

Research

The role of exposure to nature in perceived stress by veterinary students

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Abstract

Veterinary school is intense and represents a challenging time for students, and increasingly, veterinary students are being diagnosed with a variety of concerning mental health issues including stress, anxiety, and depression, often resulting in poor academic performance. Because of the disproportionately high risk of mental health problems in the veterinary field, it is important that students learn, understand, and utilize simple and effective techniques to cope with stress, and demands of the profession. Spending time in natural environments such as outdoor parks, green spaces, and urban forests is an effective strategy for improving mental health. In this study, we examined the self-reported effects of repeated, structured time in a nature-based intervention, vs a control group of veterinary students. Participants reported significantly lower perceived stress levels compared to a control group. Students overwhelmingly reported that they would recommend this stress reduction technique to their classmates, and they stated that they planned to continue spending time in nature to improve their mindset and reduce stress in the future.

Keywords Veterinary student stress · Nature · Natural environment · Green space

1 Introduction

Worldwide, students pursuing a veterinary degree perceive more psychological stress than comparable cohorts of medical students, practicing veterinarians, and the general public [1, 2]. The academic rigor of veterinary training often increases students' risk of stress, anxiety, and depression [3–5]. During the recruitment process, veterinary schools often select students based on their academic capabilities to ensure most likely success; however, with high academic expectations, these prospective students also frequently exhibit increased levels of trait-perfectionism which predisposes them to mental illness [6]. There is growing evidence associating academic stresses and the rising incidence of anxiety and depression diagnoses among veterinary students [5]. Furthermore, after completion of the academic program, neophyte veterinarians will immediately be exposed to work related stressors inherent to the profession that can lead to further deterioration, mental health problems, and even suicide [7–9].

For these reasons, veterinary students' mental health is paramount. Although short-term light stress can improve some limited learning and decision making processes [10–12], beyond a threshold, stress becomes detrimental to working

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memory, reduces coping skills, decreases academic performance [13, 14], inhibits cognitive functions of attention and concentration [15] and disrupts decision-making processes [16]. Deterioration of mental health is also correlated to burnout and compassion fatigue during veterinary education [17], and may be associated with career attrition after graduation [1]. High risk of mental health problems in the veterinary profession makes it essential for students to learn to cope with stress while balancing the demanding academic training with the social, emotional, and financial challenges outside of school as well as after graduation.

Nature-based interventions (NBI) may aid veterinary students in coping with the stresses of their academic training. Spending time in nature provides physiological and psychological benefits [18] including stress reduction, restoration of cognitive capacities, inducing feeling of rejuvenation and calmness [19]. These diverse benefits, referred to as psychological ecosystem services [20], have proven effective in improving well-being [21]. For the purposes of this study, the psychological term ecosystem services refer to the previously defined measurable resources that nature offers for supporting human life, natural spaces and provision of water, air, food and shelter [20].

Due to the growing body of evidence for an association between spending time in natural environments and improved mental health [22], NBI are gaining traction as effective interventions to treat mental health conditions and mood disorders [23, 24], assist cancer survivors [25] and enhance personal development [26]. The stress-reduction theory [27] describes how exposure to natural environments prompt improved psychophysiological responses that lower stress [27, 28], and aid in stress recovery [21, 29]. Similarly, other studies have shown that time spent in nature can elicit feelings of contentment due to improved parasympathetic pathway activity and inhibition of sympathetic nervous system [30].

Although many variables associated with student success and mindset have been explored previously including, motivation [31, 32], socioeconomics [33] and family expectations [34], research specific to veterinary curriculum is largely lacking within educational psychology research [35]. Specifically, mindset, in this context will describe a person's belief that personal attributes such as intelligence and morality can be honed or are permanently fixed and incapable of growth [36]. Despite the vast benefits associated with psychological and physiological services of ecosystems, exposure to nature is an underutilized approach to improved mental health [37, 38]. Veterinary schools are well-suited for conducting NBI since campuses often have ample access to natural green spaces and have disproportionately higher numbers of students experience a range of mental health problems. This study describes an NBI in a novel cohort and circumstance by monitoring perceived stress levels in second-year veterinary students attending Ross university school of veterinary medicine; an AVMA-accredited school in the Caribbean.

2 Materials and methods

2.1 Study design and subjects

A prospective, randomized intervention-control (2:1 ratio) design was utilized to measure perceived stress levels relative to an intervention group. The target population was second-year veterinary students ($n=80$) from Ross University School of Veterinary Medicine (RUSVM). These students were targeted as participants to measure stresses associated with an early component of the veterinary curriculum without the confounding variable stressors inherent to their immediate arrival to a new campus in first-semester. Students were recruited through a brief in-class presentation followed by email and social media messaging. Participants completed an informed consent form and were randomly allocated into the control ($n=28$) or intervention group ($n=52$) using a website-based random number generator (<https://www.randomizer.org>). From the original recruitment, 40 students in the variable group and 23 from the control group completed all requirements associated with the NBI and data collection. The control group was not given any instruction associated with nature exposure. Electronic pre- and post-intervention surveys were used to gather student opinions.

2.2 Ethics approval and consent to participate

All research activities were conducted under approved ethical guidelines (IRB # 21-05-XP). All participants signed a consent form prior to participation.

2.3 Nature-based intervention

Participants allocated to the intervention group were instructed to spend a minimum of 15 min per day, between 8 am and 5 pm, for a minimum of 3 times per week during weekdays, for 3 weeks. The students were free to choose the time and days they visited the research site within the preset parameters. Students were requested to remain free from distractions of electronic devices and veterinary study materials. The intervention site was a natural setting consisting of a rocky beach on the south side of the RUSVM campus bordering the Caribbean Sea. The research site can be categorized under the psychological ecosystem services [20] based on the natural environment of the seashore, as well as limited opportunity for distractions such as poor internet connection, no access to roads, minimal noise pollution and only natural visual cues. The site was isolated from all other campus activities and services, with no other nearby beach attractions within view.

The site was accessed following a dirt trail shaded by tall secondary forest and vegetation typical of a littoral ecosystem, leading to a wooden gazebo (Fig. 1). Also, an investigator (L. Cruz) was present at the site during the intervention time to comply with safety and duty of care (following United States Occupational Safety and Health Administration regulations) mandated by the university. Participants were made aware of the presence of the investigator, and it was optional for them to interact with the investigator. The intervention was conducted September through October of 2021. Email and social media (a private, university-approved Facebook group) were used to send reminders to the students, thank them for participating, and for distributing the links for the electronic pre- and post-intervention surveys.

2.4 Psychological measure of stress

To assess the effectiveness of the intervention, participant's perceived stress was measured using the Perceived Stress Scale (PSS), a commonly used test with well documented reliability and validity [39]. It consists of a 10-item questionnaire designed to measure a person's global assessment of stress (life as uncontrollable, overloading and unpredictable) over a 30-day period [39, 40]. The PSS was designed to be utilized over 1-month's time; however, for this study, a 3-week



Fig. 1 Gazebo at the beach

intervention was utilized to align with the time of availability for the students. Briefly, the PSS requires participants to answer 10 questions related to their feelings of helplessness ($n = 5$) and to feelings of self-efficacy ($n = 5$). The responses were measured on a 5-point Likert scale ranging from 0 (never) to 4 (very often) (Table 1). Both groups completed this assessment at the beginning and the end of the study period via online platform (Qualtrics XM™). The responses were anonymized prior to viewing by the authors.

2.5 Questionnaire

In addition to the PSS, a mixed-method questionnaire (closed and open-ended questions) was administered to the intervention group ($n = 40$) at the end of the study to better understand the students' perceptions. This questionnaire captured the students' qualitative comments, feedback and appraisal about the overall experience (Table 2).

2.6 Data analysis

2.6.1 Perceived stress scale

The Shapiro–Wilk test was used to assure normality. Total perceived stress was calculated as previously reported [40, 41]. Briefly, the positive questions (self-efficacy) were reversed, and all questions were summed and averaged. A two-sample t-test with unequal variances was used to compare total perceived stress between the two groups before intervention. A two-sample t-test with unequal variances was carried out to compare the change in perceived stress between the groups after the intervention.

2.6.2 Questionnaire

Descriptive statistics were used for the quantitative questions, while the qualitative responses were entered in NVivo (NVivo for Mac 12, QSR International, Burlington, MA, USA), where word frequencies and text queries were explored. An iterative, inductive thematic analysis was used to identify themes. The themes were coded and shared with the other investigators to seek consensus. A concept map was created from the identified four main themes surrounding the word nature (Fig. 2).

3 Results

3.1 Perceived stress scale

The total perceived stress was normally distributed. Prior to the NBI, no significant differences were noted in perceived stress between the two groups (P -value = 0.89) (Table 3). After the 3-week intervention, the intervention group reported

Table 1 Perceived Stress Scale [39]

In the last 3 weeks, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
In the last 3 weeks, how often have you felt that you were unable to control the important things in your life?	0	1	2	3	4
In the last 3 weeks, how often have you felt nervous and "stressed"?	0	1	2	3	4
In the 3 weeks, how often have you felt confident about your ability to handle your personal problems?	0	1	2	3	4
In the last 3 weeks, how often have you felt that things were going your way?	0	1	2	3	4
In the last 3 weeks, how often have you found that you could not cope with all the things that you had to do?	0	1	2	3	4
In the last 3 weeks, how often have you been able to control irritations in your life?	0	1	2	3	4
In the last 3 weeks, how often have you felt that you were on top of things?	0	1	2	3	4
In the last 3 weeks, how often have you been angered because of things that were outside of your control?	0	1	2	3	4
In the last 3 weeks, how often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

Adapted for 3 week intervention

0 = Never 1 = Almost never 2 = Sometimes 3 = Fairly often 4 = Very often

Table 2 Exit questionnaire completed by intervention group only

How do you feel after spending time in nature for this project?

1 2 3 4 5 6 7 8 9 10

I wasted study time

It greatly improved my mindset

In one word, how would you describe the overall experience? _____

Would you recommend the experience of spending time in nature as a stress-reducing strategy to a friend?

1 2 3 4 5 6 7 8 9 10

Definitely not

Definitely yes

What I enjoyed the most about this experience was _____

What I disliked the most about this experience was _____

Will you continue to use spending time in nature as a stress-reducing strategy?

1 2 3 4 5 6 7 8 9 10

Definitely not

Definitely yes

How interested are you in learning more strategies to cope with stress and anxiety?

1 2 3 4 5 6 7 8 9 10

Not at all

Very interested

Did the presence of the investigator (Dr. Cruz) at the study site impact your nature experience?

1 2 3 4 5 6 7 8 9 10

Negative impact

Neutral

Positive impact

From the required time (15 mins/day, 3 times per week for 3 weeks), how many days were you able to comply?

Table 2 (continued)

Week 1	1	2	3	4	5
Week 2	1	2	3	4	5
Week 3	1	2	3	4	5

Would you like to share comments, questions, concerns or give us feedback?

Name (optional): _____

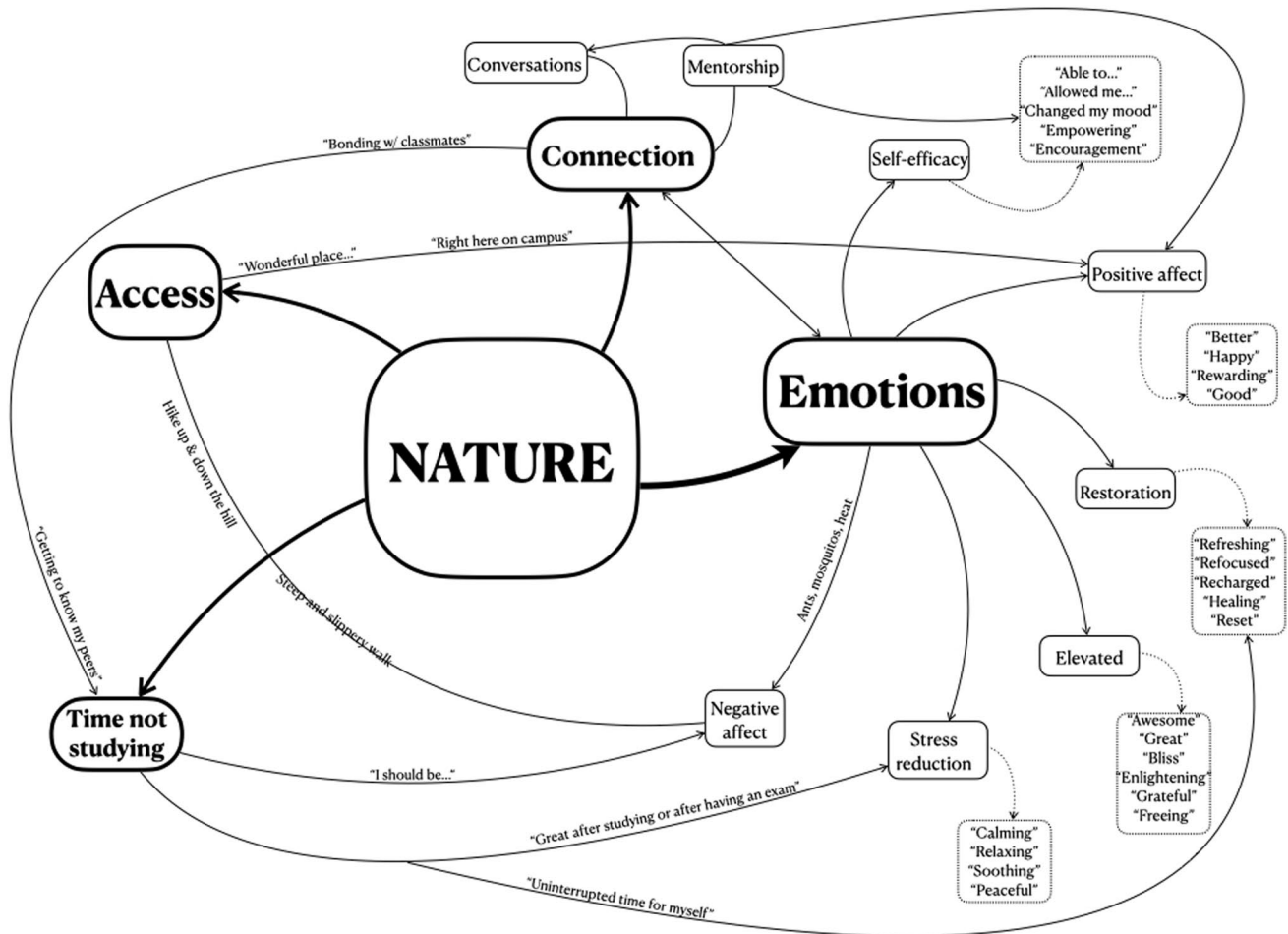


Fig. 2 Concept map constructed from the exit interviews showing the main themes related to the nature-based intervention

Table 3 Mean and SD for Perceived Stress Scale measurements before and after the research timeframe

	Control	Intervention	P-value
Before (Mean, (SD))	27.96 (4.22)	28.14 (4.92)	0.89
After (Mean, (SD))	26.78 (4.89)	24.15 (4.59)	0.035

significantly lower perceived stress compared to the control group (P -value = 0.04). Similarly, there was a significant difference in the degree to which participants from the intervention group perceived stress at the beginning compared to the end of the study (P -value < 0.0001). All students in the intervention group self-reported compliance with the required NBI minimum exposure. The perceived stress levels did not change significantly in the control group over the 3-week period (P -value = 0.23).

3.2 Questionnaire

All but one student in the intervention group completed the questionnaire. Every respondent ($n = 39$) reported that they would recommend the experience to other students and affirmed they would continue using spending time in nature as a stress-reducing strategy. Many participants (95%; 37/39) responded that spending time in nature improved their mindset.

From the qualitative portion, four main themes surrounding the NBI were identified. First, participants perceived uplifting emotions related to self-efficacy and empowered control of their own mental well-being in a positive way, stress reduction, restoration and heightened emotions (bliss and enlightening), but also expressed minor discomfort (negative feelings) associated with environmental heat and insects. Second, participants described feeling “connected” through the conversations with other participants during their interaction with nature. This is similar to previous reports [42, 43], where exposure to natural environments facilitated personal connection and promoted improved social engagement. Third, the access to the research site was mentioned multiple times in a dichotomous way as a wonderful place on campus, yet the dirt trail was somewhat challenging. A fourth theme identified an awareness amongst participants that the time not spent studying allowed for uninterrupted personal reflection and was frequently described as valuable after exams (Fig. 2).

4 Discussion

In this study, we compared the self-assessed stress levels of second-year veterinary students after a nature-based intervention of 15 min, 3-times per week, for 3 weeks, compared to a control group. From these results, students exposed to nature reported significantly lower stress compared to the control group and appraised the experience as highly valuable and beneficial. Specifically, the participants described emotions related to increased self-efficacy, feeling happier and better (positive affect), restoration (recharged, refocused, reset) and improved emotions (bliss and enlightening).

Four predominant theories in literature explain the benefits of nature on a person’s well-being [37]. First, exposure to nature can automatically elicit psychophysiological responses that reduce stress [27]. Second, humans’ survival and well-being depends on an intimate connection to natural environments [44]. Third, natural environments have beneficial effects by restoring a person’s attention and improving cognitive capabilities (attention restoration theory [45]). Fourth, experiencing nature has been described as central to understanding existential anxieties such as meaning in life, freedom and death (eco-existential positive psychology perspective [37]).

A previous study utilizing a 2-week nature intervention documented positive results in its participants including positive affect and elevated feelings of meaning and motivation relative to the control group [46], and therefore provides a framework from which to base this 3-week intervention.

Prior to intervention, both research cohorts participated in PSS testing and received similar scores, meaning that the perceived stress of all participants prior to the intervention was insignificant. Our results align well with previous findings correlating positive outcomes with utilization of natural spaces surrounding schools [47], and further supports the Attention Restoration Theory (ART) [48], which explains in detail the intense restorative effects that nature has on human attention. This theory is well accepted and accounts for a variety of benefits from exposure to nature [49]. This study provides further support to the already diverse documentation that ART is a clear benefit to the human psyche and well-being [50], especially in reducing stress levels [51].

The intervention of nature exposure of this research had the added benefit of not only tree-forested area (green space), but also the combined benefit of an aquatic shoreline of the Caribbean Sea (blue space). These blue-green spaces are reported to produce invigorating effects, as the proximity to aquatic environments awards people with “a particular restorative potential” [50]. It has been postulated that the optimal psychological environment may combine natural green spaces with shoreline meeting a large body of water [52], as these are ecological attributes that underwrite human well-being [53]. This may be unsurprising after observing that people are generally more attracted to, and have more willingness to visit places that provide green and blue features or combined water-land interface [54]. So profound are the outcomes associated with exposure to nature that beneficial effects have been documented by simply viewing images of nature without an actual outdoor experience [55, 56].

Students in the NBI group described feeling empowered regarding their mental health and well-being. This aligns closely with a central tenet of health promotion which focuses on empowering people to take control over, and to improve their own health [57]. Health promotion, seen as a relatively new public health movement since the 1970s, also recognizes ecosystem goods and services as determinants of health and emphasizes settings-based health approaches [57, 58]. As a form of health promotion, nature-based interventions could be a key component in motivating veterinary students to cultivate a mindset that favors good mental health, especially considering veterinary students worldwide are experiencing disproportionately grave mental health issues [59].

Additional advantages of nature-based interventions include their cost effectiveness, accessibility on our campus, and the general idea that nature is seen as public good in defending against climate change and contributing to environmental stewardship [60]. Veterinary schools may be poised particularly well to implement the positive effects of nature because of the impressive drive currently to support our students and promote pro-mental health activities in the veterinary field [35].

Comments from the participants grouped within four themes previously described are congruent with stress reduction in other NBI: heightened emotions, positive affect and feelings of connectedness [61]. These sentiments support the benefits of study breaks associated with exposure to nature previously described [62]. Overall, growing scientific literature suggest that time spent in a natural environment enhances personal perceptions of happiness, especially compared to time spent around the human-built environment [63]. In Japan for example, Shinrin yoku is a health promotion strategy in which people experience nature in mindful ways and has been proven to result in decreased measures of depression, anxiety, stress and anger [64]. Despite its obvious benefits, negligible costs and limited exposure necessary to reap extensive advantages, NBI are still an underutilized approach, despite the increasing number of counselling professionals recommending it to their patients [37].

Although the authors are strong proponents of nature’s impressive ability to improve the human psychological experience, we concede that “a variety of interacting factors can affect mental health, including social, economic, psychological, physiological, behavioral, environmental, genetic, and epigenetic influences, in many cases, these social and environmental determinants of health may outweigh the effects of nature contact on specific outcomes” [20].

Limitations of this study include the possibility of cohort subset variances. For example, RUSVM has a predominantly female student population and NBI effects were not broken down into gender identification or other demographic divisions, largely to maintain anonymity and to encourage participation. Although some research has shown that psychological resilience, age and gender may be significant predisposing factors associated with developing symptoms of depression and/or anxiety [65], extrapolation was not realistic for the purposes and scope of this paper. Furthermore, students who enjoy experiences in nature may have been more likely to volunteer for this research and therefore potentially have an increased benefit to the NBI compared to students who are not comfortable in nature.

Authors of this research echo others who have called for further studies on NBI’s capacity to impact stress and cognition, and for further elucidation of the correlation between these two components of our mental pathways [35]. Future research is warranted to investigate the relationship between most effective time of NBI to maintain positive affect and to describe a potential dose dependency associated with NBI, and to determine the extent to which exposure to nature may affect academic performance in veterinary curriculum. It would also be interesting to see if results were as significant if the control group were exposed to a non-academic activity which took place indoors.

5 Conclusions

Our study showed that intervention students self-reported benefits from spending prescribed time in nature. Students perceived numerous positive emotional effects, and they attributed the NBI experience. High incidence of stress, anxiety and depression secondary to intense training throughout veterinary school [3–5], all too often lead to adverse emotional

states associated with decreased academic performance, fatigue and even suicide [7–9]. It is imperative that veterinary students learn strategies to cope with stress during their academic training and continue to apply these valuable health strategies as they become practicing health professionals.

Author contributions WBL wrote the main manuscript text, LD and LPH completed statistical analysis, CAG assisted with literature search and manuscript editing. LCM wrote the IRB protocol and collected research data. All authors reviewed the manuscript.

Data availability Supporting data generated from this research including analysis, results and raw information can be made available by the principal investigator where appropriate.

Declarations

Competing interests All authors agree no competing financial or non-financial interests or personal relationships that influenced the research described herein. Funding for this project was provided via RUSVM intramural grant # 44003-2022.

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