor environment as was expected in light of the literature on the benefits of being exposed to natural green spaces. The surveys measuring different emotional categories indicated that walking in the outdoor environment tended to result in increases in positive emotions and affect, while walking in the indoor environment tended to result in decreases in positive emotion and affect.

Alpha-amylase activity did not change significantly pre- to post-walk in either environment. Though alpha-amylase activity is an indicator of physiological and psychological stress, it is also influenced by the time of day and physical cues such as the chewing motion ("Salivary Alpha-Amylase," 2017). It is possible that these individual differences in conjunction with the small sample size caused there to be no identifiable significant change from pre- to post-walk. Additionally, if the participants ate or drank shortly before providing the sample, their alpha-amylase activity would be increased as a result.

Cortisol concentration is another measure of physiological and psychological stress, so it was expected to increase pre- to post-walk due to the physical activity involved in the study. Because the walk was self-paced, the participants may not have experienced the physiological stress responses typically associated with physical activity. If there was no stress response from physical activity, then the reduction in the cortisol concentration seen during the walk in the outdoors may indicate a reduction in psychological stress. This reduction was not significant during the walk indoors.

The results of the pre- and post-walk POMS surveys indicated that tension was the only measure to change significantly. Tension, anger, depression, and confusion decreased during the outdoor walk, though tension was the only measure that decreased significantly. This corresponds with other research that has documented the positive influence on psychological factors that exposure to nature elicits (Hansmann et al., 2007). In contrast, during the indoor walk, tension, anger and depression increased, though not significantly. Despite not being statistically significant, it is interesting to note the trends in these emotional categories, as the ratings for the negative emotions tended to decrease in the outdoor environment, whereas they increased during the indoor walk.

Similarly, the PANAS survey indicated that the outdoor environment elicited a greater increase in positive affect than the indoor environment, as there was a significant increase in positive affect during the outdoor walk but no significant change in positive affect during the indoor walk. This was expected in light of the research to support the concept that green spaces have a positive impact on affect (Mackay & Neill, 2010; Pretty et al., 2005; Ulrich, 1984). The lack of any significant increase in positive affect during the indoor walk may indicate that exercisers accrue less psychological benefit from exercising indoors when compared to exercising outdoors. This would also align with previous research, for even though an indoor exercise environment can provide the opportunity for more social connections, exercising in an outdoor environment has been shown to facilitate recovery from symptoms such as stress and headaches (Hug et al., 2009). Crowdedness, a greater number of onlookers, and artificial lighting associated with the indoor walking location may have been factors that contributed to this outcome.

The Walking Environment Preference survey indicated that the participants preferred the outdoor environment to the indoor environment. Every survey question was paired with a nearly identical question that differed only in the environment it highlighted. For example, one question was “The walk inside was better than the walk outside for me” and the question it was paired with was, “The walk outside was better than the walk inside for me.” This allowed for a more direct comparison of the participants’ feelings toward the two environments. It also helped to prevent against priming the participants to answer positively about one environment over the other. The scores for every question emphasizing the appreciation for the outside environment were higher than the scores for every paired question that emphasized the indoor environment, expressing their preference for the outdoor environment.

Interestingly, all of the subjects scored similarly on the Nature Relatedness survey, indicating that they all had a similar understanding of, and appreciation for, nature and natural environments. This could be due to the fact that the individuals lived in the same largely-rural state, presumably by choice. It could also be a product of their background and experience with nature; if they each grew up near natural environments they may be comfortable with natural environments due to familiarity.

When Nature Relatedness was compared against the Walking Environment Preference survey statement, “the walk outside was better for me,” there was not a strong correlation. The intent of comparing Nature Relatedness to this statement was to identify if there was any correlation between degree of Nature Relatedness and preferred walking environment. If so, determining Nature Relatedness through a simple survey before attempting to exercise regularly could help to identify which environment an individual would likely gain the most psychological benefit from. Performing exercise in their preferred environment could help to make exercise more enjoyable for individuals. The similarities between individuals' scores made it difficult to identify any relationship between degree of Nature Relatedness and preference in environment. Larger studies involving more diverse populations from different environmental and exercise backgrounds could help to highlight a correlation between these two factors. Doing so would add valuable information to the growing body of knowledge on the factors that play into how individuals decide where to exercise to feel that they are gaining the most physical and mental benefit. For example, if an individual prefers to exercise inside then they may be more likely to stick with an exercise plan that is conducive to being done in indoors.

Recent research has indicated that a natural environment is not always the preferred exercise environment, often due the fact that individuals sometimes associate the outdoors, especially wooded areas, with fear and anxiety rather than positive emotions (Milligan & Bingley, 2007). This response typically depends on an individual's history with such an environment, as research has shown that individuals who grew up with parental anxiety around wooded areas, and subsequent restrictions on playing in wooded areas, are more likely to associate natural areas with negative emotions (Milligan & Bingley, 2007).

An individual's environmental preference is influenced by a number of other factors as well. The environment an individual lives in or grew up in may influence their level of comfort in certain environments, be it a city or a rural area. If a person has not experienced a certain environment before, their preconceived notions of that environment may influence their experience while exercising in it. With regard to exercise, an individual's self-efficacy in terms of being able to navigate obstacles and navigate in new environments may influence their decision of which environment to exercise in. Also, the convenience of nearby resources such as a restroom or other individuals to reach out to for help may play a larger role in some individuals' decision-making process than in others.

Limitations and Future Studies

The current study had a number of limiting factors. The diversity of this sample was low as all participants identified as Caucasian, were employed, and had received some level of higher education. Also, the participants volunteered for the study rather than being randomly selected form the population. Therefore, this sample is not necessarily representative of the nation as a whole. Given the small sample size (n = 8), trends in the participants preferences were not as strong as they may have been in a larger study. In terms of environmental conditions, it was not possible to control many factors such as temperature, wind, humidity, and the number of other passers-by in either environment. However, this perhaps captured the inherent variability in weather, making the study conditions more closely resemble typical environmental conditions. Additionally, this study was conducted during the Fall season, a time when colder weather may drive individuals to spend more time indoors, and this may have influenced individuals' perception of spending time outdoors, making it seem either inappropriate or like a novel opportunity.

In the future, larger studies could help to highlight the trends seen in this pilot study, including an increased preference for exercising in the outdoors and decreased cortisol concentration after walking in the outdoors. Additionally, it would be beneficial to study whether adherence to an exercise program is stronger when tailored to an individual's environmental preference. Perhaps a simple screening tool such as the Nature Relatedness survey could be used to determine environmental preference. This study provides evidence to suggest that a one-time trial run in each environment paired with a POMS and PANAS questionnaire could allow a preference to be determined. Other future research directions could include examining the general preferences of different populations. This study focused on a sedentary population, but it would be interesting to see if there is a gender or age difference in environmental preference. Also, examining any difference in preference based on history of exposure to different environments would be helpful for predicting preferred environment. Such differences would be important to take into account when creating generalized exercise recommendations, as adherence may be higher if the recommendations are shaped based off of these general preferences. Assessing the interaction between exercise intensity and environment would also be a valuable direction for future studies to go in, in order to determine if increasing intensity diminished or augments the psychological benefits of exercise in different environments. Additionally, including objective measures such as cortisol or alpha-amylase could help to indicate the underlying physiological mechanisms involved in establishing a preference for a certain environment.

Conclusion

Ultimately, increasing rates of chronic conditions such as cardiovascular disease, metabolic syndrome, and depression have prompted greater awareness of the need for more physical activity among members of the population. Creating exercise programs that target the mental wellbeing of their participants in addition to their physical wellbeing may result in higher rates of long-term adoption of these programs and, theoretically, a reduction in many of the chronic disease conditions seen today. The present study found evidence to suggest that individuals prefer, and experience more positive emotional benefit from, exercising in the outdoors compared to indoors. These findings should be considered alongside the fact that all individuals respond to different environments uniquely, meaning that exercising in the outdoors may not be the best solution for everyone. Rather, future research should look into ways of predicting which environment would be most emotionally beneficial for each individual.

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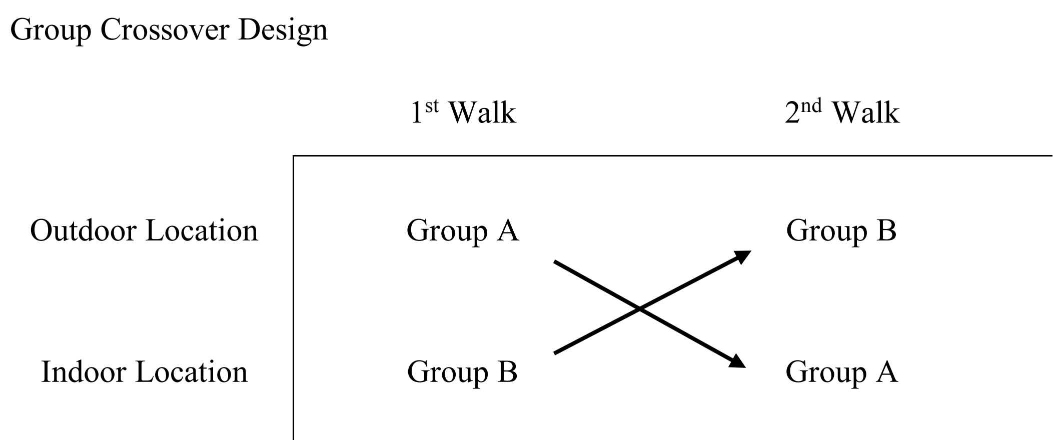

Figure 1. Crossover study design involving both groups walking in both locations at separate times.

Table 1
Sociodemographic characteristics of the study population (n=8)

Variable	**Respondents: n (%)**
Gender	
Female	5 (63)
Male	2 (25)
Non-binary	1 (13)
Age	
18-24	1 (13)
25-34	1 (13)
35-44	2 (25)
45-54	2 (25)
55-64	2(25)
Highest level of education completed	
Some college	1 (13)
Bachelors	2 (25)
Masters	3 (38)
Doctoral	1 (13)
Professional	1 (13)
Occupational status	
Part time	3 (38)
Full time	5 (63)
Household income	
< $15,000	1 (14)
$25,000 - $44,000	2 (29)
$45,000 - $64,000	1 (14)
$85,000 - $99,000	1 (14)
$100,000 - $200,000	2 (29)

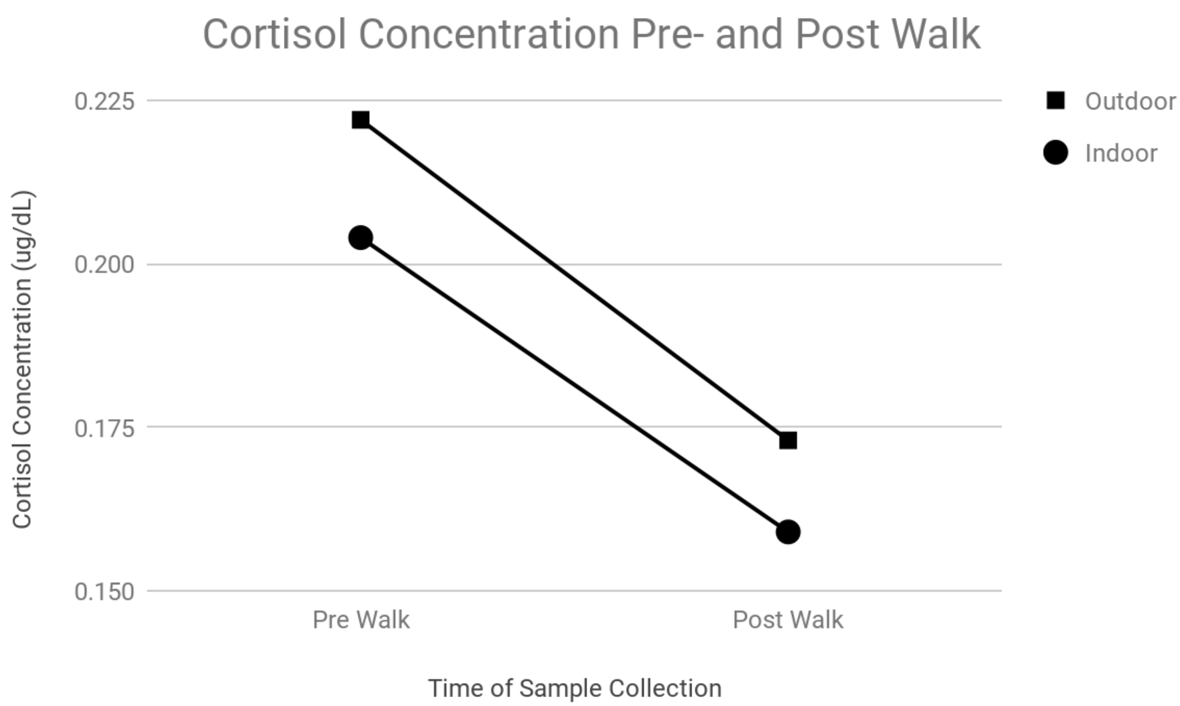

Figure 2. Significant decrease in average cortisol concentration pre- and post- walk in indoor and outdoor locations ($p \leq .05$).

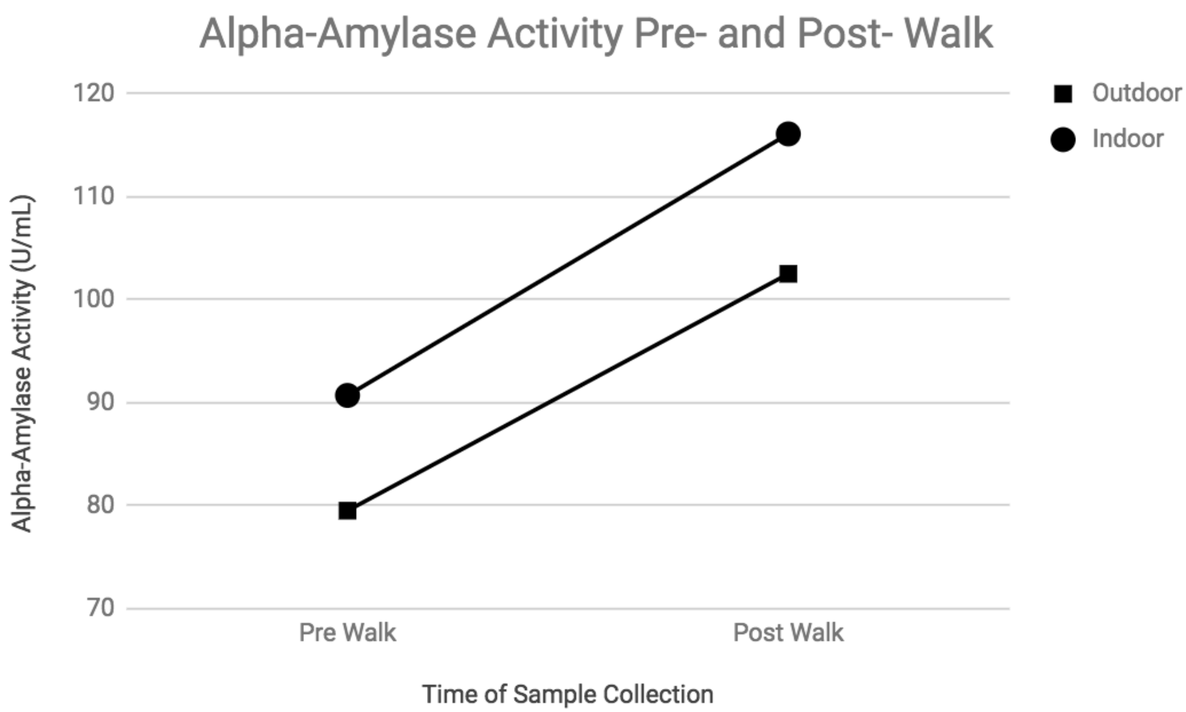

Figure 3. No significant change in average alpha-amylase activity pre- and post- walk in indoor and outdoor locations (alpha = 0.05).

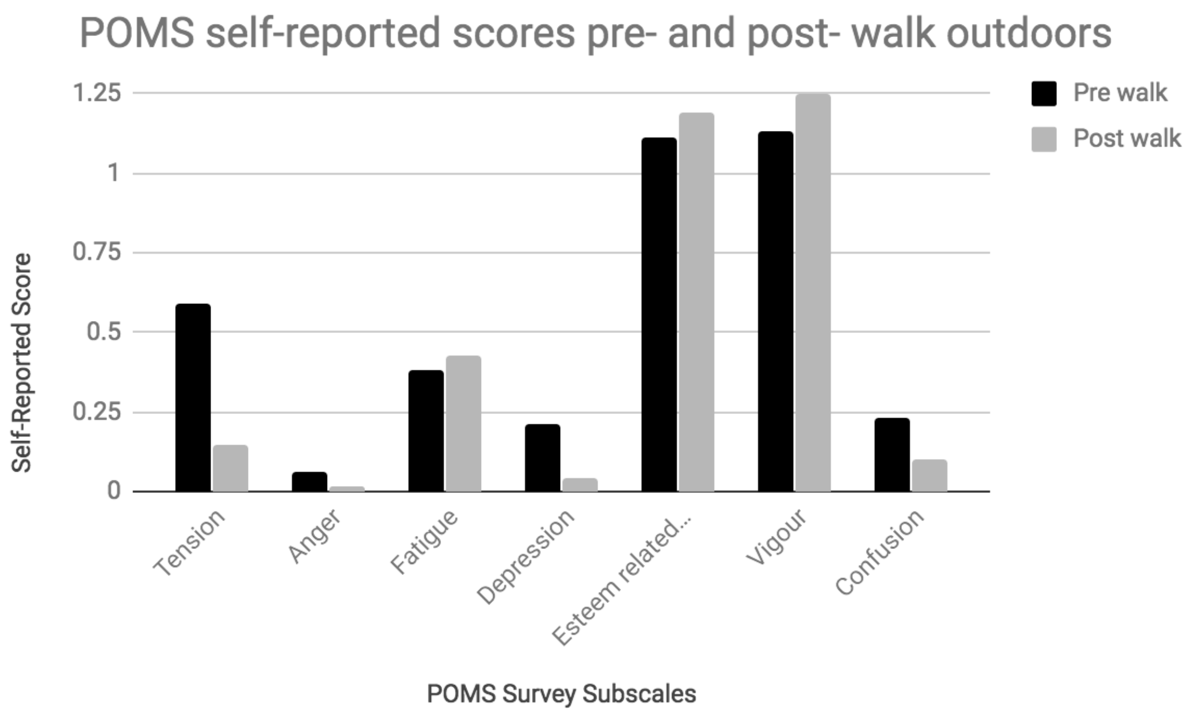

Figure 4. Average self-reported scores of POMS measures pre- and post- outdoor walk. Only tension showed a significant decrease (alpha = 0.05).

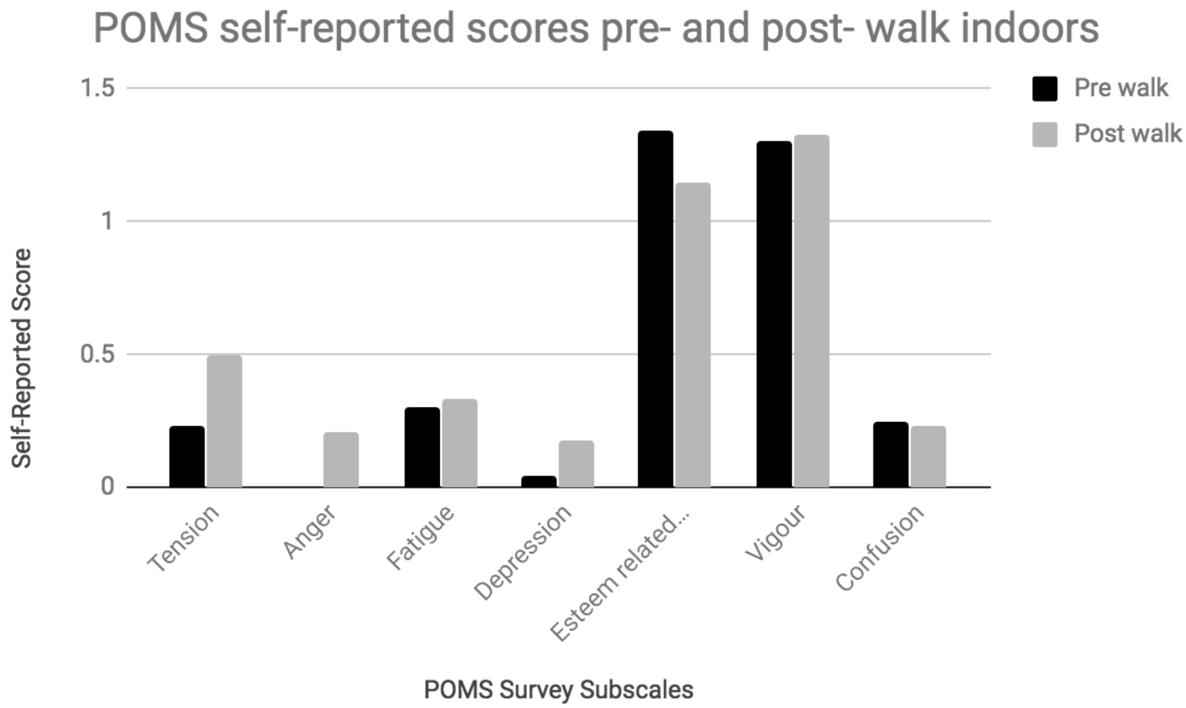

Figure 5. No significant change in average self-reported scores of POMS measures pre- and post- indoor walk.

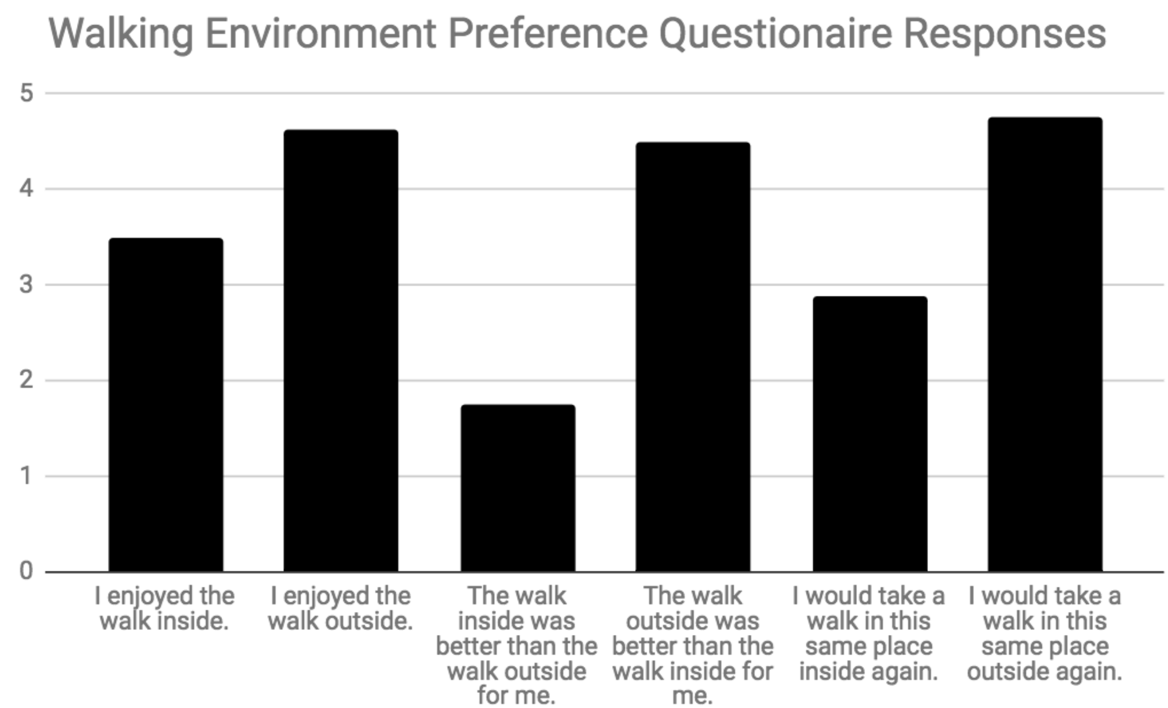

Figure 6. Average scores for Walking Environment Preference questionnaire. A score of five corresponds to "strongly agree" whereas a score of one corresponds with "strongly disagree."

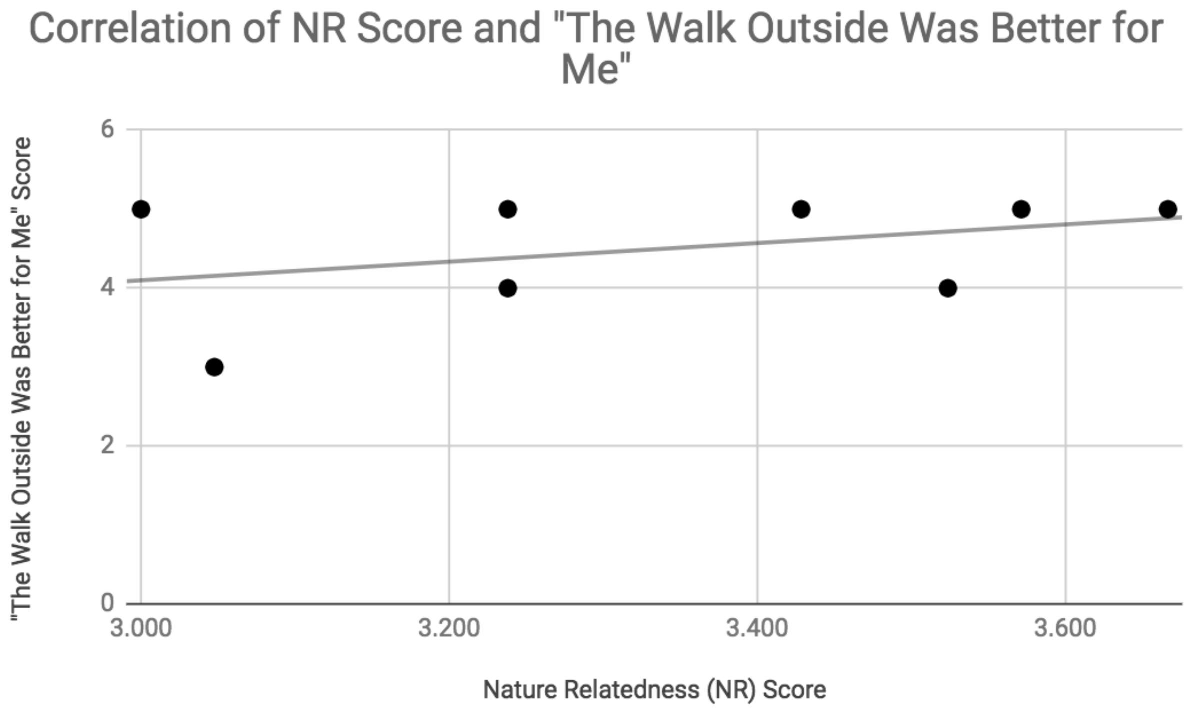

Figure 7. Correlation of Nature Relatedness scores to “the walk outside was better for me” Walking Environment Preference statement. No strong correlation was detected.