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The Role of the Environment and Type of Exercise on Acute Adrenal Modulation and Perceived Distress of Breast Cancer Survivors Practising Light-Intensity Physical Exercise

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ABSTRACT

Background: Distress and adrenal balance of breast cancer survivors (BCS) are key elements of their psychophysical health, and increasing evidence has shown both physical exercise and the natural environment are effective for their modulation. The aim of the study was to evaluate the acute effects of the environment and type of light intensity workouts, on distress, salivary cortisol and dehydroepiandrosterone sulfate (DHEA-S) in BCS.

Methods: Twenty-four BCS participated in six different workouts, each with the same duration and intensity. Three of them were conducted in natural environments – walking (W_{nature}), canoeing with assistance (C_{nature}) and a mix of myofascial and yoga exercises (MY_{nature}). The others were conducted in an urban environment, namely walking (W_{urban}), or an indoor environment, namely mobilisation and light upper body exercises (MC_{gym}) and a mix of myofascial and yoga exercises (MY_{gym}). Before and after each workout, the Distress Thermometer was completed and saliva was collected.

Results: Workouts practised in natural environments elicited a higher reduction in cortisol and the cortisol to DHEA-S ratio and a greater DHEA-S increase compared with workouts practised in urban and indoor environments. Overall, C_{nature} and MY_{nature} were the best activities; among those practised in urban and indoor environments, MY_{gym} elicited the best results. Distress was not acutely reduced after W_{urban} and MC_{gym}.

Conclusion: Natural environments seem to provide the best management of distress, cortisol, DHEA-S and their balance when working out at light intensities. The simultaneous presence of forests and rivers seems to be the key element of the observed results.

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INTRODUCTION

The literature has shown that both breast cancer diagnosis and its treatments could have negative side effects on one or multiple domains.[1-4] These negative effects favour the onset of a self-reinforcing negative loop, including a high amount of sedentary time, a low amount of daily movement, poor psychophysical health, sleep disturbance, high hypothalamus-pituitary-adrenal activity, central body fat distribution, hot flashes and fatigue, among others, leading to and reinforcing the disease.[5-9] Due to the well-established positive effects of both physical activity and exercise in all of the above-mentioned domains, researchers have affirmed that properly prescribed and practised physical activity,[9] and exercise,[10-16] are important for the health of breast cancer survivors (BCS) to help them break the self-reinforcing negative loop. This physical activity can include walking, yoga, Pilates and combined training, all of which counteract the side effects BCS may experience.[9,10] Therefore, in clinical practice there has been an increase in the prescription of both physical activity counselling and prescription in the multidisciplinary intervention for BCS.[6,11-15] There has been increased research interest in optimising physical exercise characteristics to improve the efficacy of exercise against the different side effects of treatments and to increase patient adherence to counselling and workouts.[4,5,13-16] In parallel, more researchers have focussed on optimising the choice of the environment for training.[17-21] Kuo,[17] identified 21 pathways leading to psychophysical health that are the basis for health promotion through contact with nature. Twohig-Bennett and Jones,[18] confirmed Kuo's,[17] conclusions, affirming that greenspace exposure is associated with a wide range of health benefits, and added that 'green exercise' may have additional health benefits relative to contact with nature without exercise and to urban and indoor exercise.[18]

Lesser *et al*.,[19] followed up on the studies of both Kuo,[17] and Twohig-Bennet and Jones.[18] They aimed to explore cancer survivors' exercise barriers, facilitators, preferences and psychosocial benefits of engaging in outdoor physical activity and found that more than half of their study participants had mainly practised physical activity in outdoor natural environments. Those who exercised in such environments were significantly more motivated and confident to be physically active.[19] A part of the positive psychophysical effects of contact with nature is linked to its neuroendocrine effects, which are mediated through several natural stimulators (i.e., colours, sounds, smells, light, air characteristics and microorganisms). These effects mainly involve hypothalamus-pituitary-adrenal activity,[17,18,20] which is also linked to distress.[21] Due to the presence of different settings, i.e. indoor and outdoor settings, of several outdoors, e.g. urbanized, mainly green, mainly blue, forest, coastal and mountain areas, and of several effective disciplines against breast cancer survivors' side effects, e.g. walking, yoga, pilates and combined trainings; [9,10] due to the key-role of distress, cortisol and dehydroepiandrosterone sulfate (DHEA-S) on psychophysical health of breast cancer survivors,[5,22–24] and due to the known effects of physical exercise practice in their management,[5,6,9,10,15] we investigated the acute effects of environments (i.e. natural, urban and gym), the type of light-intensity exercise (i.e. walking, a mix of myofascial and yoga exercises and canoeing with assistance, substituted with mobilisation and light calisthenic upper body exercises when studied in a gym setting) and of their interactions, on the levels of salivary cortisol and DHEA-S as well as distress.

METHODS

Study participants

Twenty-four BCS (49.69 ± 6.02 years old) were recruited from the eligible patients who attended the Integrative Medicine Clinic of the G. Bernabeo Hospital and the Department of Medicine and Aging Sciences of the G. d'Annunzio University of Chieti-Pescara, Italy, in April 2017. The participants were recruited after a multidisciplinary examination (i.e., oncologist, endocrinologist, nutritionist, kinesiologist and integrative medicine specialist) and after having obtained multidisciplinary eligibility to practise physical exercise by a physiatrist, a specialist in sports medicine and a psychologist. The inclusion criteria for this study were: age between 30–60 years, 6–48 months after breast surgery and current hormone therapy. The exclusion criteria for this study were: current chemotherapy, current radiotherapy, current diseases limiting motion, clinically relevant anxiety and/or depression and participation in any exercise programme within 6 months prior to the basal evaluation. The term 'current' relates to the study period. The local Ethics Committee approved this study (#312/2015), and the participants gave their written informed consent.

Study design

Each participant was randomly assigned an exercise schedule comprising six different workouts (each practised only once, separated by a week off) of the same duration (i.e., 60 minutes) and intensity (i.e., 9–11 on the 15 Rate of Perceived Exertion (RPE) Borg Scale). Hence, each participant practised the workouts in a different order of execution. The study was conducted during the spring of 2017. Three exercises were conducted in natural environ-ments, in the Tirino Valley, Capestrano (AQ), in the territory of the Gran Sasso and Monti Della Laga national park. The exercises performed in nature included walking (W_{nature}), canoeing with assistance (C_{nature}) and a mix of myofascial and yoga exercises (MY_{nature}). The natural environments used for each exercise had a distinct topography. Walking was conducted on a level path of a mountainous area close to a forest (1/3 of the path), a mountainous area close to a river (1/3 of the path) and a mountainous area with neither a forest nor a river (1/3 of the path). Canoeing with assistance was conducted on a quiet river that flowed in a mountainous area close to a forest. Each canoe included three people: one kinesiologist, specialised in physical exercise for BCS, mainly paddling, and two participants, also padding but in an assistive modality. The mix of myofascial and yoga exercises was conducted on the bank of a river, in a forest, and close to mountains. The workout was characterised by 30 minutes of whole-body myofascial exercises followed by 30 minutes of yoga exercises. The remaining three workouts were conducted in urban or indoor environments. One workout, level walking (W_{urban}), was conducted in an urban environment, in Chieti Scalo, while the other two, mobilisation and light calisthenic upper body exercises (MC_{gym}) and a mix of myofascial and yoga exercises (MY_{gym}), were conducted in an indoor environment, namely the gym of G. d'Annunzio University of Chieti-Pescara. The organisation of the MY_{gym} workout was the same as that of MY_{nature} workout. Each workout was conducted by two kinesiologists specialised in physical exercise for BCS.

Immediately before each workout, each participant completed the Distress Thermometer,[25,26] and provided a saliva sample. Immediately after each workout, each participant completed the Distress Thermometer again. Saliva was collected again 30 minutes after the workout had ended. During the waiting period, participants remained seated in the place of training without talking and without access to personal electronic devices.

The Distress Thermometer is a single-item tool using a 10-point Likert scale (from 0 [no distress] to 10 [extreme distress]) resembling a thermometer. The patient rated her level of distress over the past week. The established cut-off score for further screening was 4.[25,26]

Each workout was conducted in the morning at 9:30a.m., 2.5 hours after the participants had woken up, and a maximum of 2 hours after they had eaten breakfast. Each participant recorded the breakfast they ate before the first workout and then ate the same thing before each remaining workout. After breakfast, the participants could only consume water.

Saliva samples were collected by using a Salimetrics Oral Swab (Salimetrics Europe, Suffolk, UK), a small, absorbent and non-toxic pad passed within the oral cavity for 2-3 minutes before being placed inside a labelled tube. The samples were refrigerated within 15 minutes and frozen at -20°C within 3 hours of collection. On the day of the assay, samples were thawed and centrifuged for 5 minutes at 1,000rpm to extract saliva and remove the mucins; the swab was then discarded. The assays were performed using the following salivary assay kits: Salivary DHEA-S ELISA kit and the High Sensitivity Salivary Cortisol ELISA Kit (Salimetrics Europe). The samples were processed in duplicate during the same assay session. For the cortisol ELISA, the intra-assay coefficient of variation was 4.6% and the inter-assay precision was 6%. For the DHEA-S ELISA, the intra-assay coefficient of variation was 7.25% and the inter-assay precision was 7.55%.

On the day of the first workout, a third-level anthropometrist of the International Society for the Advancement of Kinanthropometry (ISAK) performed body measurements of the participants after saliva sampling. Body weight and stretched stature were measured to the nearest 0.1kg and 0.1cm, respectively, with the participants dressed in light clothing and without shoes, using a stadiometer with a balance-beam scale (Seca 220, Seca, Hamburg, Germany). The body mass index (BMI) was calculated according to the formula body weight/stature^2 (kg/m^2).

Statistical Analysis

Statistical analysis was performed using SPSS Statistics version 20 (IBM Corp., Armonk, NY, USA). The data were tested for normality with the Shapiro–Wilk test before analysis and are presented as the mean ± standard deviation. To test the effects of the different conditions on the changes in both endocrine (i.e., salivary DHEA-S and cortisol) and psychological (i.e., distress) variables, a six (within-subjects: W_{nature}, C_{nature}, MY_{nature}, W_{urban}, MC_{gym}, MY_{gym}) × two (within-subjects: T_0 and T_1) repeated-measures analysis of the variance (ANOVA) was carried out with DHEA-S, cortisol, the cortisol to DHEA-S ratio and distress as dependent variables. Data were preliminarily checked to ensure that the assumptions for repeated-measures ANOVA were satisfied.[27]

To check for the sources of interaction, two separate repeated-measures ANOVA were performed for each time point, while a paired-samples t-test was performed for each couple of condition variables. Taking into account the results of the repeated-measured ANOVA and the paired-samples t-test, to complete the estimation of the best workout(s) for the management of the considered variables, an independent-samples t-test was performed for each variable to compare the T_1 data of the different workouts. The results were considered significant when $P<0.05$ for the repeated-measures ANOVA, $P<0.025$ for the paired-samples t-test (to account for multiple comparisons) and $P<0.003$ for the independent-samples t-tests (to account for multiple comparisons).[27] Finally, using G*Power 3.1, Cohen's d was determined and used to assess both between-group and within-group differences and interaction effects, with 0.2 considered a small effect size, 0.5

considered a medium effect size, and ≥0.8 considered a large effect size.

RESULTS

Table 1 presents the characteristics of the study participants. No adverse events or dropouts were recorded.

Table 2 shows the results of the six (within-subjects: W_{nature}, C_{nature}, MY_{nature}, W_{urban}, MC_{gym}, MY_{gym}) × two (within-subjects: T_0 and T_1) repeated-measures ANOVA considering DHEA-S, cortisol, the cortisol to DHEA-S ratio and distress as dependent variables. For each variable, there were significant time and time × treatment effects.

When repeated-measures ANOVA was performed on basal values, there were no differences in the observed variables. When the same analysis was performed on T_1 values, there were significant differences in all of the observed variables, except for distress: DHEA-S ($F_{(5,19)}$=9.807; P<0.001; η_p^2 = 0.721); cortisol ($F_{(5, 19)}$ = 21.444; P<0.001; η_p^2 = 0.849); and the cortisol to DHEA-S ratio ($F_{(5, 19)}$=10.495; P<0.001; η_p^2 = 0.734).

Following the repeated-measures ANOVA, a paired-samples t-test investigating the pre-post variation of each variable in each condition was performed to individuate the significant variations. As shown in Table 3, there were no significant variations in W_{nature} and W_{urban} for DHEA-S; W_{urban} and MY_{gym} for cortisol; W_{urban}, MC_{gym} and MY_{gym} for the cortisol to DHEA-S ratio; and W_{urban} and MC_{gym} for distress.

Table 1. Characteristics of the study participants.

Variables	N = 24
Age, mean ± SD (years)	49.69 ± 6.02
Chemotherapy (n)	5
Radiation therapy (yes/no)	18/6
Quadrantectomy (n)	20
Mastectomy with breast reconstruction (n)	3
Mastectomy with lymphadenectomy and breast reconstruction (n)	1
Tamoxifen therapy (n)	16
Letrozole therapy (n)	8
Weight, mean ± SD (kg)	68.14 ± 14.44
Height, mean ± SD (m)	161.23 ± 5.90
Body mass index, mean ± SD (kg/m^2)	26.15 ± 5.38

SD=standard deviation.

Table 2. Results of the six (within-subjects: W_{nature}, C_{nature}, MY_{nature}, W_{urban}, MC_{gym}, MY_{gym}) × two (within-subjects: T_0 and T_1) repeated-measures analysis of the variance

Variables	F	df	p	η_p^2	d	1 − β
DHEA-S						
Time	57.604	1, 23	<0.001	0.715	1.6	1
Time × treatment	21.069	5, 19	<0.001	0.847	0.8	1
Cortisol						
Time	340.470	1, 23	<0.001	0.937	3.9	1
Time × treatment	30.382	5, 19	<0.001	0.889	1.1	1
Cortisol to DHEA-S ratio						
Time	11.791	1, 23	0.002	0.339	0.7	0.91
Time × treatment	2.689	5, 19	0.05	0.414	0.8	0.7
Distress						
Time	151.948	1, 23	<0.001	0.869	2.5	1
Time × treatment	30.883	5, 19	<0.001	0.890	2.8	1

DHEA-S=dehydroepiandrosterone sulfate

Table 3. Paired-samples t-tests investigating the pre-post variation of each variable in each condition.

Variables	T_0 (N = 24)	T_1 (N = 24)	p
DHEA-S C_{nature} (pg/ml)	3132.91 ± 2104.75	6788.06 ± 3050.26	<0.001
DHEA-S W_{nature} (pg/ml)	4415.87 ± 4664.54	4516.92 ± 4357.96	0.712
DHEA-S MY_{nature} (pg/ml)	3194.44 ± 3144.1938	6763.01 ± 4494.13	<0.001
DHEA-S W_{urban} (pg/ml)	2782.75 ± 2378.21	2958.87 ± 1695.93	0.557
DHEA-S MC_{gym} (pg/ml)	3540.28 ± 4007.69	2491.47 ± 2600.50	0.01
DHEA-S MY_{gym} (pg/ml)	4071.12 ± 4323.19	6430.33 ± 6762.18	0.01
Cortisol C_{nature} (pg/ml)	4021.67 ± 1604.37	1725.00 ± 549.87	<0.001
Cortisol W_{nature} (pg/ml)	3465.83 ± 787.43	2415.00 ± 922.53	<0.001
Cortisol MY_{nature} (pg/ml)	4392.08 ± 2088.68	2240.00 ± 1667.01	<0.001
Cortisol W_{urban} (pg/ml)	3077.08 ± 705.02	3309.58 ± 858.52	0.108
Cortisol MC_{gym} (pg/ml)	3235.83 ± 727.19	2871.67 ± 567.61	0.002
Cortisol MY_{gym} (pg/ml)	3343.75 ± 945.97	2975.42 ± 788.32	0.106
Cortisol to DHEA-S ratio C_{nature}	2.41 ± 3.21	0.30 ± 0.15	0.003
Cortisol to DHEA-S ratio W_{nature}	1.94 ± 2.29	1.31 ± 1.92	0.001
Cortisol to DHEA-S ratio MY_{nature}	2.95 ± 4.17	0.51 ± 0.61	0.003
Cortisol to DHEA-S ratio W_{urban}	1.90 ± 1.25	1.60 ± 1.15	0.151
Cortisol to DHEA-S ratio MC_{gym}	1.76 ± 1.57	2.49 ± 2.85	0.06
Cortisol to DHEA-S ratio MY_{gym}	1.71 ± 1.52	1.33 ± 2.71	0.423
Distress C_{nature}	3.92 ± 2.71	2.38 ± 1.92	<0.001
Distress W_{nature}	3.13 ± 2.62	2.42 ± 2.12	0.001
Distress MY_{nature}	3.17 ± 2.53	1.75 ± 1.82	<0.001
Distress W_{urban}	2.58 ± 2.65	2.42 ± 2.60	0.043
Distress MC_{gym}	2.63 ± 2.51	2.54 ± 2.39	0.162
Distress MY_{gym}	2.71 ± 2.13	1.71 ± 1.51	<0.001

DHEA-S, dehydroepiandrosterone sulfate; W_{nature}, walking in a natural environment; C_{nature}, canoeing with assistance in a natural environment; MY_{nature}, mix of myofascial and yoga exercises in a natural environment; W_{urban}, walking in an urban environment; MC_{gym}, mobilisation and light calisthenic upper body exercises in the gym; MY_{gym}, mix of myofascial and yoga exercises in the gym.

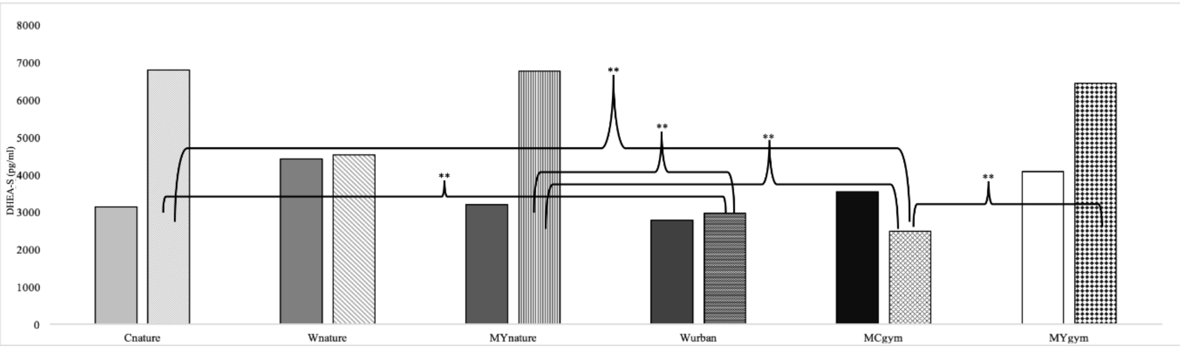

Figure 1. Significant dehydroepiandrosterone sulphate (DHEA-S) differences at T_1. The connecting lines show the bars that are significantly different from each other at T_1. The data are available in Table 3. W_{nature}, walking in a natural environment; C_{nature}, canoeing with assistance in a natural environment; MY_{nature}, mix of myofascial and yoga exercises in a natural environment; W_{urban}, walking in an urban environment; MC_{gym}, mobilisation and light calisthenic upper body exercises in the gym; MY_{gym}, a mix of myofascial and yoga exercises in the gym. Columns with a solid colour fill present T_0 values; columns with a textured fill present T_1 values. $^{**}P \leq 0.003$.

When the analysis moved to compare T_1 data, to complete the estimation of the best workout for DHEA-S, cortisol, the cortisol to DHEA-S ratio and distress management, there were differences for the considered variables. Specifically:

a) C_{nature} and MY_{nature} elicited higher T_1 values than W_{urban} and MC_{gym}, while there were no differences among C_{nature}, MY_{nature} and MY_{gym}, and no differences among W_{nature}, W_{urban} MC_{gym} and MY_{gym} (Figure 1). When the attention was focussed on W_{urban}, MC_{gym} and MY_{gym}, MY_{gym} elicited better T_1 DHEA-S values than MC_{gym} but was not significantly different from W_{urban} (Figure 1).

b) C_{nature} elicited lower T_1 cortisol values than W_{nature}, W_{urban}, MC_{gym} and MY_{gym}, while MY_{nature} elicited lower T_1 cortisol values than W_{urban}, MC_{gym} and MY_{gym} (Figure 2). When focussing on W_{nature}, T_1 cortisol was lower than W_{urban}, but there were no differ-rences compared with MC_{gym} and MY_{gym} (Figure 2).

c) C_{nature} elicited a lower T_1 cortisol to DHEA-S ratio than W_{nature}, W_{urban}, MC_{gym} and MY_{gym}, but it was not different compared with MY_{nature} (Figure 3). MY_{nature} elicited a lower T_1 cortisol to DHEA-S ratio than W_{urban}, MC_{gym} and MY_{gym} (Figure 3). When focussing on W_{urban}, MC_{gym} and MY_{gym}, there were no significant differences (Figure 3).

d) There were no significant differences among the treatments for distress T_1 values.

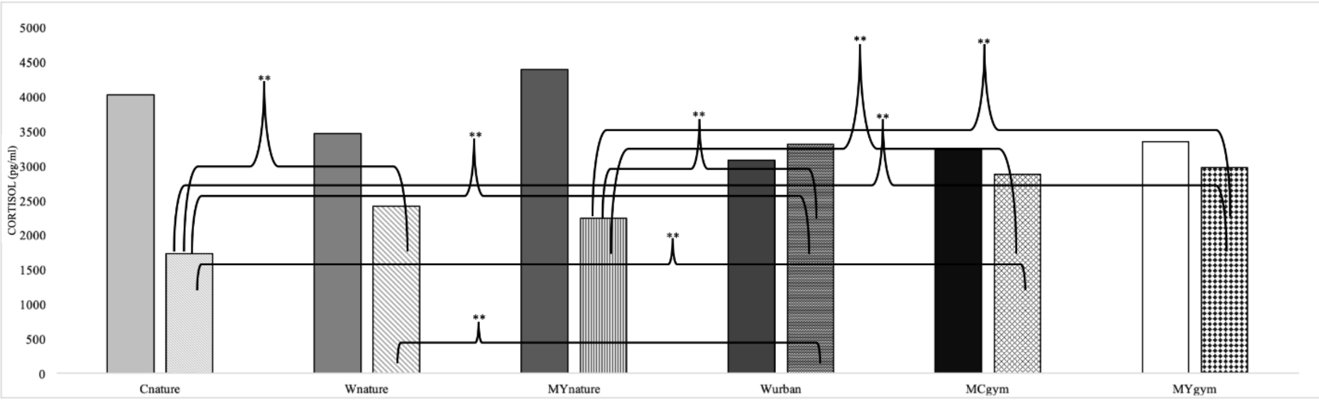

Figure 2. Significant cortisol differences at T_1. The connecting lines indicate the bars that are significantly different from each other at T_1. The data are available in Table 3. W_{nature}, walking in a natural environment; C_{nature}, canoeing with assistance in a natural environment; MY_{nature}, mix of myofascial and yoga exercises in a natural environment; W_{urban}, walking in an urban environment; MC_{gym}, mobilisation and light calisthenic upper body exercises; MY_{gym}, a mix of myofascial and yoga exercises. Columns with a solid colour fill present T_0 values; columns with a textured fill present T_1 values. $^{**}P \leq 0.003$.

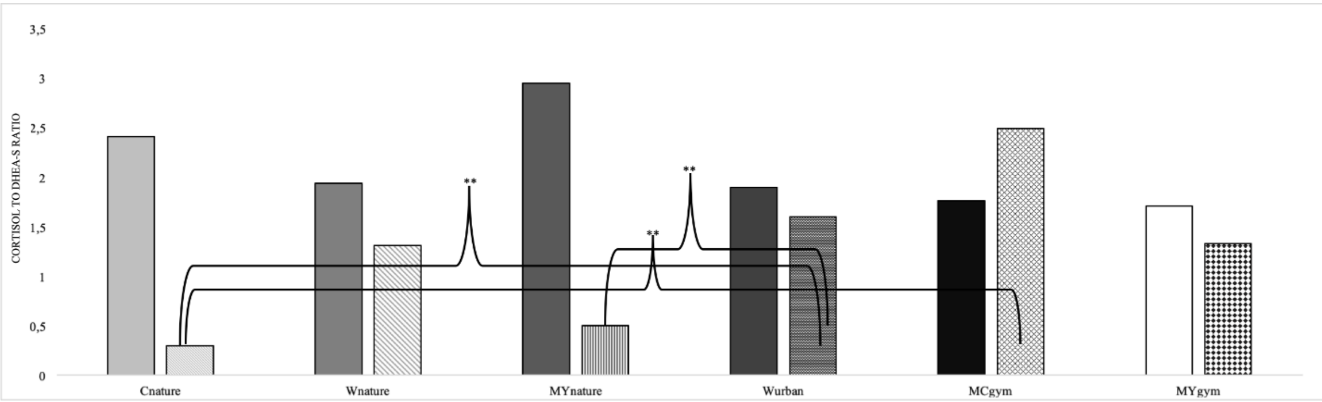

Figure 3. Significant cortisol to dehydroepiandrosterone sulphate (DHEA-S) ratio differences at T_1. The connecting lines indicate the bars that are significantly different from each other at T_1. The data are available in Table 3. W_{nature}, walking in a natural environment; C_{nature}, canoeing with assistance in a natural environment; MY_{nature}, mix of myofascial and yoga exercises in a natural environment; W_{urban}, walking in an urban environment; MC_{gym}, mobilisation and light calisthenic upper body exercises; MY_{gym}, a mix of myofascial and yoga exercises. Columns with a solid colour fill present T_0 values; columns with a textured fill present T_1 values. $^{**}P \leq 0.003$.

DISCUSSION

The most important result of our study regards the effects of both the environment and type of physical activity on adrenal modulation and distress. In summary, the natural environment is more effective than urban and gym environments in acute modulation of both the adrenal gland and distress. Specifically, at the studied exercise intensity, the most effective activities were C_{nature} and MY_{nature}, eliciting an increase in DHEA-S and a decrease in cortisol, the cortisol to DHEA-S ratio and distress, relative to their basal values. In addition, C_{nature} and MY_{nature} elicited the best T_1 values of the same variables with respect to the other workouts. W_{nature} also elicited positive results, with a decrease in cortisol, the cortisol to DHEA-S ratio and distress with respect to their basal values, and elicited lower T_1 values of cortisol than W_{urban}. While W_{urban} was not able to elicit a significant modification of all the studied variables, MY_{gym} was the best workout among the urban and gym workouts, as it elicited an increase in DHEA-S and a decrease in distress. At the same time, the T_1 values of DHEA-S of C_{nature}, MY_{nature} and MY_{gym} did not differ significantly. Practically, the best results concerning the studied adrenal variables were linked to the simultaneous presence of both river and forest for the entire workout, even though their alternated presence while walking elicited positive results. These results suggest that simultaneous exposure to blue and green environments leads to better adrenal balance, probably through their effects on the sympathetic-parasympathetic balance.

Previous studies have shown an increase in parasympathetic activity indicators (e.g., heart-rate variability parameters), and/or a decrease in sympathetic-parasympathetic balance indicators (e.g., heart-rate variability parameters, pulse rate, blood pressure, salivary cortisol and psychological variables), when there was an exposure to green or green-blue environments.[28–30] This is due to a self-reinforcing positive multidisciplinary stimulation, including the following. (a) Sights and sounds of nature have important physiological impacts on human health. Indeed, looking out of a window and viewing images of nature reduce sympathetic nervous activity, increase parasympathetic activity,[30,31] and restore attention,[32] while sounds of nature (i.e., flowing water and tweeting birds) increase parasympathetic activation.[33] Bird sounds have been found to increase recovery of skin conductance level, a measure of stress, while people who visited a local river cited the sound of water as a reason to visit it, for its relaxing effects.[34] (b) The odours of nature positively affect the limbic system, the hypothalamus-pituitary-adrenal axis, the hippocampus and their related functions.[34] (c) Negative air ions, which are present in greater concentrations in forests, mountainous areas and places with moving water, seem to boost parasympathetic nervous activity, according to research conducted with animal models.[35] (d) The simultaneous presence of blue (i.e., water and sky) and green (i.e., forest and lawn) environments elicits greater improvements in mood than when only green is present,[36] through the enhancement of positive affective states and the reduction of negative affective states, compared with indoor environments.[37] (e) The absence of grey colours of urban environment elicits feelings of aggression and dominance.[34] When a particular exercise (i.e., MY_{nature}, favouring relaxation and focussing attention on the breathing technique) or a particular situation (i.e., canoeing on calm and crystal-clear water, favouring relaxation and normalising breathing) is added to the 'described natural stimulators', additional benefits are achievable. The benefits of relaxation and breathing characteristics on health are mediated through vagal nerve stimulation.[38] The importance of both relaxation and breathing characteristics was underscored in the MY_{gym} results, which were the best results among the urban and indoor workouts. Mazgelyte *et al*.,[39] provided the functional connection between the described psychophysical effects and our observed results, as they found signifycant associations between diminished parasympathetic vagal tone, evaluated by time domain heart rate variability measures, higher salivary cortisol and lower levels of both DHEA-S and the DHEA-S to cortisol ratio in healthy individuals.

The Distress Thermometer asks, 'Please circle the number (0–10) that best describes how much distress you have been experiencing in the past week including today.'[26] C_{nature}, W_{nature}, MY_{nature}, and MY_{gym} workouts, lasting 1 hour, significantly reduced the distress of BCS relative to what they had felt in the past week. It is possible that the BCS could have answered this question only considering the discomfort they felt after exercising, despite the written and oral instructions they were given. Both the attention restoration and stress reduction theories could explain the observed results. According to the attention restoration theory, natural stimuli (so-called 'soft fascinations', capturing attention without effort) create the feeling of 'being away', leading to attention restoration, accompanied by an improved affective state,[40] and the ability to modify the perception of the distress of the past week. According to the stress reduction theory, natural stimuli as well as breathing and relaxation-centred workouts reduce the complexity and the aggressiveness of the environment, resulting in greater psychophysiological stress reduction, including an improved affective state, than urban and some indoor environments.[41]

The clinical relevance of our results is the fact that if simple and common factors, such as the type of exercise and environment, are combined properly, they can positively modulate adrenal balance and distress that are linked with the psychophysical health of BCS. Indeed, cortisol, DHEA-S and distress are part of that self-reinforcing negative loop, described in the introduction that negatively affects the quality of life among BCS. Our results could help improve both inpatient and outpatient services, but also 'at-home prescriptions', because they widen the possibilities to reach positive results through simple and effective solutions also applicable to people who do not like indoor workouts.

The main study limitations are the small sample size and the lack of control group, both of which might negatively affect the power of the study. Therefore, the study design, the standardisation of participants and the chosen statistical analysis allowed us to mitigate this issue. In our opinion, the use of the 15 RPE Borg scale to standardise the workout intensity, instead of the use of heart rate, energy expenditure or oxygen consumption, is a strength of our study, considering the side effects of breast cancer treatments and the day-to-day variability in fatigue. The choice to test different workouts, practised at the same intensity, instead of just testing the effects of being in different environments is linked to the volition to find a way to optimise multiple aspects of health through physical exercise. Moreover, the choice of light intensity is linked to the volition to detect the effects of the environment on psychophysical variables without the confounding effects of moderate-to-vigorous intensity on the same variables. In other words, although the participants exercised in different ways, it was at the same intensity, and thus did not influence the observed variables.

CONCLUSION

Natural environment seems to elicit the best acute modulation of both adrenal balance (i.e., cortisol and DHEA-S production) and distress when working out at light intensities. Considering the chosen settings, the simultaneous presence of forest and river for the entire duration of the workout seems to be critical. When a natural environment is not available, when a person does not like or cannot train outdoors and when moderate-intensity exercise is not applicable, MY_{gym} seems be the best solution to manage both DHEA-S production and distress. Considering the multisystem connections/causes/consequences of the studied variables, our results are particularly useful in optimising the health of BCS, through safe and simply applicable suggestions, in the absence of supervised and competent interventions, but also in combination with them. Additionally, our results allow facilitating the compliance of BCS to behavioural prescriptions aimed at improving their quality of life and recovery.

ETHICAL CONSIDERATION

The local Ethics Committee approved this study (# 312/2015), and the participants gave their written informed consent.

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CONFLICT OF INTEREST

The authors declare they have no conflict of interests.

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