Does Outdoor Recreation Decrease Stress?

Investigating the physiological responses of outdoor recreation in Idaho

Ellie Opdahl, Dr. Kathryn Demps, Dr. Julie Heath
Departments of Anthropology & Biological Sciences, Boise State University
MILES Project, Idaho EPSCoR

Background

- Outdoor recreation can provide human well-being benefits such as decreased blood pressure, decreased heart rate, decreased stress, improved mood, and improved self-esteem that can help alleviate urban stressors (Pretty et al., 2005; Park et al., 2007).
- While beneficial to humans, outdoor recreation can have negative effects on wildlife through increases in physiological stress and behavioral changes (Thiel et al., 2008; Taylor & Knight, 2003).
- The use of salivary cortisol to investigate physiological stress has rarely been used within the outdoor recreational literature.
- Studies are limited by small sample sizes, self-reported stress, similar landscapes, low interdisciplinary effort, and a lack of a human-environment systems approach.

Objectives

1. Compare biological cortisol concentrations of three different recreation types (hiking, mountain biking, and OHV) before and after recreating.
2. Identify factors influencing physiological response
3. Evaluate differences between physiological and psychological stress response.
4. Discuss results within a human-environment systems conceptual framework.

Methods

- Collected saliva samples and used ELISA immunoassays to determine the biological concentration of cortisol before and after recreating.
- Gathered survey data on basic demographics, motivation, familiarity of the area, recreational frequency, group size, wildlife observations and self-reported stress scores of recreationists.
- Accumulated weather, recreational duration, day of week, and saliva collection time data for each participant.
- Conducted one-way ANOVA and Tukey analysis to compare change in cortisol concentration by recreation type. An ANOVA analysis was also used to evaluate self-stress scores by cortisol. Model competition was used to look at factors affecting change in physiological stress.

Results

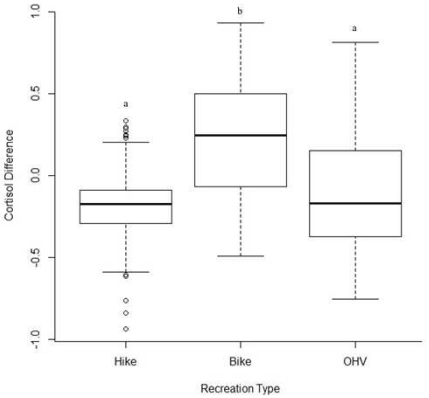

Figure 1. The relationship between the change in salivary cortisol concentration after recreation by hikers, mountain bikers, and OHV riders (n=184). There is a significant mean difference between cortisol (µg/dL) and recreation type ($F_{2,181}$=33.844, p<0.001). A Tukey test revealed that there was a significant difference between mountain bikers and hikers (p<0.001) as well as mountain bikers and OHV riders (p<0.001). There was no mean difference between hikers and OHV riders (p=0.7693). Different letters denote a significant mean difference.

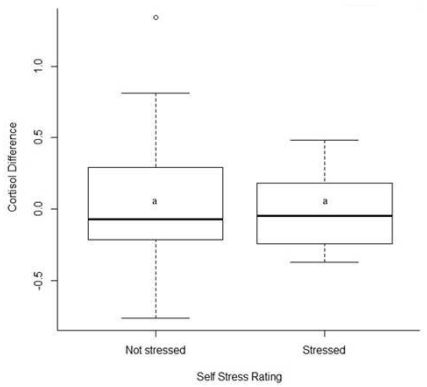

Figure 2. The relationship between the change in salivary cortisol concentration (µg/dL) and self-reported stress rating (n=126). There was no significant difference between the "not stressed" and "stressed" category with respect to physiological cortisol concentrations ($F_{1,124}$=0.1844, p=0.6684). Same letters denote no difference in means.

Table 1. AICc ranking of candidate models investigating the effects of each hypothesized predicted measurement on the change in biological cortisol concentrations (µg/dL) from recreational activity. Each model was created using the best combination of variables within each category. Categories that had variables with low impact on cortisol were not included. Model competition was conducted for the entire dataset as well as subset data by recreation type.

All Recreation Types (n=120)				Hikers (n=48)				Mountain Bikers (n=52)				OHV (n=22)			
Model	K	ΔAICc	w_i	Model	K	ΔAICc	w_i	Model	K	ΔAICc	w_i	Model	K	ΔAICc	w_i
Frequency	5	0.00	0.88	Wildlife[4]	3	0.00	0.42	Intercept-only	2	0.00	0.37	Familiarity[5]	4	0.00	0.44
Motivation[1]	4	6.05	0.04	Start Time	2	2.07	0.15	Group Size	3	1.36	0.19	Group Size	3	0.89	0.28
Recreation Type	3	6.07	0.04	Intercept-only	3	2.17	0.14	Duration	3	1.75	0.15	Motivation[6]	3	2.16	0.15
Wildlife[2]	3	7.41	0.02	Day of Week	3	2.31	0.13	Start Time	3	2.03	0.13	Intercept-only	2	3.91	0.06
Intercept-only	2	11.96	0.00	Duration	3	3.39	0.08	Day of Week	3	2.25	0.12	Duration	3	5.39	0.03
Demography	4	12.04	0.00	Group Size	3	4.34	0.05	Demography	4	4.53	0.04	Start Time	3	6.06	0.02
Duration	3	13.09	0.00	Demography	4	4.62	0.04					Demography	4	8.19	0.01
Group Size	3	13.12	0.00												
Weather[3]	3	13.49	0.00												
Day of Week	3	13.92	0.00												
Start Time	3	14.01	0.00												

[1] All Motivation = Develop skills + View wildlife
[2] All Wildlife = Total wildlife seen
[3] All Weather = Temperature
[4] Hiker Wildlife = Recognized plants + Total wildlife seen
[5] OHV Familiarity = Recreational area + Plant ID
[6] OHV Motivation = Meet new people

Conclusions

- Physical stress from mountain biking results in short-term increases in biological cortisol (Fig 1).
- Psychological and physiological stress measurements are not related. Previous research using self-reported stress scores cannot be translated to physiological stress response (Fig 2).
- Across all recreation types decreased biking frequency, decreased motivation to develop skills, recreation type, and increased observation of wildlife were associated with decreased cortisol (Table 1).
- Within hikers, hypothesized variables only had slight trends toward decreased cortisol while no other variable helped explain cortisol change in bikers.
- In OHV riders increased area familiarity, decreased plant familiarity, larger group sizes and increased motivation to meet new people were associated with lowered cortisol.
- All results must be interpreted within the context of short-term changes on physiological stress.
- Wildlife observation was associated with decreased physiological stress, suggesting wildlife can play an important role in the outdoor recreational experience and human well-being benefits.
- The role of wildlife and the natural system in terms of human well-being benefits should be incorporated in land use decisions and management.

Future Directions

- Future research should further focus on the interactions between human physiological stress and the natural environment to discuss outdoor recreation in a human-environment systems context.
- Additional research should assess quantitative measurements of stress to place outdoor recreation as a cultural ecosystem service within the ecosystem service framework.

Literature Cited

Park, B-J., Y. Tsunetsugu, T. Kasetani, H. Hirano, T. Kagawa, M. Sato & Y. Miyazaki. 2007. Physiological effects of *shinrin-yoku* (taking in the atmosphere of the forest) using salivary cortisol and cerebral activity as indicators. *Journal of Physiological Anthropology* 26(2):123-128.
Pretty, J., J. Peacock, M. Sellens & M. Griffin. 2005. The mental and physical health outcomes of green exercise. *International Journal of Environmental Health Research* 15(5):319-337.
Taylor, A.R. & R.L. Knight. 2003. Wildlife responses to recreation and associated visitor perceptions. *Ecological Applications* **13**(4): 951-963
Thiel, D., S. Jenni-Eiermann, V. Braunisch, R. Palme & L. Jenni. 2008. Ski tourism affects habitat use and evokes a physiological stress response in capercaillie *Tetrao urogallus*: a new methodological approach. *Journal of Applied Ecology*. 45:845-853.

IDAHO EPSCoR NSF MILES Managing Idaho's Landscapes for Ecosystem Services