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Healthy Parks Healthy People as an Upstream Stress Reduction Strategy

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Abstract

One of the primary goals of the Healthy Parks Healthy People (HPHP) program, located in the San Francisco Bay Area, is to offer group-based physical activities in natural settings. These activities arefor racially and ethnically diverse groups of individuals as an "upstream" strategy for improving health. This study investigated the health impact of selected two-hour HPHP Bay Area events that targeted low-income racial and ethnic minority groups using physiological and self-reported measures of stress and related variables.

Study participants (N=52) in the selected HPHP Bay Area events donated saliva and filled out psychological measures of perceived stress (PSS-4; Cohen et al.) and mood state (I-PANAS-SF; Thompson, 2007) at the beginning and the end ofa two-hour guided walk in green spaces. Moreover, a measure of perceived restoration (SRRS; Han, 2007) was completed at the end ofthe walk. Study participants wore a physical activity self-monitoring device (Garmin Vivofit 2) to capture their step count and heart rate during the event.

Stress, both measured by the analysis of salivary cortisol and self-reported perceived stress, significantly decreased over the course of the event (p<.0$) and there was a significant increase in positive mood (p<.05). The monitoring device also indicated that individuals were engaged in

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moderate levels of physical activity during the guided walks (<di>x</di> =8,990 steps, HR 95 bpm).

The results encourage further development of nature-based health interventions to mitigate stress. Such interventions may be especially appropriate for low-income, urban, racial and ethnic minority groups that likely experience increased levels of stress due to social inequities and poor living conditions.

Keywords

stress; mood; underserved population; Healthy Parks Healthy People

Introduction

Seven of the top ten leading causes of death in the United States are due to chronic illnesses; including, heart disease, cancer, and diabetes mellitus type two (Centers for Disease Control and Prevention, 2012). These chronic diseases disproportionately impact racial and ethnic minority populations. For example, African Americans have the highest rate of death due to heart disease, and non-Black Hispanics have the greatest number of “years of life lost” due to diabetes (Mensah et al. 2005; Centers for Disease Control and Prevention, 2013).

Health equity research necessitates the engagement of transdisciplinary approaches to gathering comprehensive evidence about how environmental and social stress *gets under our* skin and affects people at a biological level (Warnecke et al., 2008). This evidence is necessary in developing meaningful strategies to address “upstream” factors, such as social inequities and poor living conditions, which can lead to chronic illness and other health disparities (Bay Area Regional Health Inequities Initiative, 2015). A potential strategy is to increase the exposure of socially disadvantaged groups to the natural environment (Ward Thompson et al., 2012).

Healthy Parks Healthy People (HPHP) is an international movement that enacts an agenda based on the beliefin a reciprocal relationship between people’s mental, physical, spiritual health, and social well-being and the sustainability of the environment. Although the importance of the HPHP activities and events is often presumed apart of the the field of parks and recreation, this is based on general evidence regarding the impact of, and the exposure to, recreation in natural environments (Maller, Townsend, Pryor, Brown, & St Leger, 2006). There is limited empirical data indicating the impacts of HPHP activities. This is the first study to use both physiological and self-report measures to investigate the health outcomes of participating in a HPHP event.

The purpose of this study was to examine the health impacts of selected Healthy Parks Healthy People Bay Area (HPHP) events that included primarily urban, low-income individuals that identified as belonging to a racial and/or ethnic minority group. The study explored the effect of a two-hour nature- based walk on stress levels while monitoring the participants’ physical activity levels during the HPHP event.

Residential environments have an important impact on people's health (Roe et al., 2013). Individuals residing in impoverished neighborhoods, especially racial and ethnic minority individuals, have less access to safe environments that promote physical activity, which can then lead to poor health outcomes (Huston, et al., 2003; Lovasi, et al., 2009). Furthermore, individuals who live in neighborhoods with higher rates of poverty tend to suffer from overcrowding, pollution, discrimination, and experience more stressful life events (Baum et al., 1999; Matheson et al., 2006; Roosa, 2010). The aggregation of life stressors also coincides with elevated levels of psychological stress in these populations (Boardman et al., 2001).

Elevated levels of stress act through a multitude of biological pathways (Merkin et al, 2009). In response to a perceived threat, our body releases various hormones, including cortisol. Cortisol has a wide range of physiological effects (e.g., metabolism, gluconeogenesis and immune system suppression), but its most vital function is to regulate the body's stress response system. The stress response system functions appropriately in instances of acute stress, but chronic stress (i.e., stress experienced over an extended period of time) can cause cortisol dysregulation leading to negative health consequences. The biological consequences of chronic stress are modulated by the interplay of multiple factors, this includes, an individual's coping mechanisms, available support/stress buffers, and access to resources enabling coping with or minimizing stressors (Braveman et al., 2011; Chen & Miller, 2013; Hertzman & Boyce 2010; Salleh, 2008).

One potential resource for reducing the impact of stressors, that is often available to members ofimpoverished communities, is physical activity in parks and other green spaces (Abercrombie et al., 2008; Boone, Buckley, Grove, & Sister, 2009). Spending time in green spaces has long been thought to improve physical and psychological health (van den Berg, Hartig, & Staats, 2007). More recently, there is a growing body of evidence showing that exposure to natural environments improves physical and mental health (e.g., Mitchell & Popham, 2007, 2008; White, Alcock, Wheeler, & Depledge, 2013). More specific to this study, the amelioration of stress has been a guiding principle of park design since at least the era of American landscape architect Frederick Law Olmstead where there was construction of grand parks, such as Central Park (Dustin, Bricker, & Schwab, 2010). Additionally, there is enduring common knowledge that leisure is associated with a reduction in stress (Hull IV & Michael, 1995; Ulrich, Dimberg, & Driver, 1990).

The current study that leisure is associated with a reduction in stress is grounded in one of the two primary restoration theories, Ulrich's (1981, 1983, 1984) Stress Reduction Theory (SRT). This theory contends that natural environments reduce psychological and physiological stress and restore individuals to equilibrium, due to humans' evolutionary adaptations to natural environments. Ulrich's theory assumes that the initial response to the environment is affective rather than cognitive (Ulrich, 1983). Support for the theory can be found in previous studies where associations between an increase in green space near individuals' residences and significantly lower levels of stress (Gidlöf-Gunnarsson & Öhrström, 2007) results in decreased mortality (Takano, Nakamura, & Watanabe, 2002). Although the exact mechanism for how nature can reduce stress is still being debated, it has been documented that nature buffers the negative impact of stressors (e.g., Brown, Barton, &

Gladwell, 2013) and decreases recovery time following exposure to a stressor (e.g., van den Berg, Jorgensen, & Wilson, 2014).

Findings about the impacts of the environment on cortisol are mixed, but largely support a positive association between natural environments and lower cortisol levels in humans. Numerous studies, including an extensive series of shinrin-yoku (forest bathing) field experiments (Lee et al., 2009; Lee et al., 2015; Mao, et al., 2012; Miyazaki, Lee, Park, Tsunetsugu, & Matsunaga, 2011; Park, Tsunetsugu, Kasetani, Kagawa, & Miyazaki, 2010), found that exposure to the natural environment was significantly associated with lower cortisol levels in comparison to exposure to an urban environment. Additional field experiments showed significantly lower levels of cortisol while gardening (Rodiek, 2002; van den Berg & Custers, 2010) and running (Harte & Eifert, 1995) in outdoor settings. The impact of the level of naturalness (from pristine to polluted) on restoration is still being explored; however, Lee et al. (2015) found that exposure to agricultural settings also led to significantly lower levels of cortisol.

Despite these repeated findings in the literature, that exposure to natural settings reduces cortisol, some studies have failed to identify significant differences in stress-reduction between natural and artificial settings. These studies speculate that their lack of significance was due to low levels of participant stress before environmental exposure (Beil & Hanes, 2013), a lack of environmental pristineness (Tyrväinen, et al., 2014), and the duration of exposure to the nature environment that was too brief (Beil & Hanes, 2013; Hartig, et al., 1996).

Although studies, such as the one cited above, have failed to find significant cortisol reduction as a result of exposure and recreation in a natural settings, the larger body of evidence currently supports the claim that nature exposure reduces stress, as measured by cortisol. Given this evidence, the current study provides exploratory empirical evidence from a population of primarily racial and ethnic minority individuals living in low-income communities. Furthermore, this study provides the first evaluation of HPHP events using physiological and self-report measures to investigate the health outcomes of participating in a HPHP event. Given SRT's assumption of an initial affective response, through the restorative quality of natural environment (Ulrich, 1983), mood and the perceived quality of the event sites were also measured.

Methods

Participant Recruitment

This study recruited racial and ethnic minority individuals from low-income communities in the San Francisco Bay Area in the fall of 2016. This population was chosen to examine if their stress and mood changed after a guided walk.The sample was a convenience sample of participants in three Bay Area HPHP events. The researchers chose to collect data at HPHP events located in a rural regional park and within a large urban park. This choice was due to previous studies' (e.g., Tyrvainen, et al., 2014) speculations that "natural pristineness" (e.g., influence of visual, sound and air pollution) may have an association with stress reduction. A total of 142 Bay Area residents and family members joined one of the three HPHP events.

All three data collection days had similar weather conditions with moderate temperatures. Any participant over 18 that could respond to a written survey in English, Spanish or Chinese were recruited for participation in the study. A total of 99 adults were invited to participate and over half of them (N=52) agreed to participate in the study (response rate 53%).

Researchers partnered with two program providers, the East Bay Regional Park District and the San Francisco Recreation and Parks Department. These agencies had been working closely with underserved communities and had provided Healthy Parks Healthy People Bay Area (HPHP) programs once a month or more since 2014 (Institute at the Golden Gate, 2016). Their recruitment efforts were facilitated by a community outreach specialist that invited members of marginalized communities to HPHP programs, and formed ongoing, positive relationships with the communities. Additionally, one of the agencies provided a chartered bus to bring a group of primarily Latino residents from one of the most impoverished regions of the San Francisco Bay Area to participate at an event in a regional park. All the programs were free of charge and open to local residents; however, the agencies primarily targeted underserved communities. Program providers promoted their HPHP programs through websites, email solicitation with flyers, and word-of-mouth.

The research team intentionally included culturally diverse graduate and undergraduate students that represented the racial and ethnic diversity of the San Francisco Bay Area to minimize participant anxiety through cultural sensitivity during data collection (Napoles-Springer & Stewart, 2006; Yancy, 2006). All members of the research team spoke at least one other language than English fluently (e.g., Spanish, Chinese [Mandarin and Cantonese], Japanese). The research team received training in how to effectively build trust with potential study participants, articulate the importance of this study to target communities, and respond to any concerns or misconceptions pertaining to the nature of biospecimen (i.e., saliva) collection process. Throughout the study, members of the research team provided feedback to improve the recruitment procedure (Napoles-Springer et al., 2017) and biospecimen collection protocol (Ramirez et al., 2017) to accommodate the range of cultural norms in the targeted communities. Members of the research team and program facilitators modeled every step of the collection process to decrease participant anxiety and increase participation.

Measurements

A mix of biomarker assays and validated surveys were used, with the impacts of the HPHP events being measured using salivary cortisol, perceived stress, and the positive and negative affect. Other variables, such as time (prepost event), perceived restoration (perception of the natural environment experienced during the HPHP event), and physical activity (heart rates and step counts), were measured to examine if they significantly influenced outcome variables.

Physiological Stress (salivary cortisol levels).

Similar to other studies investigating the link between the environment and stress, salivary cortisol was used to measure stress levels. While some studies have used Alpha-amylase

(Razani et al., 2016) or both Alpha-amylase and cortisol (Beil & Hanes, 2013), salivary cortisol is the primary biomarker for measuring physiological stress (El-Farhan, Rees, & Evans, 2017) and is more resilient to ambient temperature fluctuations prior to analysis. Additionally, it can be stored at room temperature for three weeks without significant reductions in measured cortisol (Djuric et al., 2008).

Saliva was collected before and after the guided nature walk. To obtain the cleanest samples possible, participants were asked to not eat 30 minutes prior to donating saliva. Participants were asked to pool saliva in their mouth for transfer into a 2 mL collection tube via a straw. After each 1 mL (1/5 teaspoon) of saliva was collected pre and post-event, the researchers stored the samples at −4°C until they were placed into a laboratory freezer immediately following each event.

Perceived Stress.

Stress was measured pre and post-event using the four-item Perceived Stress Scale (PSS-4; see Table 1; Cohen et al., 1983). PSS is one of the most commonly used psychological instrument for measuring the perception of stress (Cohen, 1994). The PSS has a strong body of published psychometric data supporting the validity and reliability of the scale (e.g., Lee, 2012; Roberti, Harrington, & Storch, 2006). Many investigators studying the impact of nature on health in the U.S. and other countries have also used this scale (e.g., Beil & Hanes, 2013; Fan, Das, & Chen, 2011; de Vries, van Dillen, Groenewegen, & Spreeuwenberg, 2013; Herzog & Strevey, 2008; Irvine, & Warber, 2013; Marselle, Roe et al., 2013; Ward Thompson et al., 2012). The short version PSS-4 was selected for this study since it is recommended as useful and feasible in situations where a short questionnaire is required (Cohen, et al, 1983). Although the original questionnaire asks feelings and thoughts during the previous month (e.g., *In the last month, how often have you felt that things were going your way?*), this study slightly modified the response question stem (e.g., How *often do you feel . . .?*) and response options using a 7-point Likert Scale from *Never* to *Very often* (see Table 1).

Perceived Mood.

Perceived mood was measured using the International Positive and Negative Affect Short-Form (I-PANAS-SF; Thompson, 2007). I-PANAS-SF is a 10-item scale. This validated measure asks participants, "*how do you feel now?"* using a 7-point Likert scale anchored at the ends with *Not at all* and *Very much so.* Negative affect (NA) consisted of five items including *Upset, Hostile, Ashamed, Nervous,* and *Afraid,* and positive affect (PA) included *Alert, Inspired, Determined, Attentive,* and *Active.* This instrument has also been used in a number of health and nature studies (e.g., Brown, Barton, & Gladwell, 2013; Herzog & Strevey, 2008; Tyrväinen et al., 2014). Previous research found positive and negative affects to be consistent across cultures (Russel, 1983; Russel, Lewicka, & Niit, 1989).

Perceived Restoration.

Perceived restoration was measured in the post period using Han's (2003) 8-item Short-version Revised Restoration Scale (SRRS) that is grounded in Ulrich's (1983) Stress Reduction Theory (SRT). SRRS was used to assess whether participants perceived the restorative qualities of the natural environments at the two sites as different. Furthermore, this instrument was used to evaluate whether observed changes in stress and mood levels varied with perceived restoration. The instrument has previously been used in both laboratory (e.g., Han, 2007; Vassiljev et al., 2010) and field experiments (e.g., Wilson, et al., 2016).

Physical Activity.

The level of physical activity during the HPHP events was measured by two indicators, heart rate and step count, using a wearable activity monitorGarmin Vivofit 2.0. After reviewing over a dozen commercially available physical activity self-monitoring devices, Garmin Vivofit was selected due to its accuracy of heart rate and step count measurement as well as the relative ease of use for research participants. Garmin Vivofit is reported as being just as good or even better than other devices measuring step count (Alsubheen, George, Baker, Rohr, & Basset, 2016; Huang, Xu, Yu, & Shull, 2016) and appears to have the lowest systematic error (i.e., −0.2% at 3.5 km /h walk test; Leth, Nielsen Nielsen, & Dinesen, 2017). Participants were asked to wear a wrist-worn Garmin Vivofit and associated chest-strap heart rate sensor. The chest-strap was placed directly on the participants' skin. Participants had access to a tall nylon tent (6'3" x 4' x 4') to lift their clothing up and fit the heart band. Not all participants took advantage of the tents. In some cases, such as women wearing traditional Muslim dresses, participants may have chosen to not wear a heart band if a discreet location to fit the heart bands had not been provided.

Data Analysis

Salivary cortisol was used to measure physiological levels of stress using Enzyme-Linked Immunosorbent Assay (ELISA) kits from ALPCO. Samples were prepared for analysis in accordance with the *Expanded Range High* Sensitivity *Salivary* Cortisol *Enzyme Immunoassay* protocol (Salimetrics, 2016). Saliva samples were frozen and stored at −20°C. After two days of storage, the samples were thawed at room temperature for analysis. Once the samples reached room temperature (23°C), they were spun at 4,000 rpm for 20-minutes. Supernatant was extracted and then analyzed using a competitive ELISA technique.

Three subsamples of each saliva sample were analyzed. Saliva was loaded on an antibody-coated 96 well plate. The plate was then read using a Synergy HTX multi-mode reader from BioTek. Five-parameter linear regression analysis (Gen 5 version 2.04) was used to determine the concentration (nanogram per milliliter, ng/ml) of cortisol. The detection kit is limited to measuring a minimum of 1 ng/ ml and maximum of ioong/ml. Samples with high levels ofvariation between the three subsamples suggest that the saliva was polluted with food or some other substance that decreased the reliability of the cortisol concentration estimation process. Therefore, only samples with a coefficient of variation (CV) of less than 20% between the three subsamples were included in the data set.

The responses to the demographic questionnaire and psychological instruments (4-PSS; Cohen et al., 1983, I-PANAS-SF; Thompson, 2007, SRRS; Han, 2007), were manually entered into a Microsoft Excel worksheet, then analyzed using SPSS version 24. Descriptive statistics were calculated and paired samples t-tests compared changes in the levels of cortisol, perceived stress, and positive and negative mood before and after the nature walk. Bivariate correlations and regression analyses were used to explore relationships.

The step count and heart rate from the wearable Garmin Vivofit activity tracker were subsequently uploaded to the online Garmin Connect website. The peak and average heart rate values and step count data were then extracted and analyzed in SPSS. Additionally, the duration and the type of activities observed were manually recorded. The average duration of the walk was calculated during each of the nature walks.

Results

The study participants (N=52) represented a similar age distribution with the San Francisco Bay Area, yet they were more likely to be female, Hispanic/Latino, and lower-income compared to the overall population of the Bay Area (U.S. Census Bureau, 2018; U.S. Department of Housing and Urban Development, 2018; see Table 2). While half (50%) of Bay Area residents were female, nearly two-thirds (63%) of the participants were female. Whereas 22% of the Bay Area population identified as Hispanic or Latino, almost half (43%) of the research participants identified as Hispanic or Latino. While the educational attainment rates of participants were similar, the research participants showed 11% lower level ofemployment than Bay Area residents in general.

The San Francisco Bay Area is an expensive place to live. The cost of living in San Francisco is 62.6% higher than the U.S. average and housing is nearly three times more expensive than in other U.S. cities (America: Cost of Living Index by City 2017 Mid-Year, 2018; Sciacca, 2017; Wallace, 2018). The median Bay Area household income in 2017 was $109,000 (U.S. Department of Housing and Urban Development, 2018), whereas 88% of the participants of the study had a household income below $100,000. Assuming a conservative average family size of three (estimated at 3.28 in 2000; Association of Bay Area Governments, 2017), then the low income limit for the six Bay Area counties would be an average of $84,575 (U.S. Department of Housing and Urban Development, 2018). Using this measure of poverty, approximately 80% of the study participants had a low income or less, and at least 63% had a very low income.

There were no significant differences for perceived restoration between the participants at the two program sites. Similarly, no significant differences were apparent between the two program sites in terms of pre-post changes in salivary cortisol, change in perceived stress, or changes in positive or negative affect. The number of average steps was significantly lower ($p < .05$) at the event provided by one program provider ($\bar{x} = 5{,}490$) compared to the average at the other two events provided by another program provider ($\bar{x} = 11{,}232$). However, there were no differences in average or maximum heart rate.

Demographics

Physical Activity—As a whole, participants averaged 8,990 steps during the two-hour nature walk. Therefore, participants nearly averaged the 10,000 steps per day that is recommended for an adult to be considered active (Tudor-Locke, & Bassett Jr, 2004). The minimum number of steps recorded for any participant was 1,752 steps per event and the maximum was 14,567 steps per event. This large variability is likely attributable to some participants choosing to walk only part of the route, differences in the number of steps needed to cover the same distance, and differences in the length of the walk in different events.

Due to the requirement for the heart tracker to be placed directly on the skin of participants' chest as well as the limited time to synchronize a chest monitor with a wrist device, only 17 sets of valid heart rate data were collected and analyzed. The average heart rate for these participants was 95 beats per minute. The mean of the maximum heart rate was 132 beats per minute.

Positive and Negative Affect—The level of positive affect significantly increased from before- to after- the nature walk ($M_{before} = 19.52$ vs. $M_{after} = 22.29$, $P < .05$; Table 3). Cohen's effect size value ($d = 0.35$) suggested a low to moderate practical significance (Richardson, 2011). In contrast, although the mean for negative affect did decrease, this change was not significant ($M_{before} = 7.39$ vs. $M_{after} = 6.59$, $p > .05$). Participants who were employed full-time had significantly higher levels of positive affect before the event ($M_{full\text{-}time} = 23.20$ vs. $M_{non\ full\text{-}time} = 15.96$, $p < .05$); however, there were no significant differences after the event or for the change in positive affect, suggesting participation led to a equalizing of positive affect that benefitted individuals that were not employed full-time.

Salivary Cortisol—Out of the 52 saliva samples provided by research participants, 41 were included in this analysis. Saliva samples were excluded due to high rates of variation between the three subsamples that were assayed or insufficient saliva was provided.

There was a significant decrease in salivary cortisol ($M_{before} = 14.20$ ug/dL vs. $M_{after} = 11.05$ ug/dL, $p < .05$). Additionally, the value of Cohen's effect size ($d = 0.54$) suggested a moderate practical significance (Richardson, 2011). Although bivariate correlations suggested that age was significantly correlated with lower levels of salivary concentration before and after the nature walk ($p < .05$), a regression analysis with change in salivary cortisol as the dependent variable and demographic variables (income, education, employment, age, and gender) as independent variables was not significant ($p < .05$).

Although the number of heart rate observations is relatively small, significant bivariate correlations between maximum heart rate with pre-event salivary cortisol concentrations ($r = .58$, $p < .05$) and change in salivary cortisol concentrations from pre- to post-event ($r = -.69$, $p < .05$) suggest areas for future research. There were no significant gender differences in the average cortisol levels or changes in cortisol before and after the guided walk in the current study ($p > .05$).

Three multiple regression analyses were conducted with intake time and wake-up time as independent variables and pre-event cortisol, post-event cortisol, and change in cortisol as the dependent variables. The analysis explained a significant amount of variance in pre-event cortisol ($F(2,35) = 4.523$, $p < .05$, $R^2 = .205$); however, only wake-up time and not intake added statistical significance to the prediction ($p < .05$). This finding that a later wake-up time was significantly correlated with pre-event cortisol levels was expected based on normal diurnal decreases in salivary cortisol (DeSantis, Adam, Hawkley, Kudielka, & Cacioppo, 2015). The other analyses did not explain a significant portion of post-event cortisol nor change in cortisol concentrations (p > .05).

Perceived Stress—Perceived stress significantly decreased from before to after nature walk (M = 14.24, M = 12.02 retrospectively; $p < .05$). Cohen's effect size value (d = .39) suggested low to moderate practical significance (Richardson, 2011). Participants' perceived stress *before* the nature walk did not significantly differ by employment status; however, *after* the nature walk, participants with fulltime employment showed significantly lower levels of perceived stress than the participants without full-time employment ($M_{FT} = 9.52$; $M_{none\ FT} = 14.21$; $p < .05$). Similarly, the changes in pre- and post-perceived stress levels were significantly different by employment status ($M_{FT} = -4.43$; $M_{none\ FT} = -.29$; $p < .05$). Participants with at least a bachelor's degree had significantly lower levels of perceived stress before the event ($M_{4\text{-year degree or higher}} = 12.81$; $M_{\text{less than a 4-year degree}}$, $= 15.46$; $p < .05$), but the post-event difference nor the change significantly differed by educational attainment.

Discussion

The results of this study indicate that participants' stress decreased and their positive mood increased after participating in the Healthy Parks Healthy People programs that included group walks in natural environments. Concentrations of salivary cortisol and perceived stress decreased significantly (p < .05) from the start to the end of the event. Salivary cortisol concentrations decreased 22%, and self-reported perceived stress average decreased 16%. The decrease in salivary cortisol is similar to or exceeds decreases in salivary cortisol previously reported in shinrin-yoku studies (e.g., Park, Tsunetsugu, Kasetani, Kagawa, & Miyazaki, 2010). Furthermore, self-reports of positive affect increased 14%. This aligns with the Stress Reduction Theory's assumption that individuals' initial reaction to natural environments is affective (Ulrich, 1983). In summary, our findings from a biomarker of stress test, self-reported stress measures, and positive affect indicators support the thesis that participants were less stressed and felt better after engaging in physical activity in a natural environment.

Implications

This work documents that racial and ethnic minority individuals from low- income communities can benefit from guided walks in nature. Previously, most studies that examine the impact of nature on stress that included cortisol measurements have not reported the race, ethnicity, or income of study participants (Harte & Eifert, 1995; Hartig, Böök, Garvill, Olsson, & Gärling, 1996; Rodiek, 2002; Roe et al., 2013; Tyrväinen et al., 2014; van den Berg & Custers, 2010; Ward Thompson et al., 2012). In studies that have included racial demographics, all participants were reported as members ofpredominant racial and/or ethnic groups. For example, a U.S. study included all White participants (Beil & Hanes, 2013) and shinrin-yoku studies exclusively used young healthy Japanese (Lee et al., 2015; Lee et al., 2009; Miyazaki et al., 2011; Park et al., 2010) or Chinese (Mao et al., 2012) male university students as research participants. Teas and colleagues' (2007) study of post-menopausal women is one of the few studies that used salivary cortisol to measure the impact of environment on stress that included study participants that were not part of the predominant racial or ethnic group (6 of the 19 subjects were Black women). Given this lack ofinclusion of racial or ethnic minority groups in such research, coupled with research about how urban populations of color may have fears or other constraints that may prevent them from positively experiencing nature (Bixler & Floyd, 1997; Virden & Walker, 1999), it could be falsely concluded that urban populations may not benefit from such nature-based interventions.

In contrast, this study’s findings suggest that racial and ethnic minority urban populations from low-income communities can benefit from public health interventions that include physical activity in nature. This is an important finding for marginalized populations in urban areas who may be the most in need of such nature-based interventions because they are more likely to experience social inequities and poor living condition that are “upstream” determinants of health disparities (Bay Area Regional Health Inequities Initiative, 2015). Because of these life stressors, low-income racial and ethnic minority individuals may have the most to benefit from the stress buffering or restorative properties of experiences in nature (Hynes & Lopez, 2007; Jennings, Johnson Gaither, & Gragg, 2012; Kabisch, Qureshi, & Haase, 2015).

Related literature on health impacts of nature has found that lower socioeconomic status groups benefit more from increases in nearby residential green space compared to other groups (e.g., Maas, Verheij, Groenewegen, De Vries, & Spreeuwenberg, 2006; Mitchell & Popham, 2008). For example, a couple of studies in Scotland specifically investigated the association between low-income communities and nearby residential green space by measuring cortisol levels as a biomarker of stress (Roe et al., 2013; Ward Thompson et al., 2012). Both Ward Thompson and colleagues (2012) and Roe and colleagues (2013) found significantly lower levels of cortisol for low-income people residing near green spaces compared to matched comparison groups residing farther from these spaces. The current study reinforces these previous findings and shows that exposure to natural environments is associated with decreased levels of cortisol for racial and ethnic minority members of low-income urban communities.

Although both the measured physiological indicator of stress (cortisol) and self-reported level of stress decreased, the two measures of stress were not significantly correlated to one another. This is not the first study to find low or no levels of correlation between physiological and self-report measures of stress (e.g., Tyrvainen et al., 2014; Ward Thompson et al., 2012).

Limitations

This study was a pilot study with multiple issues limiting its generalizability. The sample was a convenience sample ofpeople that self-selected to participate in the event and in the study. A control group that did not participate in the nature-based intervention was not included and measures collected from the participants before and after the nature walk were not administered on days when they did not participate in this activity. Additionally, the analysis has limited information about the daily diurnal fluctuation of cortisol levels.

Although the sample of participants was less White and poorer than residents from the local area, it did not exclusively contain racial and ethnic minority individuals living in low-income households.

Future Research

This study focused on a group-based intervention in nature. Future research is needed to understand if such group-based events are more effective than individual activities for the population investigated in this study. In contrast to the group experience in the current study, findings from previous studies with different participant characteristics showed greater benefits for people recreating in natural environments individually rather than with a group. In a study that used the related construct of revitalization, investigators found that participants were more revitalized after a walk in a park when they walked alone, and relatively more revitalized after a walk along a street when they walked with a friend (Johansson, Hartig, & Staats, 2011). Moreover, other Scandinavian research found that individuals with high levels of stress preferred to avoid activities that involved socializing (Stigsdotter & Grahn, 2011). However, different cultures have varying orientations to solitude or socializing in natural settings (Loukaitou-Sideris, 1995). In their Taiwanese study, Weng and Chiang (2014) found the largest reductions in anxiety and increases in perceived restoration occurred after walking outdoors and chatting with friends. Moreover, urban residents may appreciate the increased perceived security of visiting a natural area in a group (Bixler & Floyd, 1997). However, more research is needed to understand if group programs in nature, such as the Healthy Parks Health People activities studied in this work, are more or less effective compared to individual interventions for urban populations.

Conclusion

Healthy Parks Healthy People (HPHP) is an international movement that contends that parks and other green spaces can benefit people's physical and mental health (Maller et. al, 2006). Although a previous study looked at how HPHP activities increased the perceived value of parks and frequency of visits (de Kievit, 2001), this is the first study to use both physiological and self-report measures to examine the health outcomes of participating in a HPHP related event. The findings of this study suggest that these types of programs, which include group walks in nature, can benefit participant health, including low- income racial and ethnic minority participants.

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Table 1:

Measurements and Administered Time.

Measurements	**Pre**	**During**	**Post**
Stress hormone (cortisol levels)	X		X
Saliva Sample			
Perceived Stress (PSS-4; Cohen, et al., 1983)	X		X
Question: How often do you feel . . .			
1. confident about your ability to handle your personal problems?			
2. that you are unable to control the important things in your life?			
3. that things are going your way?			
4. difficulties are piling up so high that you cannot overcome them?			
Response Options: Never 1..2..3..4..5..6..7 Very Often			
Positive and Negative Affect Schedule (I-PANAS-SF; Thompson, 2007)	X		X
How do you feel now?			
1. Upset			
2. Hostile			
3. Alert			
4. Ashamed			
5. Inspired			
6. Nervous			
7. Determined			
8. Attentive			
9. Afraid			
10. Active			
Response Options: Not at all 1..2..3..4..5..6..7..			
Very much so			
Restoration (SRRS; Han, 2003)			X
Question: How would you describe the effect of the landscape had on you during the program?			
1. Grouchy vs. good natured			
2. Anxious us. relaxed			
3. My breathing becamefaster			
4. My hands began sweating			
5. I was interested in the scenery			
6. I felt attentive to the scene			
7. I would like to visit this place more often			
8. I would have liked to stay there longer			
Response Options: Not at all 1..2..3..4..5..6..7			
Very much so			
Physical Activity (Garmit Vivofit 2.0)		X	
1. Step Count			
2. Heart Rate			

Table 2:

Participant Demographics (N = 52).

	Study Participants	2017 Bay Area Data★
Sex		
Female	63%	50%
Male	37%	50%
Age (years)		
18–64	91%	79%
65 and older	9%	21%
Race/Ethnicity		
Asian	31%	26%
Black or African American	9%	6%
Hispanic or Latino (any race)	43%	22%
White (not Hispanic or Latino)	13%	44%
Employment Status		
Employed (Full and Part Time)	66%	77%
Educational Attainment		
High school graduate or higher	87%	89%
Bachelor's degree or higher	47%	49%
Pre-tax household income (USD)		
Median	$25,ooo-$49,ooo	$109,009

★Note.-The information was calculated using the data provided by the U.S. Census Bureau and the U.S. Department of Housing and Urban Development

Table 3:

Paired t-test Results for Affect and Stress Before and After Nature Walk.

	Before Nature Walk		After Nature Walk				
	M	SD	M	SD	t	Cohen's d	df
Positive Affect	19.52	8.23	22.29	8.93	2.24*	0.35	41
Negative Affect	7.39	3.8	6.59	4.95	ns	0.14	40
Perceived Stress (PSS-1o)	14–24	4.25	12.02	4.78	3.63**	0.54	41
Cortisol (ug/dL)	14.2	7.75	11..05	7.2	2.52*	0.39	40

*Notes: $p<.05$,

**$p<.01$