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Evaluating the effectiveness of green exercise as a workplace mental health and wellbeing intervention: A systematic review and randomised controlled trial

Leona Cunningham

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Table of Contents

Declaration of Own Work 2

Acknowledgements 3

Table of Contents 4

Lay Summary 5

Reseacrh Portfolio Abstract 7

Chapter 1: Systematic Review 9

Abstract 10

Introduction 12

Methodology 21

Results 25

Discussion 39

References 44

Chapter 2: Empirical Project 48

Abstract 49

Introduction 51

Methodology 59

Results 64

Discussion 72

References 78

Appendices 84

Lay Summary

Poor mental health and wellbeing in the workplace is a public health concern due to the prevalence of the problem and the cost to economies and societies. Healthcare workers are at increased risk of developing psychological difficulties due to the demanding nature of their work. There is a need for further research into workplace interventions which would be cost effective and easy to implement. Nature – based interventions are becoming increasingly more popular and one such intervention is green exercise.

The first chapter of this thesis reviews the existing literature into green exercise interventions in the workplace in relation to employee mental health and wellbeing. Extensive searches of online databases were conducted which identified 5 studies. The outcomes of these studies and their strengths and weaknesses were discussed. It was concluded that the available evidence into the area was too limited to draw any definitive conclusions about whether green exercise interventions benefit employee mental health and wellbeing. Suggestions for future research are explored.

The second chapter of this thesis was an original research study which explored the efficacy of a green exercise intervention for a group of healthcare workers. A total of sixty-five healthcare workers participated in the study from an NHS health board in Scotland. Participants were randomised into either a nature walking group or an urban walking group and asked to complete two 10-minute walks a week for 4 weeks. Measures of depression, stress, anxiety, burnout, and sleep quality were taken both before and after the intervention. Results showed that walking in both natural and urban environments significantly improved anxiety, stress, and sleep quality. There was a trend towards improved depression levels, however, these results were not significant. Results also showed that participation in the

urban walking condition reduced burnout levels further than the nature walking condition. There was no support that walking in natural environments provided greater benefits for healthcare workers when compared with walking in urban settings.

Both chapters contribute to the research literature which investigates the efficacy of physical activity and green exercise workplace interventions for employees and healthcare workers.

Research Portfolio Abstract

Background: Mental health difficulties and poor wellbeing in the workplace are of concern to both organisations and societies. The COVID-19 pandemic has highlighted this problem even further and employers are looking to policy drivers and researchers to support them to identify what is likely to benefit the mental health and wellbeing of the workforce. Healthcare workers have been at a particular disadvantage both prior to and following the pandemic. Green exercise interventions are low cost and easy to implement within workplaces and the evidence to support their efficacy in improving employee outcomes is growing.

Methods: Chapter one is a systemic review which synthesised the available evidence into green exercise interventions for employee mental health and wellbeing. Eight databases were searched using a rigorous search process and the quality of 5 identified studies was assessed. Chapter two is an original research project which investigated the effects of a green exercise intervention on healthcare worker's psychological distress, burnout, and sleep quality. Sixty – five participants were randomised into either a nature walking group or urban walking group. They were given route maps with walk descriptions and asked to complete 2 10-minute walks a week, for 4 weeks. Baseline data and post intervention data were collected.

Results: Searches identified 5 studies that met the inclusion criteria for the systematic review. Evidence into the benefits of green exercise interventions for employee mental health and wellbeing was limited due to the small number of studies and limited methodological quality of the research.

The randomised controlled trial did not find any evidence to support that walking in nature has additional benefits to walking in urban settings for healthcare workers. Findings showed

that participants showed significant improvements in anxiety, stress, and sleep quality when they completed the walking intervention, regardless of what environment they were allocated too. Depression levels also reduced for each group, but this result was not statistically significant. Unexpected results for burnout were found where participants who walked in the urban environment showed greater apparent improvements than those who walked in the natural environment.

Conclusion: Taken together, the results from both chapters of this thesis conclude that brief outdoor exercise interventions in the workplace can be beneficial for employee psychological health. However, the evidence for additional benefits for nature – based activity is limited.

Chapter 1: Systematic Review

Green Exercise and Employee Mental Health and Wellbeing: A Systematic Review

Leona Cunningham[1], Dr Paul Graham Morris[2]

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[1] Corresponding Author: Leona Cunningham, NHS Forth Valley and University of Edinburgh, Scotland
Email:

[2] Department of Clinical and Health Psychology, School of Health in Social Science, University of Edinburgh, Scotland.

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Abstract

Background: Poor employee mental health and wellbeing poses a public health concern due to the prevalence of the problem and the cost to economies and societies. Workplace nature – based interventions (NBIs) are gaining more popularity in organisational health promotion literature and could be a viable option for addressing this issue. One form of NBI is green exercise which is any form of physical activity in natural surroundings. The benefits of this type of intervention for employee mental health and wellbeing has yet to be systematically assessed.

Methods: A systematic review was conducted with the aim of collecting and synthesising all the available evidence examining the effects of green exercise on employee mental health and wellbeing. Databases searched were Psychinfo, Embase, Medline, ASSIA, Proquest Dissertations and Theses Global, CINAHL Plus, Greenfile, SPORTDiscus and Web of Science. Studies were eligible if they were intervention studies, included an outcome which measured mental health or wellbeing, had a sample consisting of employees and investigated a green exercise intervention which had been implemented in the workplace. The Effective Public Health Practice Project (EPHPP) quality assessment tool was used to assess the methodological quality of the included studies.

Results: Five studies met the inclusion criteria with most of the green exercise interventions involving walking in natural environments. Study outcomes included various measures of psychological health. Some support was found for the benefits of green exercise for employee

mental health and wellbeing however, the methodological quality of the included studies was limited, preventing definitive conclusions.

Conclusions: The available evidence is broadly supportive of benefits of green exercise for employee mental health, though existing evidence is methodologically limited, and further research is needed to determine whether there are additional benefits of green exercise relative to other forms of exercise.

Keywords: green exercise, nature – based interventions, mental health, wellbeing, employees.

Introduction

Employee Mental Health and Wellbeing

Poor mental health and wellbeing in the workplace has become an increasingly important topic. In high income countries in 2013, it was estimated that 15% of working populations were affected by moderate mental health problems and 5% were affected by severe mental health problems (OECD, 2013). Common mental health disorders (e.g., anxiety and depression), resulting from poor mental health and wellbeing, are recognised as the leading cause of sickness absence in most developed countries (Joyce et al, 2016). Within the UK in 2016, mental health issues were reported as accounting for 11.5% of all sickness absences and 15.8 million lost working days (Office for National Statistics, 2017). A recent report highlighted that mental health problems cost the UK Government at least £117.9 billion for the year 2019 due to lost productivity and informal care costs (McDaid & Park, 2022). The report also argued that the workplace provides a crucial context for the prevention of mental health problems and researchers and policy makers should promptly seek to identify what interventions works and for whom.

Occupational health psychology appears to be trending towards fostering employee mental health and wellbeing using preventative approaches alongside targeted interventions to address mental illness in the workforce (Avey et al, 2010). Organisations currently offer interventions such as relaxation and meditation session as well as psychological approaches such as cognitive – behavioural therapy. A critique of these types of interventions is beyond the scope of this review. However, the evidence – base for physical activity interventions and nature – based interventions (NBIs) for employees will be considered.

The outbreak of COVID-19 created unprecedented challenges for organisations, and many workplaces will never return to their pre – pandemic state. The shift to remote working and the application of new policies and procedures have led to radical changes for employees

(De-la-Calle-Durán & Rodríguez-Sánchez, 2021). Workers have reported negative effects of these changes including loneliness, home – work interference and difficulties disconnecting from work demands (De-la-Calle-Durán & Rodríguez-Sánchez, 2021, Yang et al, 2022). Furthermore, furlough schemes, pay cuts and layoffs have increased job insecurity and uncertainty (Carnevale & Hatak, 2020).

Studies into the mental health and wellbeing of employees during the COVID-19 pandemic have tended to concentrate on healthcare workers, and there is a dearth of evidence regarding wider working populations. Yet it seems likely that, because of challenges faced by employees due to COVID-19, adverse mental health outcomes are likely to be observed for years to come.

Various definitions of the terms 'mental health' and 'mental wellbeing' are used within research literature. According to the World Health Organisation (2022), mental health is a state of mental wellbeing which allows individuals to learn and work well, cope with stressors, realise their potential and contribute positively to society. When individuals have difficulty with their mental health, specific symptoms can arise, leading to persistent emotional distress and the potential of developing a mental health problem (e.g., anxiety, depression). The term mental wellbeing is a ubiquitous term, and it is generally agreed that the term is both subjective and objective, relating to how a person functions and feels about themselves and their life (Dodge et al, 2012). Scholars debate whether the constructs 'mental health' and 'mental wellbeing' are independent or synonymous. Yet, many agree that they are reciprocal in nature with one affecting the other. Hence, for the purpose of this review, 'mental health' and 'mental wellbeing' will be used interchangeably, acknowledging that the constructs are not mutually exclusive.

Physical Activity Interventions for Employees

The evidence that physical activity positively effects mental health and wellbeing has been well documented and several hypotheses exist which seek to explain the connection between these variables. The endorphin hypothesis proposes that exercise stimulates elevated endorphins in the central nervous system (CNS), which leads to a decrease in cortisol levels and an increase in serotonin, norepinephrine, and brain–derived neurotrophic factor levels (Peluso & Andrade 2005). Another hypothesis postulates that physical activity triggers the synaptic transmission of monoamines by stimulating the sympathetic nervous system (Peluso & Andrade 2005). Physiological theories for the positive effects of physical activity on mental health and wellbeing overlook some of the complex psychological and social mechanisms which could also explain the relationship. Psychosocial theories seek to remedy this issue. The distraction hypothesis suggests that mood is improved when activity distracts the brain away from unfavourable stimuli and the self – efficacy hypothesis promotes that human self – confidence and mood are improved by engaging in the challenge of exercise (Morgan, 1985; North et al, 1990). Additionally, the social interaction hypothesis indicates that positive effects to mental health and wellbeing through exercise are evident due to the social relationships which can be facilitated through physical activities (Ransford, 1982). Taken together, these physiological, psychological, and social hypotheses have informed research studies into the efficacy of physical activity interventions for employee mental health and wellbeing.

Chu et al (2014) conducted a systematic review of seventeen studies published between 1990 and 2013 which examined the effects of workplace physical activity interventions on mental health outcomes. Generally, these studies showed a lack of consensus on the efficacy of these types of interventions, limiting the evidence – base for the effects of physical activity

interventions on stress outcomes for this population. The authors argued that this was likely due to the small sample sizes within the studies and the delivery of low doses of exercise within study protocols. Out of the studies which examined the effects of these interventions on anxiety in Chu et al's (2014) review, no evidence was found for the positive effects of workplace physical activity interventions on this outcome variable. The authors found moderate evidence for the effects of these types of interventions for depression through studies which conducted high quality RCTs, strengthening the validity of these results. Publication bias was an issue with Chu et al's (2014) review, due to only published studies being included in their search criteria. A more recent systematic review by Skold et al (2019) investigated the effects of workplace exercise on a range of employee psychosocial and mental health outcomes. Out of the twenty-two studies included in their review, only 8 showed significant positive results, suggesting that exercise interventions may have effects on psychosocial and mental health outcomes but that the effects are small. Moreover, none of these studies were appraised as being of high quality, further undermining the overall results. Overall, research into physical activity interventions for workplace mental health and wellbeing could still be considered as being in its infancy, with most of the evidence published in the last twenty years. The evidence delivers mixed results and future studies would benefit from strategies to promote exercise adherence within their interventions, larger sample sizes and the inclusion of control groups receiving no treatment.

Nature – Based Interventions and Employee Mental Health and Wellbeing

Evidence is emerging for the use of nature – based interventions (NBIs) for employee mental health and wellbeing. Based on previous definitions, NBIs are defined as intentional activities which are designed to promote wellbeing by promoting the interaction between humans and natural environments (Shahanan et al, 2019). To understand how NBIs can contribute to

workplace wellbeing, the theoretical mechanisms underpinning the relationships between nature connection and human mental health and wellbeing must be explored. The biophilia hypothesis supports the view that humans have an innate tendency to be drawn to living elements of the natural world. Hence, when engaging with these environments, emotional processes are nurtured and developed, leading to improved mental health and wellbeing (Wilson, 1984). Critiques of Wilson's theory state that it overestimates the evolutionary origin of human's emotional affiliation with life – like processes (Joy & De Block, 2011). Nevertheless, it continues to be cited in the literature as one of the founding theories of nature connection and human mental health and wellbeing. A second hypothesis which both expands on and challenges the biophilia hypothesis is the topophilia hypothesis. This proposes that humans can also feel affiliated with inanimate objects in nature such as rocks and sand (Beery et al, 2015).

Another theory which has been proposed in this area is Attention Restoration Theory (ART). ART postulates that being emersed in a natural environment allows for recovery from direct attention fatigue which offers a restorative function (Kaplan & Kaplan, 1989). Central to this theory is the idea that nature consists of (soft) fascinating stimuli that captures human attention, decreasing the cognitive demands of effortful attention towards other stimuli. However, critiques argue that the theory is flawed due to the central role of 'fascination', as the term is conceptually vague, and it also remains to be verified whether fascination promotes restorative effects (Joye & Dewitte, 2018).

Ulrich's (1983) Stress Reduction Theory (SRT) proposes a psycho – evolutionary perspective on the connection between nature and wellbeing. It theorises that nature may allow for humans to experience psychophysiological stress recovery due to natural environments being perceived as related to survival and safety. One serious weakness of SRT is the assumption

that the restorative effects of natural environments are detached from cultural contexts (Joye & van den Berg, 2011).

Despite their theoretical weakness, biophilia, ART and SRT provide explanations for the evolutionary, cognitive, and affective mechanisms which are facilitated when humans interact with nature. These theories form the basis of studies into nature – based interventions and employee mental health and wellbeing.

Hartig (2006) argued that encouraging short outdoor 'booster breaks' could be an effective way of mitigating symptoms of work-related stress for employees. A randomised controlled trial (RCT) by Largo – White et al (2017) randomised university staff into two groups and participants in the group who took their breaks outdoors showed significantly lower levels of stress when compared with the group who took their breaks indoors. In a more recent RCT by Souter – Brown et al (2021), the effects of engaging with a sensory garden were investigated for one hundred and sixty-four University staff and students. Participants were randomised into either a nature rich sensory garden group, urban plaza group or control group and those in the first two groups were instructed to spend thirty minutes in their allocated environments. Despite the intervention being brief and the study suffering from some recruitment losses, significant intervention effects were found for salivary cortisol and self – reported wellbeing when compared with the control group. This provided some evidence that sensory gardens have the potential to reduce stress and improve wellbeing for employees. The research into the effects of employees being immersed in nature – rich environments would benefit from the use of longer interventions and the availability of follow – up data to determine whether intervention effects continue.

Forest therapy, also known as *shinrin – yoku,* which originates from Japan, involves structured programmes where employees engage in activities aimed at improving mental and

physical health whilst being in a forest environment (Kotte et al, 2019). Jung et al (2015) found evidence that a group of workers assigned to a forest therapy programme showed subjective stress relief and higher scores of mastery. Mastery can be described as having a sense of control over one's life and this construct has been hypothesised as having potential to relieve symptoms of burnout (Jung et al, 2015). A recently published RCT by Choi et al (2022) showed improvements in work – related stress symptoms, health – related quality of life and mood states for employees who took part in a forest therapy programme when compared with a control group. However, the intervention was only three days long and follow – up effects were not captured, meaning the durability of the effects of this programme could not be confirmed.

Nature– based therapy programmes are like forest therapy ones as they incorporate therapeutic activities alongside nature connection opportunities. Sahlin et al (2014) investigated the effects of a twelve-week nature – based stress management course on thirty-three female employees which involved garden/nature activities alongside practising stress - reduction strategies. Decreased burnout and stress – related symptoms were reported by the participants; however, their study design lacked a control group. A recently published RCT by Ho et al (2022) investigated the psychological effects of a ten-day nature programme on university employees. The programme involved spending lunch breaks engaging with nature - based activities aimed at involving multiple sensory processes (e.g., butterfly sketching). Results showed significant intervention effects for depression, anxiety, stress, and wellbeing for the participants. However, insignificant results were found for burnout, which could be attributed to the short study period. In contrast, intervention effects were found for employee burnout levels in a recently published study by Daniels et al (2022). Their study involved nature – based activities for two hours, twice a week for 3 weeks. Within their programme, participants also had access to 2 qualified psychologists who offered stress – reduction

strategies. Hence, it is unclear whether the improved outcomes for participant burnout levels could be attributed to the nature engagement elements or the other components of the programme.

A major limitation of most existing research into the effects of nature – based interventions for employees is sampling bias. Most of the studies are conducted in industries where females are dominant, such that there is relatively little data with male employees. This area of research is still very much in its infancy and more studies are required to investigate whether NBIs are indeed a viable option for workplace mental health and wellbeing interventions.

Green Exercise and Employee Mental Health and Wellbeing

There is a growing body of evidence that both physical activity intervention and NBIs have the potential of improving mental health and wellbeing outcomes for employees. The theoretical mechanisms underpinning each of these approaches suggest that there could also be synergistic or additive effects if both occur at the same time. Green exercise is defined as physical activity which occurs in nature rich environments (Lahart et al, 2019) and the benefits of this type of intervention in the general population have already been explored in the research literature. Bowler et al (2010) reviewed twenty-five studies and found that activities in natural environments were associated with reduced anxiety, sadness and fatigue when compared with indoor built environments. However, this review has been criticised for not considering possible confounders which could have contributed to negative emotional responses (Lahart et al, 2019). In 2011, Thomson Coon et al reviewed eleven studies which compared the effects of physical activity in natural environments with physical activity in indoor environments on mental and physical wellbeing. They found that physical activity in natural environments provided beneficial effects for multiple psychological outcomes

including energy, revitalisation, positive engagement, confusion, tension, and anger. Nevertheless, all the interventions within this review only used a single episode of activity meaning it is unclear whether similar effects would be found for repeated physical activity sessions. Lahart et al (2019) expanded on the review by Thomson Coon et al (2011). Their findings indicated that green exercise may increase levels of enjoyment and affective valence, but not influence emotions such as depressed mood, anger, tension, calmness. Both reviews reported that studies in this area were generally of low quality and provided limited support for the mental health and wellbeing benefits of outdoor exercise when compared with indoor exercise. A more recent systematic review of twelve studies by Kotera et al (2021) found evidence to suggest that nature walks reduced state anxiety but not generalised anxiety and had no effect on depression. However, the overall results were inconclusive due to factors such as high variability in study participants. Although some positive effects of green exercise in the general population have been reported, review papers into this area appear to suffer from a range of weaknesses. Importantly, more research which synthesises the available evidence into how green exercise could benefit certain groups (such as employees) is needed.

Study Aim

This systematic review aims to synthesise all the available research evidence which examines whether green exercise interventions improve mental health and wellbeing outcomes for employees.

Methodology

This review was registered with the International Prospective Register of Systematic Reviews (PROSPERO ref. CRD42022331405) and was conducted according to the PRISMA guidelines (Moher, 2009).

Eligibility Criteria

Eligibility Criteria were defined using the PICOS Framework (Population, Intervention, Comparator, Outcome, Study Design) (CRD, 2009). Only articles in the English language were included.

Population: Adults 18+ years old actively employed within any type of working environment were included in this study. Studies examining students, retired individuals and veteran or prison populations were excluded.

Intervention: Green exercise intervention studies implemented within any type of workforce in the workplace were included. Green exercise was defined as any type of physical activity which takes place in an area where direct exposure to nature is present (i.e., trees, grass, plants, rivers, lakes). Activities that were already part of the participant's occupational role were excluded (e.g., farming, park ranger tasks). Both group and individual interventions were included. Interventions which used stimulated physical activity in virtual nature platforms were excluded, as were interventions where green exercise was only a part of the intervention (e.g. forest therapy with nature walks as part of the larger intervention programme).

Comparator: No restrictions were placed in terms of comparators.

Outcomes: Studies which included any measurement of mental health or wellbeing captured through pre and post intervention questionnaire data were included.

Study Design: All experimental study designs were included even if they did not have a control group. All observational designs and qualitative studies were excluded.

Literature Search Strategy

Initial scoping searches of main databases and PROSPERO were conducted between March 2022 and May 2022. These searches determined the scope of previous reviews and refined the current research question and search terms. Thesauri terms from relevant databases were used in these initial scoping searches. These were then refined and and an experienced librarian reviewed the terms prior to finalising them. On July 4th, 2022, 9 databases were searched based on their title, abstract and keywords. These included Psychinfo, Embase, Medline, ASSIA, Proquest Dissertations and These Global, CINAHL Plus, Greenfile, SPORTDiscus and Web of Science. All databases were searched using the search terms outlined in Table 1. The areas were grouped and combined with the AND function ensuring all three were searched simultaneously.

Table 1. Search Terms for all Databases

Area	Search Terms
1. Mental health and wellbeing	wellbeing or "well being" or "well – being" or "emotional health" or "psychological health" or "mental health" or "mentally ill" or "mental illness" or mood* or depress* or worry or fear or anxi* or stress or irritability or happiness or sadness or "psychological* disturb*" or sleep or insomnia or "psychological distress" or burnout or fatigue or "life satisfaction" or "quality of life" or "exhaustion" or nervousness or "trauma symptom*" or posttraum* or "post traum*" or PTSD or "positive affect" or" positive emotion*" or "negative affect" or "negative emotion*"

2. Employee	Worker* or staff or personnel or employee* or occupation or office or workplace or work place or professional*
3. Green exercise	"green exercise" or greenspace or "green space" or "nature walk" or "nature connection" or "nature exposure" or "nature based" or "outdoor exercise" or "outdoor activity" or forest or park or garden or gardening or "blue space" or bluespace or "shinrin yoku"

Manual searches were also conducted by checking the reference lists of key articles. The first ten pages of a Google Scholar search were also reviewed for additional studies using various combinations of the search terms outlined above e.g., green exercise and employee mental health. Finally, a key author in the field was contacted and asked if they knew of any papers which were either in progress or under consideration for publication.

Screening and Study Selection

References from the results of the database searches were imported into Endnote and deduplicated. The remaining references were then uploaded onto the online systematic review platform, Covidence for title and abstract screening followed by full text review.

Data Extraction

Data extraction was performed using Covidence. Descriptive data extracted for each paper included study authors, date, country of study, study design, sample size and participant details (age and gender). Intervention data extracted for each paper included the type of green exercise, frequency and duration of the intervention and details of any comparators. Details of outcome measures used in each study, the number of completers and study analysis and results were also extracted.

Quality Assessment

The quality of each of the selected studies were assessed using The Effective Public Health Practice Project (EPHPP) Quality Assessment Tool for Quantitative Studies (Thomas et al, 2004). The EPHPP tool comprises of six domains: selection bias, study design, confounders, blinding, data collection method, and withdrawals and dropouts. The EPHPP guidance states that each domain is given points according to what it has been rated, 1 point = strong, 2 points = moderate, 3 points = weak. The domains scores are then averaged to gain the global score.

The studies were rated on their quality by the lead researcher (first reviewer) and then 50% of the papers were randomly selected using random.org and rated by a second reviewer (Trainee Clinical Psychologist). Inter – rater agreement between first and second reviewers was achieved for 85% of the of the items. Reviewers met and resolved any disagreements though discussion before consensus was reached.

Results

Study Selection

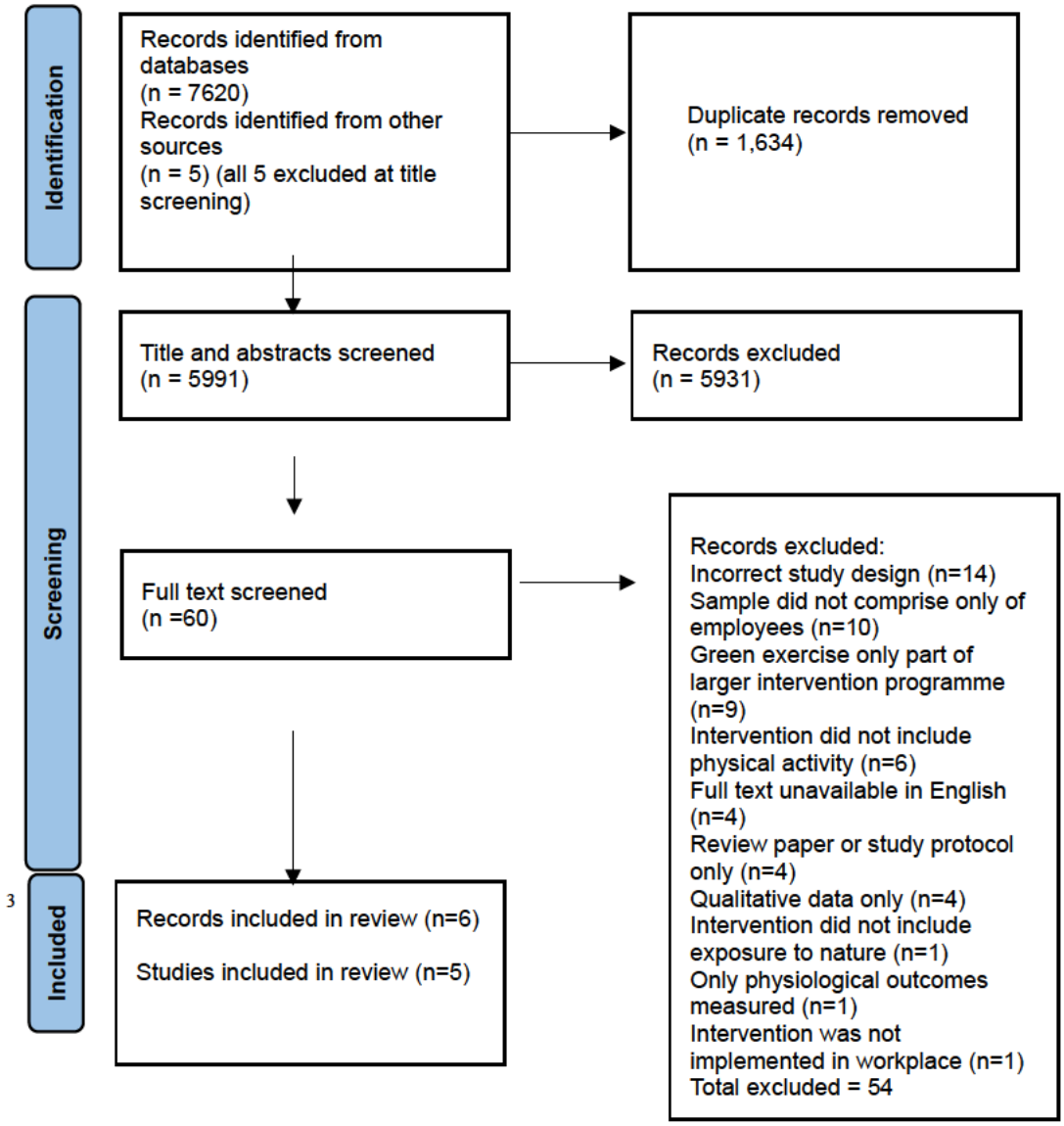

Figure 1. PRISMA Flow Diagram of Study Selection and Identification

[3] de Bloom et al (2017) and Sianoja et al (2018) are two records from the same study. The paper by Sianjona et al (2018) pools the participants from the two RCTs within the de Bloom et al (2017) paper.

The studies included in this review were assessed as being highly heterogenous for employee type, intervention details and outcome measures used. Therefore, a meta – analysis was deemed inappropriate for this this systematic review and effect sizes were not calculated. The results are therefore presented as a narrative synthesis.

Study Characteristics

All 5 studies included in the review were published in the last decade and conducted in the United Kingdom, Norway, Finland, Spain, and Pakistan. They comprised 4 RCTs and one randomised cross over study. The sample sizes across the studies ranged from fourteen to two hundred and fifty-six. Samples were mixed gender with mean ages ranging from 29 to 50 years old. Occupations of the participants included employees from a financial and stock exchange company, employees from a company supplying occupational health care services, office workers and healthcare workers. Four of the interventions were walking in a green or blue space (lake) and the other intervention was cycling and strength training in an outdoor environment with direct exposure to authentic nature. The intervention details varied within each study. One comprised of two 20-minute walks in nature per week for 8 weeks (Brown et al, 2014), another involved two 45-minute outdoor cycling and strength training sessions per week for 2 weeks (Calogiuri et al, 2015) and another involved a 15-minute park walk for each working day for 2 weeks (de Bloom et al, 2017; Sianoja et al, 2018). The last 2 comprised of a 20 minute walk a day in a blue space for 4 days in 1 week (Vert et al, 2020) and a 50-minute walk in nature per week for twelve weeks (Noushad et al, 2022). Comparators included walks in urban areas, exercising indoors, relaxation exercises, sitting in nature and no intervention control groups. An overview of all study characteristics is presented in Table 2.

Study Outcomes

Included studies were highly heterogenous in terms of outcome measures. Recognised measures included SF 8 Health Questionnaire (perceived mental health), Perceived Restoration Scale (subscales: fascination and being away), Post Traumatic Growth Inventory (PTGI), Traumatic Stress Scale (TSS) and the Trauma Symptom Checklist (TSC-40). The studies by de Bloom et al (2017) and Vert et al (2020) used single item questions to capture data.

Study Results

Overall, results showed some support that green exercise interventions are effective for employee mental health and wellbeing. Evidence indicated that this type of intervention improves outcomes for perceived mental health, positive affect, fascination and being away. Results were mixed in terms of the effects of green exercise on recovery experiences, wellbeing, and job satisfaction. Green exercise was shown to have positive effects on strain, mood, wellbeing, trauma symptoms and post traumatic growth.

Table 2. Characteristics of Included Studies

Study and Summary of Findings	Design	Sample Size (male: female) & Characteristics	Intervention Details	Comparator Details	Outcome Measures	Results
Study 1: Brown et al (2014) UK Summary of Findings: *Improvements for participants in the nature walk group for perceived mental health.*	RCT	n = 94 (74:20) mean age = 42 SD = 10.6 Financial Times and Stock Exchange employees	Nature walk 2 X 20-minute walks per week for 8 weeks.	Built Walk 2 X 20-minute walks per week for 8 weeks. Control group – no intervention	SF 8 Health Questionnaire (perceived mental health)	● *Perceived mental health:* Confidence intervals identified that the mean score in the nature walk group to have increased above baseline scores by 2.7 (95% CI 0.0-5.4) whilst the no intervention control group and BW group did not [-3.3 (95% CI -6.3-0.3) and -0.3 (95% CI -4.3-3). No follow – up data available.
Study 2: Calogiuri et al (2015) Norway	RCT	n = 14 (7:7) mean age = 49 SD = 8 Office workers	Green Exercise Group: 45-minute outdoor	Control Group: Same 45-minute exercise routine in	Physical Activity Affective Scale (PAAS) - positive	● *Positive affect:* green exercise group significantly higher positive affect post – exercise when compared with control (p = 0.001) but when post – exercise values were corrected for pre – exercise values, only marginal significance found (p =0.06)[4]. ● *Tranquillity:* no significant difference between groups.

[4] $p<0.05$

Summary of Findings: *Greater improvements observed for the green exercise group when compared with the indoor exercise group for positive affect, fascination and being away but not tranquillity.*			exercise session. bike session (25 minutes) strength session (20 minutes). 2 X 45-minute sessions per week for 2 weeks.	an indoor gym hall.	affect and tranquillity Perceived Restoration Scale (subscales: fascination and being away)	● *Restorativeness:* statistically significant pre and post differences between both groups on perceived restorativeness for both exercise sessions (p<0.001) ● *Fascination:* green exercise environment scored significantly higher than control (p < 0.01). ● *Being away* (from the attentionally fatiguing features of daily life) green exercise group scored significantly higher than control (p < 0.01). <u>Follow – Up (10 -weeks)</u> ● *Positive affect:* green exercise participants scored higher when compared with control group (p =0.02). ● Tranquillity: no significant results.
Study 3: de Bloom et al (2017) (2 X RCTs), Sianoja et al (2018) and **Three sets of results in total.** Finland	RCT					
Results 1 from Study 3 (2017)[5]:		n = 83 (9:74) mean age = 48.9	1 X 15-minute park walks for	1 X relaxation exercises	Single item questions.	**<u>Intervention effects</u>** (during intervention) No significant group x time interactions found.

[5] Only data which was relevant to park walking group was extracted.

Spring (2017) *Summary of Findings: Mixed results found for the effects of park walking on recovery experiences and wellbeing. No effects found for park walking on job satisfaction.*		Employees of a Finnish company supplying occupational health care services.	each working day for 2 weeks.	for each working day for 2 weeks. Control group with no treatment		All results compared to baseline unless otherwise stated. ● *Recovery experiences (relaxation, detachment, enjoyment):* During lunch breaks, trivial effects found for the two intervention groups (d< 0.15). ● *Wellbeing (restoration and fatigue):* During lunch breaks, wellbeing improved in all groups. At the end of the afternoon, both relaxation and control experienced somewhere higher levels of wellbeing. Park walking was associated with less fatigue after lunch and more fatigue in the afternoon. ● *Job satisfaction:* No effects found for park walking group. **Post intervention effects** (1 week directly after intervention) All results compared to baseline unless otherwise stated. ● *Recovery experiences*: Park walking group reported slightly lower levels of enjoyment of lunch breaks (d=0.38). ● *Wellbeing:* Only the park walking group reported positive change to restoration after lunch (d=0.34). Park walking group reported increase in fatigue at end of afternoon (d=-0.22). ● *Job satisfaction:* no effects found. Week after intervention – similar levels to before intervention in all three groups for recovery experiences and outcomes. No follow – up data available.

Results 2 from Study 3[6]: Fall (2017) *Summary of Findings:* *Mixed results found for the effects of park walking on recovery experiences, wellbeing, and job satisfaction. Slightly better outcomes for the park walking group.*	RCT	n = 70 (7:63) mean age = 45.5	No change to green exercise intervention.	No change to relaxation or no treatment control groups. Both included in analyses.	No change to measures.	**<u>Intervention period</u>** <u>(during intervention)</u> Significant interaction effects found for group x time for detachment, enjoyment of lunch break and fatigue at end of afternoon. Marginally significant intervention effect for relaxation. All reported effects relative to baseline unless otherwise stated. ● *Recovery experiences:* For the park walking group, levels of relaxation, detachment, and enjoyment all significantly increased when compared with baseline and when compared with control (p<0.05). ● *Wellbeing:* two intervention groups reported greater wellbeing during lunch breaks and at end of afternoon (higher restoration and lower fatigue). Park walking group reported less fatigue at end of afternoon ((d=-0.54). Fatigue increased in control group during lunch break (d=0.25). Park walking group reported higher restoration in evening (d=0.26). ● *Job satisfaction*: at the end afternoon, park walking group more satisfied with job (d=0.22). **<u>Post intervention period</u>** <u>(1 week directly after intervention)</u>

[6] Only data which was relevant to park walking group was extracted.

						All reported effects relative to baseline unless otherwise stated. ● *Recovery experiences:* No meaningful changes for park walking group on recovery experiences. ● *Wellbeing:* trivial changes for restoration and fatigue after lunch for all groups. Park walking group fatigue significantly decreased at end of afternoon (d=0.29). Park walking group reported slightly better wellbeing when compared with relaxation and control. ● *Job satisfaction:* no change for any groups. Week after intervention – recovery experiences and outcomes slightly higher for park walking group and similar to baseline for relaxation and control groups. No follow – up data available.
Results 3 from Study 3 (Sianoja et al, 2018) Summary of Findings: *Positive effects found for participating in the park walking condition on levels of strain.*		Combined participants from Fall and Spring (2017)	No change to green exercise intervention.	No change to relaxation or control groups.	No change to measures.	● *Afternoon strain:* park walking predicted lower levels for the within-person level ($\beta = -.34$, $SE = .17$, $p < .05$). Beta coefficient in the comparison group (relaxation) even greater ($\beta = -.60$, $SE = .18$, $p < .01$). Lower levels of strain reported before leaving work for both park walking and relaxation groups during lunchtime. ● Once detachment and enjoyment considered as mediators, park walking main effect only marginally significant. No follow – up data available.

Study 4: Vert et al (2020) Spain Summary of Findings: *Walking in a blue space improved some variables of wellbeing and mood when compared with group that walked in urban environment and control group.*	Randomised Crossover Study	n = 59 (18:41) mean age = 29 Office workers	Walk in blue space. 1 X 20-minute walk for 4 days a week. 1 week per condition. 3 weeks in total.	Urban walk group. 1 X 20-minute walk for 4 days a week. 1 week per condition. 3 weeks in total. Control Group.	● Subjective wellbeing - 2 items from UK's Office of National Statistics. ● WHO-5 Wellbeing. ● Total Mood Disturbance (Spanish short version of Profile of Mood State POMS). ●Somatisation ● Vitality and mental health. ● Sleep characteristics ● Life Satisfaction. ● Eudemonic wellbeing.	● *Subjective Wellbeing* - no statistically significant results found. ● *WHO-5 Wellbeing*: significantly higher score for blue space condition when compared with urban and control groups (p<0.01). ● *Total Mood Disturbance:* significantly lower for blue space condition when compared with urban and control groups (p<0.01). ● *Somatisation:* no statistically significant results found. ● *Vitality and mental health* – both blue space and urban conditions showed statistically significant increases when compared with control group (vitality p<0.02; mental health p<0.04). ● *Sleep characteristics* - lower OR observed for sleeping < 7 hours a day for urban when compared with control (p<0.05). No other significant effects for sleep were found. ● *Life Satisfaction:* no statistically significant results found. ● *Eudemonic wellbeing* - no statistically significant results found. No follow – up data available.

Study 5: Noushad et al (2022) Pakistan Summary of Findings: *Walking in nature reduced trauma symptoms and improved post – traumatic growth both directly after intervention and at three months follow – up.*	RCT	n = 256 Experimental group n= 131 (58:73) Mean age = 33.14 SD = 9.45 Control group (71:60) Mean age = 32.41 SD = 9.84 Healthcare workers.	Nature walk 5 X 50-minute walk in nature per week. 12 weeks in total.	Sit in nature 5 X 60-minute episodes of sitting nature per week. 12 weeks in total.	TSS PTGI TSC-40	● *TSS:* significant decline in the mean for both groups. nature walk group: ES = 0.93 $p<0.01$ sit in nature group: ES = 1.00; $p<0.01$ ● *PTGI:* nature walk group experienced more significant post – traumatic growth than sit in nature group. nature walk group: ES = -2.10; $p<0.01$ sit in nature group: ES = -1.23; $p<0.01$ ● *TSC-40:* significant decline in the mean for both groups. nature walk group: ES = 1.51; $p<0.01$ sit in nature group: ES = 1.17; $p<0.01$ <u>Follow – Up (3 months)</u> ● *TSS:* no significant results found. ● *PTGI:* significant post – intervention difference at follow – up ($p = 0.02$) ● *TSC-40:* significant post – intervention difference at follow – up ($p <0.001$). ● *PTGI subscales:* significant difference in the means between groups at follow – up for new possibilities ($p = 0.001$) and spiritual change *(*$p = 0.02$). No significant results for relating to others, personal strength, and appreciation for life. ● *TSC – 40 subscales:* significant differences in the means for sleep disturbance ($p<0.01$), SATI ($p = 0.02$), depression ($p = 0.007$), anxiety ($p = 0.06$), dissociation ($p = 0.009$). In all significant follow – up results, walk in nature group improved more than sit in nature group.

Abbreviations: RCT = randomised controlled trial; SATI = Sexual Abuse Trauma Index; TSS = Traumatic Stress Scale; PTGI = Post Traumatic Growth Inventory; TSC – 40 = Trauma Symptom Checklist; ES = effect size; SD = standard deviation.

Quality Assessment

A summary of quality appraisal is presented in Table 3. The EPHPP tool indicates that global ratings are strong if they receive no weak ratings, moderate if they receive one weak rating and weak if the receive two or more weak ratings. All the reviewed studies received a global rating of weak. Selection bias was assessed as being a significant limitation of all the studies according the EPHPP tool. Studies were given a strong rating in the EPHPP for study designs if they were described as RCT. Only the studies by Brown et al (2014) and Calogiuri et al (2015) evidenced that there were not any significant differences between participant characteristics in each of their groups at baseline. The remaining studies were significantly limited in this category as confounders may have been present and not controlled for. This category was not applicable to Vert et al (2020) due to it being a cross – over study. Within each of the studies, outcome assessors were aware of the intervention or exposure status of participants and only Brown et al (2014) and Calogiuri et al (2015) blinded participants to the research question. Data collection methods were rated as weak for de Bloom et al (2017) and Vert et al (2020) as neither of these studies used suitably validated measures. Noushad et al (2022) used measures that are reported as being reliable and valid in the literature, but they did not report psychometric properties for the scales in relation to their own study, meaning they received a moderate rating for this category. The remaining studies were rated as strong in this category due to using measures which were shown to have good psychometric properties (Calogiuri et al, 2015; Brown et al, 2014). Although Brown et al (2014), Calogiuri et al (2015) and de Bloom et al (2017) reported participant numbers pre and post intervention, they were rated as weak for the withdrawals and dropout's category due to their high percentage of dropouts. The study by Vert et al (2020) was rated as strong in this category due to high completion rates. Noushad et al (2022) was rated as moderate for this category due to not reporting their drop out/withdrawal reasons.

Table 3. Summary of Quality Assessment

EHPP Category							
Study	Selection Bias	Study Design	Confounders	Blinding	Data Collection Methods	Withdrawals and Dropouts	Global Rating
1. Brown et al (2014)	W	S	S	M	S	W	W
2. Calogiuri et al (2015)	W	S	S	M	S	W	W
3. deBloom et al (2017) Sianoja et al (2018)	W	S	W	W	W	W	W
5. Vert et al (2020)	W	S	N/A	W	W	S	W
4. Noushad et al (2022)	W	S	W	W	M	M	W

W = Weak
S = Strong
M = Moderate

Summary of Evidence

Brown et al (2014) found that participants in the nature walk group showed improvements for perceived mental health. Despite considering confounders and using a reliable outcome measure, this study received an overall week rating using the EPHPP. Calogiuri et al (2015) found that positive affect and perceived restoration improved for employees after participating in a green exercise intervention. At follow – up, positive affect continued to improve for this intervention group. Their study was similar to the one by Brown et al (2014) with regards to quality ratings, as they also considered confounders and used reliable psychometrics therefore received strong ratings for these categories. The results from Bloom et al (2017) and Sianoja et al (2018) were from the same study, which was rated as particularly limited in methodological quality. It only received one strong rating due to being an RCT and was rated weak in all other categories. Therefore, although they found

some positive effects for park walking on wellbeing, recovery experiences and job satisfaction, only preliminary conclusions can be drawn due to limited study quality. Vert et al's (2020) study had a particular strength with its low attrition rates. However, most of their outcome measures were adapted from other questionnaires and the psychometric properties of the measures they used were not provided. This therefore limits their findings that green exercise improved wellbeing and mood disturbance for participants. Noushad et al's (2022) study used two measures which have been reported in the literature as having good psychometric properties (TSC-40 and PTGI) (Elliot & Briere, 1992; Thiago Loreto Garcia da, 2018). However, the TSS does not appear to be as widely cited and so the psychometric properties of this scale are questionable (Noushad & Ahmed, 2013). Selection bias and lack of blinding and confounders were also significant limitations of the Noushad et al (2022) study, undermining their findings that green exercise participation positively effects post traumatic growth and trauma symptoms even at three months follow – up.

Discussion

Main Findings

This review examined the quality and extent of the evidence for studies investigating the effects of green exercise interventions on the mental health and wellbeing of employees. Following a rigorous search process, only 5 studies were identified which focused specifically on this research area and met the specified inclusion criteria. Overall, the methodological strength of the studies was limited, leading to largely inconclusive evidence. There were challenges in drawing comparisons or conclusions due to studies varying substantially in both outcome measures and intervention composition. The findings in the present review are similar to other reviews which have examined the efficacy of green exercise for mental health and wellbeing outcomes in different populations. Mnich et al 's (2019) review of children and adolescents and Lahart et al's (2019) and Thomson Coon et al's (2011) reviews of adults and children all agreed that the evidence suggests green exercise *might* be beneficial for psychological and psychosocial outcomes. Yet, they also concluded that the heterogeneity in outcomes measures and interventions, together with the relatively low quality of evidence prohibits any definitive conclusions being drawn and more high-quality research into the area is needed. Kotera et al's (2021) review of the effects of walking in nature on anxiety and depression further demonstrates that this type of intervention *may* be beneficial for these symptoms, but low-quality studies which were highly heterogenous also limited the strength of their conclusions.

The studies in the current review all received an overall rating of weak based on the EPHPP quality assessment tool. These results are comparable to the systematic review conducted by Mnich et al (2019) into green exercise and psychosocial and physiological health outcomes for children and adolescents, where thirteen of the fourteen studies included in their review were assessed as weak using the EPHPP. Carazon et al (2019) conducted a systematic review into the psycho-physiological stress recovery effects of engaging in nature – based interventions and also used the EPHPP tool to

assess the quality of their included studies. Their review differed from the present one due to their inclusion of non – employee populations and physiological as well as psychological outcomes. Yet, a similarity can be found in that sixteen of the seventeen green exercise studies included in their review were rated as weak using the EPHPP.

A systematic review by Gritza et al (2020) into workplace nature – based interventions and employee mental health and wellbeing included 3 of the 5 studies which have been considered in the current review. Using the Revised Cochrane risk of bias tool (RoB2), they found that the studies by Brown et al (2014) and de Bloom et al (2017) were at high risk of bias. This rating using the RoB2 is the equivalent to the weak rating given to these studies using the EPHPP in the current review. This demonstrates that the use of a different quality assessment tool within the present review is likely to have yielded similar results, strengthening the findings.

Study Implications

Unfortunately, due to the scarcity of studies and limited quality of the evidence base, practical recommendations are difficult to outline. Based on what is available, it appears as though the benefits of green exercise is not limited to one type of employee and with nature being free and accessible, these types of interventions would be reasonably easy for organisations to implement. The dearth of studies into the area could be due to many workplaces not having accessible green spaces near to their sites. Additionally, employees often do not have the organisational support necessary to take breaks that involve leaving their workspace and going outdoors.

One option to overcome this is virtual nature interventions. A study by van den Berg et al (2003) showed that university staff and students who viewed a 7-minute video of walking through a forest showed greater decreases in stress, depression, anger, and tension than those who watched a video of walking through a city street. Although lacking from a control group, a recently published study by Beverly et al (2022) found that subjective stress decreased for a group of healthcare workers when

they viewed a tranquil nature scene. Thus, if there are barriers to accessing real nature for some employees, the use of virtual nature could be an alternative. Nevertheless, some would argue that if real nature is a viable option, this should be the preferable course of action for organisations considering nature – based interventions for their employees.

Strengths and Limitations

The present review's strengths include the use of a validated tool to assess study quality, use of PRIMSA guidelines and the pre – registration of the study protocol on PROSPERO. Furthermore, the included studies were limited to green exercise interventions in actual natural environments, unlike previous reviews which have included virtual environments (Lahart et al, 2019). Additionally, the studies eligible for inclusion in the present review focused on all types of physical activity in nature whereas a previous review by Kotera et al (2021) limited their criteria to walking in nature only. Another strength of the present review is that no limitations were set on the dates searched within the databases. Carazon et al (2019) limited their review into nature – based interventions and stress recovery outcomes to only the previous 8 years meaning crucial studies could have been missed which could have guided the outcome of their review in more detail. Finally, grey literature and unpublished articles were included alongside published literature in the search strategy to minimise publication bias.

This review's limitations include that only studies focusing on green exercise interventions exclusively were included. This strengthens the conclusions due to the focus being solely on the one approach, however, studies which have examined the outcomes of green exercise interventions in conjunction with or in addition to other interventions have been disregarded (e.g., nature walks alongside forest bathing). Close examination of nature – based interventions for employees which include an element of green exercise would offer additional insights. Another limitation is that only studies published in the English language were included in the present review. A study by Bang et al

(2016) into the effects of forest walking on office workers was only published in Korean and so was excluded from this study.

The EPHPP tool has been criticised for having unbalanced scoring instructions. Namely, a study which receives two weak subcategory scores alongside moderate and strong ratings for the other subcategories receives the same weak global rating as another study which receives weak ratings for all subcategories (Yeo et al, 2020). It is also worth noting that some of the quality assessment results the EPHPP categories are possibly not as important as others. For example, the results of the blinding category should be considered carefully as it is not possible to blind participants to environmental conditions, and it can also be considered as being unethical to blind participants to the research question. This is arguably especially the case within workplace interventions, where employees are being asked to sacrifice their energy and time during the working day. Within the present review, the blinding category ratings did not lead to any studies being rated overall as weak that otherwise wouldn't have been if this category was not included. A final criticism of the use of this tool is that a study's design is rated as strong if the design is described as an RCT, regardless of whether the randomisation strategy or control group is detailed or deemed appropriate. It is possible for an RCT to be limited if authors do not use a feasible randomisation strategy or appropriate control group and outline this in their methods. Given these limitations of the EPHPP, some might argue that the Rob2 may have been a more suitable tool for this review. However, it was chosen as it was originally developed for health promotion interventions and has been judged as an objective tool which is suitable for systematic reviews aiming to investigate effectiveness (Thomas et al, 2004). Armijo-Olivo et al (2012) found the inter – rater reliability of the EPHPP tool's final grade assignment as ICC = 0.77 (95% CI 0.51–0.90), which is considered as being 'excellent'. The same authors also found the inter-rater reliability of the individual domains to be 0.60, which is considered as being 'fair'. The EPHPP has also been used in previous reviews within the field of nature contact and

human health outcomes allowing for the present review to draw comparisons with other reviews in this field (Yeo et al, 2020; Ohly et al, 2016).

Suggestions for Future Research

Despite employing a robust search strategy, this review only found a small number of studies of limited methodological quality for green exercise and employee mental health and wellbeing. The author would like to appeal to researchers to conduct larger, more rigorous RCTs, over longer periods of time, including higher 'doses' of nature exposure within the experimental condition. If future studies consistently used validated measures of mental health and wellbeing, these results could be pooled and used for meta – analyses in future reviews. Furthermore, capturing follow – up data permits evaluation of the effect of these types of interventions over time. An extension of this review is recommended in the future as more studies into green exercise and employee mental health and wellbeing become available.

Conclusions

The research evidence synthesised within this review found preliminary evidence to suggest that green exercise has the potential to positively influence mental health and wellbeing outcomes for employees. These outcomes included perceived mental health, positive affect, perceived restoration, wellbeing, recovery experiences, job satisfaction, wellbeing mood disturbance, post traumatic growth and trauma symptoms. However, due to the limited methodological quality of the studies and the variation in intervention details and outcome measures, only limited conclusions about the effects of green exercise interventions for employee mental health and wellbeing can be drawn. Given the current challenges with workplace mental health and wellbeing, more rigorous RCTs using robust valid outcome measures are needed to establish whether green exercise interventions could be a viable workplace mental health and wellbeing intervention.

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Chapter 2: Empirical Project

The Effects of a Green Exercise Intervention on NHS Healthcare Worker's Psychological Distress, Burnout and Sleep Quality: A Randomised Controlled Trial

Leona Cunningham[7], Dr Paul Graham Morris[8], and Dr Edel McGlanaghy[9]

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[7] Corresponding Author: Leona Cunningham, NHS Forth Valley and University of Edinburgh, Scotland
Email: s1253870@ed.ac.uk.

[8] Department of Clinical and Health Psychology, School of Health in Social Science, University of Edinburgh, Scotland.

[9] NHS Forth Valley.

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Abstract

Background: Healthcare workers are at risk of adverse mental health and wellbeing outcomes due to the challenging nature of their work. Poor healthcare worker psychological health has been linked to negative outcomes such as greater staff turnover and reduced patient safety and satisfaction. Green exercise is a form of nature – based intervention which could promote positive health outcomes amongst the healthcare workforces.

Methods: This randomised controlled trial examined whether walking in nature can effectively improve healthcare workers depression, anxiety, stress, burnout, and sleep quality outcomes. Pre and post intervention data was captured for sixty-five healthcare workers who were randomised into either a nature walking group or an urban walking group. Participants were asked to complete 2 10-minute walks per week for 4 weeks in each condition.

Results: Participating in both nature walking and urban walking group conditions resulted in statistically significant improvements for anxiety, stress, and sleep quality. Depression levels also reduced for each group; however, this result was not significant. Burnout levels in the urban group reduced more than the nature group. Walking in nature did not evidence any statistically significant additional improvements for any outcomes relative to walking in an urban environment.

Conclusions: Findings suggest that brief outdoor walks, regardless of environment, showed statistically improvements for healthcare worker anxiety, stress, and sleep quality outcomes. The unexpected outcome for burnout suggests that this construct may respond differently than other psychological outcomes. More research into this area would be beneficial to support with the development of healthcare worker physical activity or nature – based workplace interventions.

Keywords: green exercise, nature – based interventions, mental health, wellbeing, employees, healthcare workers.

Introduction

Healthcare Worker's Psychological Distress, Burnout and Sleep Quality

Healthcare workers (HCWs) endure heavy workloads and are exposed to many stressful experiences within their working environment, leading to adverse outcomes for their psychological health. There is a need for low cost and effective interventions to support this population.

Studies indicate that higher levels of mental health problems exist in HCW samples when compared with the general population (Petrie et al, 2019). It has been suggested that a range of workplace factors contribute to the higher prevalence of mental health difficulties within this population including, longer working hours, intense workloads, pressures of service and patient demands and being faced with continual ethical dilemmas (Petrie et al, 2019). In 2019, Hunter et al examined prevalence rates of psychological distress in a sample of midwives in the United Kingdom (n = 1997) and found that 33% scored in the moderate – extreme range for depression, 36.7% for stress and 38% for anxiety.

Burnout is generally defined in the literature as being the emotional and behavioural responses to work – related stress. Yet, the specificities of the construct remain greatly debated. A substantial amount of research into burnout still supports the early conceptualisations of it which define the symptoms as being emotional exhaustion, reduced personal efficacy and depersonalisation (detachment from work) (Maslach, 2001). Scholars have critiqued the original interpretation of burnout, with some arguing that personal efficacy should not be considered a core dimension of the construct (Bakker et al, 2004). These debates have resulted in multiple outcome measures of burnout being developed and used within the research domain. A recent robust systematic review conducted by Rotenstein et al (2018) pooled burnout data from one hundred and eighty-two studies, published between 1991 and 2018 involving 109,628 physicians. Out of the included studies, one hundred and twenty-two provided data on overall burnout and prevalence rates ranged between 0% and 85%. This

large range is likely due to the issues previously mentioned with variations in both conceptualisations of burnout and outcome measures used.

Sleep is a vital restorative function for humans and the quality of sleep can affect a person's mental health and wellbeing (Vandekerckhove & Cluydts, 2010). There is a lack of recent research into UK HCW's sleep quality. However, considering the high prevalence of sleep disturbance and sleep problems reported for HCWs from other countries, it is likely that similar levels of poor sleep quality exist amongst UK HCW. A meta – analysis by Zeng et al (2020) reviewed fifty-three observational studies from across the world and found that the pooled prevalence rates of poor sleep quality using the Pittsburgh Sleep Quality Index (PSQI) amongst nurses was 61%. Perhaps the most serious limitation of this review was the use of difference cut-offs for the PSQI in the studies with cut – off values ranging between ≥5 to ≥10. Yet, it suggests the scale of the problem of poor sleep quality in this population.

Healthcare Worker Psychological Distress, Burnout and Sleep Quality Following COVID-19

Healthcare workers (HCWs) have carried a heavy burden during the COVID-19 pandemic and continue to play a vital role in the response to the virus (De Kock et al, 2021). The COVID-19 pandemic exacerbated the pressures on this population due to the increased exposure to the virus within working facilities, colleague fatalities, increased risk posed to family members, redeployment concerns and the changing guidance surrounding infection control measures such as PPE and social distancing (De Kock et al, 2021). It is therefore unsurprising that researchers have conducted studies into prevalence rates of difficulties for this population in the context of COVID-19. A two – wave cohort study conducted in Scotland between July and September 2020 found substantial levels of depression (30.8%) and anxiety (20.1%) amongst a sample of one hundred and sixty-nine HCWs (De Kock et al, 2022). Alarming rates of stress and burnout within UK HCW samples following the outbreak of the pandemic have also been documented. Using the Perceived Stress Scale (PSS-10)

with 1113 HCWs, Debski et al (2021) demonstrated that 27% of the sample reported low stress levels, 60% moderate stress levels and 14% severe stress levels. Ferry et al (2021) administered a UK wide online survey to HCWs which captured data from 539 respondents and the majority were from Scotland. Using a standardised measure of burnout, the authors demonstrated that moderate – severe levels of burnout were present for 79% of the participants. Results from a meta – analysis by Salari et al (2020) also showed that the prevalence of sleep disturbance for HCW caring for COVID-19 patients was 34.8% for nurses and 41.6% for physicians.

Research into the area of HCW mental health and wellbeing during the pandemic has been criticised for the use of varying cut off levels for clinical significance and the dominant use of cross – sectional designs and convenience sampling (Pierce et al, 2020). Nevertheless, the reported levels of depression, anxiety, stress, burnout, and sleep difficulties amongst UK HCWs following the outbreak of the pandemic are concerning. Importantly, prevalence rates of these difficulties were at concerning levels even before the pandemic. It is therefore vital that we identify measures to support HCWs with their psychological health and wellbeing and now is a particularly fitting time to evaluate such interventions.

An Occupational Health Perspective on Healthcare Worker Psychological Health

Poor healthcare worker (HCW) psychological health has been shown to contribute to poorer quality of care, increased absenteeism, and decreased staff morale (Tawfick et al, 2019). Higher levels of burnout and stress and poorer sleep quality amongst HCWs have also been shown to be directly related to greater sickness rates, compromised patient safety and satisfaction and reduced quality of care and professionalism (Hall et al, 2016; Panagioti et al, 2018; Sagherian et al, 2017; Shaufeli et al, 2009). These factors have led to many clinicians leaving the NHS to pursue employment elsewhere. Even prior to the pandemic, NHS staff turnover levels and the number of unfilled posts were alarming, and evidence indicates a growing crisis in staffing numbers. A 2018 report by The Health

Foundation highlighted that 41,000 nursing posts were lying vacant in NHS England. Recent figures indicate that these nursing vacancies have risen to 46,000 (BMA, 2022).

Reduced productivity and greater levels of staff turnover within the UK's National Health Service (NHS) due to staff mental health problems is significantly costly to a system which is already financially overwhelmed (Shanafelt et al, 2017). Hence, policy drivers are aiming to reduce stress and promote positive mental health for NHS workers. Current workplace wellbeing interventions for HCWs both within the UK and other countries include yoga classes, mediation and mindfulness sessions, art and music interventions, internet – based interventions and stress – reduction or prevention programmes (Arapovic – Johansson Bozana et al, 2018; Gollwitzer et al, 2018; Phillips et al, 2019; Sung et al, 2012). However, these interventions are costly as they require facilitation and resources. Ideally, NHS worker interventions should be both inexpensive to implement and maintain and be able to reach all those who could benefit from them. Once such intervention which has the potential do fulfil these aims are workplace nature – based interventions (NBIs).

Theoretical Overview of Nature Connection and Mental Health

Various theories have been proposed to explain the relationship between nature connection and enhanced mental health and wellbeing. Nature can be defined as areas which include living systems such as animals, plants, trees and can range from vast wilderness to urban parks (Bratman et al, 2012). In the Theory of Biophilia, Wilson (1984) postulated that the innate tendency of humans to be attracted to the natural world and other living organisms. This affiliation with nature becomes biologically encoded and contact with these environment fosters emotional wellbeing. The Topophilia Hypothesis both builds on and challenges this theory stating that it is also possible for humans to feel connected to habitats which do not contain vegetation but natural materials such as sand and stone (Beery et al, 2015). Joy and De Block (2011) state that the evolutionary reasoning behind the biophilia theory is unclear and more empirical evidence is necessary to confirm that

humans hold this innate preference for vegetation and greenery. Despite their claims, many researchers still consider biophilia as providing the underpinnings for the other main theories into this area, namely, Attention Restoration Theory (ART) and Stress Reduction Theory (SRT). ART proposes that natural environments provide restorative benefits to humans when they are performing tasks which require direct attention (Kaplan & Kaplan, 1989). These restorative benefits of the environment are postulated to promote feelings of escapism from routine thoughts and activities (Kaplan, 1995). Ulrich's (1983) SRT posits that being in nature leads to positive emotional states and feelings of safety and survival for humans. Both SRT and ART propose persuasive arguments for the mechanisms connecting nature and human mental health and wellbeing. Yet, despite dominating the nature connection literature, neither appear to fully explain to what extent these mechanisms are universal, or whether they can be culturally explained.

Workplace Nature – Based Interventions (NBIs)

The workplace could be considered as being one of the most crucial social contexts for promoting positive mental health and wellbeing due to the amount of time humans spend within working environments (WHO, 2010). Within organisational psychology, the Job – Demands Resource Model (JD-R model) suggests that within work environments, humans utilize a mixture of job demands, job resources and personal resources (Bakker et al, 2017). The model postulates that when job demands exceed the employee's perceptions of their own abilities, stress can arise. Furthermore, when personal resources are depleted, this leads to poor mental health (e.g., burnout) (Bakker et al, 2017). This model is particularly applicable to healthcare workers, especially in the context of the pandemic for the reasons outlined earlier. Based on the nature connections theories outlined above, alongside the JD-R model, NBIs may have the potential to improve personal resources by activating stress reduction and attention restoration abilities therefore fostering positive mental health.

A widely acceptable definition of NBIs has not yet been determined but it they are generally understood as being interventions which involve individuals interacting with some form of nature with the aim of improving health and wellbeing (Gritza et al, 2020). Workplace NBIs which have been reported in the literature include nature savouring (mindfully attending to nature), direct exposure to nature (contact with indoor plants or nature views from windows), forest therapy, natural therapy programmes, virtual NBIs and green exercise.

Nature savouring interventions invite participants to mindfully attend to the natural environment. Studies into this type of NBI have shown that even short breaks in nature can reduce stress levels and improve psychological wellbeing for employees (Largo – Wight et al, 2016; Gola et al, 2021). Interventions which involve direct exposure to nature have also shown promising results. A study by Nieuwehuis et al (2014) showed that working in an enriched green environment improved concentration and workplace satisfaction for employees.

Forest therapy (*shinrin – yoku*) and other nature – based programmes incorporate different elements of nature connection in conjunction with approaches such as mindfulness. There have been some positive results reported for these types of programmes on employee stress, sleep, recovery experiences and burnout outcomes (Jung et al, 2015; Kim et al, 2022; Kotte et al, 2019; Sahlin et al, 2014). Virtual NBIs using nature sounds or visuals using technology have also yielded some positive results for healthcare worker's subjective wellbeing and stress levels (Beverly et al, 2022; Hu et al, 2022; Putrino et al, 2020). NBIs vary in content and have yielded some positive results for employee psychological outcomes. Yet, this research area is still very young and more robust RCTs are necessary to draw any confident conclusions about the efficacy of these types of interventions with this population.

Green Exercise as a Workplace NBI

One specific type of NBI is green exercise, which can be defined as activities involving physical activity whilst in natural environments such as green spaces (e.g., woodlands and parks) and blue spaces (e.g., lakes and rivers) (Pretty, 2004). Brown et al (2014) randomised office workers into three groups (nature walk, built walk and control). Results showed that only participants from the group who walked in nature showed improvements in self – reported mental health indices. The authors controlled for multiple confounders in this study, strengthening the results. Another 2 studies found that employees who participated in green exercise interventions reported higher levels of life satisfaction, positive affect, and perceived restoration (Bang et al, 2016; Calogiuri et al 2016). A study by de Bloom et al (2017) compared park walking with relaxation breaks for employees. This study found that participants in the park walking group reported greater psychological detachment from work and enhanced levels of wellbeing throughout their day. Using the same data from the study by de Bloom et al (2017), Sianjona et al (2018) also found evidence that levels of enjoyment mediated the relationship between park walks and higher concentration and lower levels of fatigue within the sample.

More recently, researchers found improvements in multiple indicators of mood and wellbeing for office workers who participated in repeated short walks in blue spaces when compared to a control (Vert et al, 2020). Noushad et al (2022) is the only published study to date which has examined the effects of green exercise on a sample which exclusively comprised healthcare staff. The participants from their study who engaged in nature – based physical activity showed improvements in post – traumatic growth levels and reductions in traumatic stress levels when compared with the other nature – sitting group. This provides evidence for the benefits of the physical activity element in green exercise interventions. Hence, studies into the effects of green exercise interventions for employees are promising, but more research into this area is required. Specifically, the research to date is limited in the use of validated measures of psychological distress, burnout, and sleep quality.

Additionally, to the best of the authors knowledge, there exists only 1 study which has examined the effects of a green exercise intervention for psychological outcomes for healthcare workers. Finally, researchers have recently argued that studies into the connection between nature and mental health is at a problematic phase due to weak evidence in support of positive associations between the two constructs (Moore et al, 2018). Hence, more robust experimental designs are required to investigate the relationship and determine possible associations.

Study Aims and Hypotheses

The following study aims to address some of the gaps which exist in the literature into green exercise interventions for employees. Specifically, this study has been conducted exclusively on healthcare staff, and examines indices which have been shown to be at concerning levels within this population, namely, depression, anxiety, stress, burnout, and sleep quality. This study aims to use a robust experimental design to determine whether this type of intervention should be promoted within the NHS and by other healthcare providers across the world as a viable staff wellbeing initiative.

Hypothesis 1: Healthcare workers who participate in the nature walking intervention will report lower levels of *depression, anxiety and stress* when compared with participants in the urban walking control group.

Hypothesis 2: Healthcare workers who participate in the nature walking intervention will report lower levels of *burnout* when compared with participants in the urban walking control group.

Hypothesis 3: Healthcare workers who participate in the nature walking intervention will report better *sleep quality* when compared with participants in the urban walking control group.

Methodology

Study Design

This study was a multi – site, randomised controlled trial conducted in 7 clinical sites of NHS Forth Valley Health Board. Full ethical approval was obtained by the University of Edinburgh's Clinical and Health Psychology's Ethics Committee (ref. CLPS190). Approval for the study was also obtained from NHS Forth Valley's Research and Development Department (ref. FV1365). This study was registered on the Open Science Framework prior to data collection (https://osf.io/da9gq/).

Participants and Recruitment

Participants were NHS healthcare workers recruited from seven sites in Forth Valley Health Board, Scotland. An advert for the study was uploaded onto the NHS Forth Valley Staff Intranet on both the Staff News and Staff Brief sections which employees have access to as soon as they open the internet page on their work computers. Emails were distributed through multiple mailing lists reaching approximately nine hundred and ninety-five staff with an invitation to participate in the study and instructions of how to take part.

Individuals were eligible to participate if they met all the following criteria:

- Employed as a healthcare worker by NHS Forth Valley.
- Based in one of the 7 intervention sites.
- Able to read English fluently and understand written and verbal instructions.
- Could walk for 10 minutes, twice a week, for 4 weeks.

Procedure

Participants accessed the study by following the link or QR code in the email invitation or online study advert and were taken to the pre – intervention survey on secure survey platform, Qualtrics. They were asked to read the participant information sheet and provide consent. Within the information sheet, participants were informed of the general structure of the study and any risks or benefits that may occur. They were also informed that there would be two groups (nature walking group and urban walking group) and given a wiki page address where they could view the study results once they were available. The study's hypotheses were not disclosed. Participants were asked to indicate whether they met eligibility criteria, then they were invited to enter their email address. If they did not enter their email address, they were unable to proceed as this was essential for gathering post – intervention data. Demographic information was gathered for each participant including their age, gender, job category, number of working hours per week and amount of time spent in nature each week. Each participant then completed online questionnaires gathering data on each of the measures. They were then asked to choose which site they worked in and were automatically randomised into either the nature walking group or urban walking group by Qualtrics' randomisation feature. This feature was set up to ensure nature and urban conditions were evenly presented across sites. Once they had completed the walking intervention, each participant received an email asking them to complete a second online survey through Qualtrics. In this survey, participants entered their email address again meaning the lead researcher could match the pre and post data. They were asked how many of the weeks they were able to complete at least one of the walks as per instructed in the participant information sheet. Data was also gathered on whether they walked alone or with others. Participants then completed the same online questionnaires as the pre – intervention survey and were debriefed on the proposed study hypotheses.

Intervention

The lead researcher designed nature and urban walking route for each of the seven NHS work sites (see Appendix E for example walk instructions). The nature walks consisted mostly of trees, grass spaces, woodland paths and the urban walks were mostly adjacent to roads, houses, and office buildings. Routes were chosen for both conditions which could be directly accessed from buildings within each site and efforts were made to choose routes of similar lengths and inclines. Once randomised, written instructions and a map were administered to each participant where they were asked to follow a walking route at a normal pace twice a week for 4 weeks. They were advised that each walk should take approximately 10 minutes to complete and should be undertaken during their working hours within usual break times. Feasibility discussions took place with one of the health board's health promotion officers and occupation health clinical psychologists who agreed that 2, 10-minute walks per week would be achievable for staff as it would allow them to have time to eat lunch as well as walk if they were taking part during their lunchtime. To promote adherence, participants were advised that they could choose which days they completed their walks and whether they wanted to walk alone or with others. Data was collected after the intervention to check adherence.

Measures

In both the pre – intervention and post - intervention Qualtrics surveys, all participants were asked to complete the following measures of depression, anxiety, stress, burnout, and sleep quality.

Depression, Anxiety and Stress Scale-21 (DASS-21)

Self – reported depression, anxiety and stress was measured using the DASS-21 (Lovibond & Lovibond, 1995). The depression dimension of this scale measures symptoms of inertia, lack of interest or involvement, anhedonia, dysphoria, hopelessness, self – deprecation and devaluation of

life. The anxiety dimension measures symptoms of autonomic arousal, skeletal muscle affects and subjective experiences of situation anxiety and anxious affects, The stress dimension measures symptoms of over activity, impatience, being upset, agitation, nervousness and difficulty relaxing (Szabo, 2010). The scale measures severity of symptoms using a 4-point Likert scale and higher scores indicate higher severity of each difficulty.

The DASS-21 has consistently been shown to be reliable and valid in both clinic and non – clinical samples of adults (Henry & Crawford, 2005). Reliability analyses were conducted on baseline data for the current sample on each of the subscales. Cronbach's alpha demonstrated good reliability for depression (α = .92), anxiety (α = .76) and stress (α = .89).

Oldenburg Burnout Inventory

Burnout was measured using the Oldenburg Burnout Inventory (OLBI) (Demerouti et al, 2003). This self – reported scale features two subscales for exhaustion and disengagement and was it was designed to capture burnout symptoms for any occupational group, regardless of whether they had roles involving direct patient contact (Halbesleben & Demerouti, 2005). Within this scale, higher combined scores of emotional exhaustion and disengagement indicate higher levels of burnout. The scale's internal consistency was found to be acceptable (Halbesleben & Demerouti, 2005), with Cronbach's alpha scoring between .74 and .87.

Reliability analyses were conducted on baseline data for the current sample for the total OLBI score and both subscales. Cronbach's alpha demonstrated good reliability for total burnout scores (α = .84), emotional exhaustion ((α = .72), and disengagement (α = .76). Only the total scaled score of burnout was used within this study.

Sleep Quality Scale (SQS)

Sleep quality was measured using the single item sleep quality scale (SQS). The SQS asks participants to rate their overall sleep quality in the last 7 days on a 10-point Likert scale ranging

from 0 = terrible sleep quality to 10 = excellent sleep quality. A recent study found test – retest reliability of the SQS in a sample of two hundred and thirty-eight healthy adults to be high (ICC = .82 (95% CI: 0.66 to 0.91) (Dereli & Kahraman 2021).

At the end of the intervention, data was gathered on adherence and whether participants chose to walk alone or with others.

Statistical Analysis

IBM SPSS Statistics 27 software was used for this study. Missing data was dealt with using series mean imputation. Outliers within the data set were detected using the studentized residuals feature on SPSS. They were considered as being data entries where the studentized residuals were ±3. Outliers were found for pre- and post-depression and pre- and post – anxiety within the data set (7 outliers in total). These were dealt with using winsorizing, replacing their value with the closest non – outlier data entry for the variable. The residuals for all pre and post variables were checked for normality using Normal Q-Q Plots and all were approximately normally distributed.

Descriptive statistics was completed for baseline measures, and independent t-tests were used to compare the baseline scores for the nature group and urban group on the outcome measures. Two – way mixed design ANOVAs were then performed for each outcome variable. A priori power calculation was based on detecting an interaction effect and a medium effect size was used ($f = 0.25$) (Cohen, 2013). This effect size was chosen as it would increase the feasibility of recruiting an appropriate sample size. Furthermore, a previous study of similar design detected a medium effect size when comparing the changes in mean pre and post mental health scores for nature walking condition vs urban walking condition ($d = 0.40$) (Brown et al, 2014).

The power calculation determined that a total sample size of n = 34 would be required. Brown et al (2014) also estimated that a 40% attrition rate would likely occur in their study. Hence, n = 48 was calculated as being an appropriate sample size for this study.

Results

Within the 4-week recruitment phase, two hundred and eleven potential participants clicked on the study link for the pre – intervention survey. Four of these stated that they did not meet criteria and one hundred did not complete essential details such as the consent form (n = 82), eligibility questions (n = 6) or contact email address (n = 12). This left one hundred and seven participants, who were randomised into the 2 groups. Fifty-two participants were allocated to the nature walking group (and fifty-five were allocated to the urban walking group. Sixty-five of the randomly allocated participants completed the post intervention survey. Figure 1 illustrates participant numbers at each stage of the project. Table 1 outlines the background characteristics of all participants. There were no significant differences in baseline demographics between the 2 groups. Tables 2 and 3 indicate participation information for each group including adherence rates and percentages of participants who walked alone or with other people.

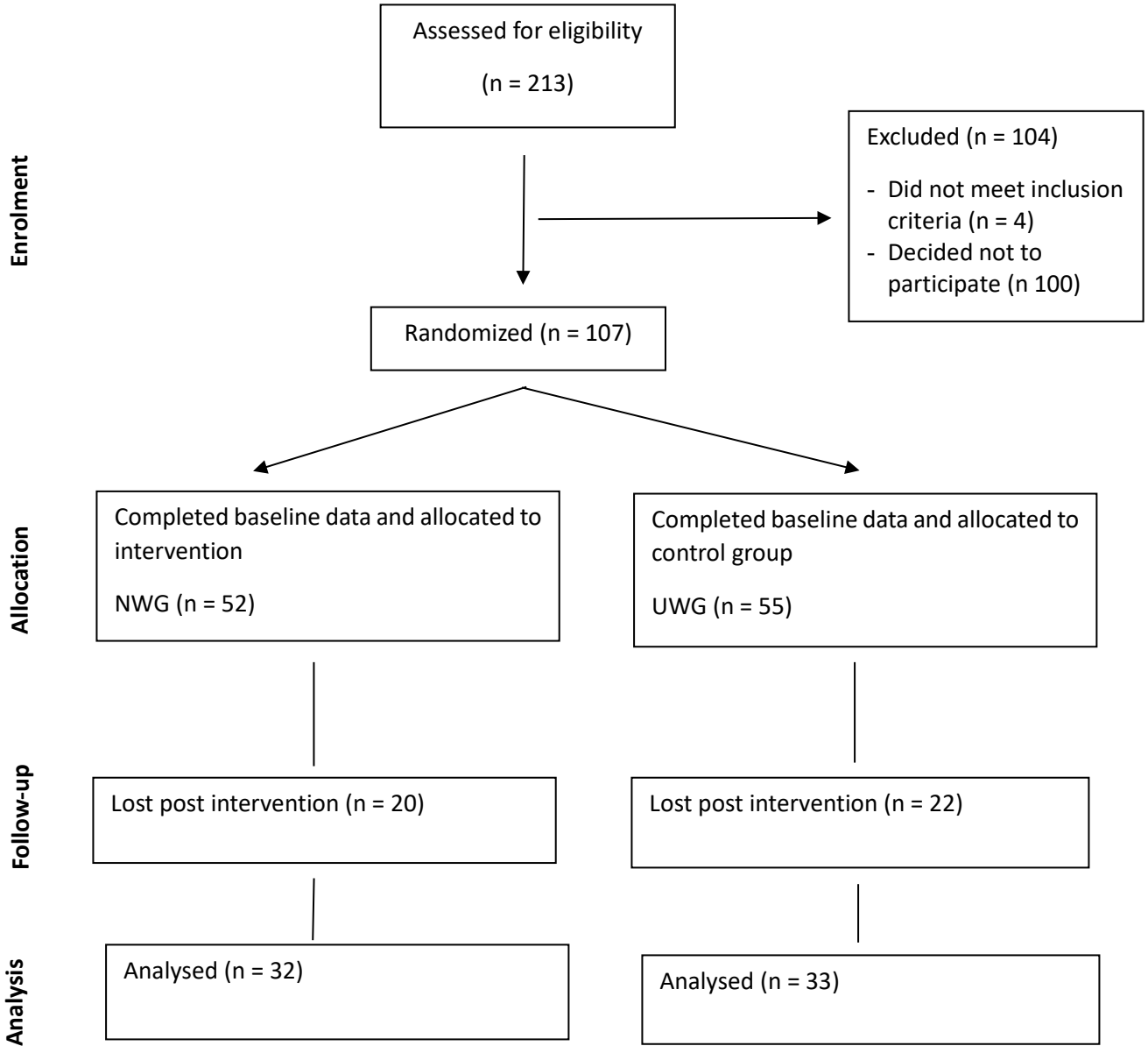

Figure 1. Participant Flow Diagram

Table 1: Baseline characteristics of all participants (completers and those lost post intervention)

% = percentage of category

Baseline variable	**All Participants**		**Participants lost to follow-up**		**Completers involved in analysis**	
	NWG (n=52)	**UWG (n=55)**	**NWG (n=20)**	**UWG (n=22)**	**NWG (n=32)**	**UWG (n=33)**
	n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Age Categories (years)						
18 – 34	18 (35)	16 (29)	5 (25)	6 (27)	**13 (41)**	**10 (30)**
35 – 54	26 (50)	29 (53)	10 (50)	12 (55)	**16 (50)**	**17 (52)**
55+	8 (15)	10 (18)	5 (25)	4 (18)	**3 (9)**	**6 (18)**
Gender						
Male	4 (8)	2 (4)	0	0	**4 (12)**	**2 (6)**
Female	48 (92)	53 (96)	20 (100)	22 (100)	**28 (88)**	**31 (94)**
Job Category[10]						
Allied Health Professionals	6 (12)	11 (20)	3 (14)	4 (17)	**3 (9)**	**7 (21)**
Business and Administration	4 (8)	7 (13)	2 (9)	2 (9)	**3 (9)**	**5 (15)**
Clinical Healthcare Support Worker	1 (3)	1 (2)	0	0	**1 (3)**	**1 (3)**
Dentistry	2 (4)	3 (5)	1 (5)	0	**1 (3)**	**3 (9)**
Healthcare Science	2 (4)	2 (4)	2 (9)	1 (5)	**0**	**1 (3)**
Medical	2 (4)	2 (4)	1 (5)	1 (5)	**1 (3)**	**1 (3)**
Nursing and Midwifery	21 (39)	17 (31)	8 (39)	10 (45)	**13 (42)**	**7 (21)**

[10] No HCWs from Optometry and Estates and Facilities participated.

Pharmacy	4 (8)	3 (5)	3 (14)	1 (5)	**1 (3)**	**2 (6)**
Psychology	9 (16)	9 (16)	1 (5)	3 (14)	**8 (25)**	**6 (19)**
Other NHS Staff	1 (2)	0	0	0	**1 (3)**	**0**
Number of working hours (per week)						
Part – time (< 37.5)	21 (40)	20 (36)	8 (40)	6 (28)	**13 (41)**	**14 (42)**
Full – time (37.5)	27 (52)	31 (57)	10 (50)	15 (68)	**17 (53)**	**16 (49)**
More than 37.5	4 (8)	4 (7)	2 (10)	1 (4)	**2 (6)**	**3 (9)**
Number of hours spent in nature on average each week before intervention						
None	3 (6)	4 (7)	2 (10)	1 (5)	**1 (3)**	**3 (9)**
Less than half an hour	5 (10)	9 (16)	2 (10)	5 (23)	**3 (9)**	**4 (12)**
Between half an hour and 2 hours	17 (32)	20 (36)	5 (25)	11 (49)	**12 (38)**	**9 (27)**
Between 2 and 4 hours	16 (31)	14 (26)	7 (35)	5 (23)	**9 (28)**	**9 (27)**
More than 4 hours	11 (21)	8 (15)	4 (20)	0	**7 (22)**	**8 (25)**

Table 2. Adherence Information

Number of Walks Completed	Nature Group (n = 32)	Urban Group (n = 33)
At least one of the walks in only one of the study weeks	16%	33%
At least one of the walks in only two of the study weeks	19%	10%
At least one of the walks in only three of the study weeks	25%	27%
At least one of the walks in all four of the study weeks	40%	30%

Table 3. Social Information

	Nature Group (n = 32)	Urban Group (n = 33)
Completed most of the walks alone	56%	76%
Completed most of the walks with other people	28%	18%
Did not indicate whether walked alone or with other people	16%	6%

Multiple independent t – tests showed no significant differences in baseline measurements for all variables between the nature group and urban group. Table 4 outlines the means and standard deviations of all variables measured at baseline and post - intervention for completers. There was homogeneity of variance, as assessed by Leven's test of homogeneity of variance for all variables ($p>0.05$). There was also homogeneity of covariances, as assessed by Box's test of equality of covariances for depression ($p = .878$), anxiety ($p = .415$), stress ($p = .057$), burnout ($p = .723$) and sleep quality ($p = .642$).

Table 4. Baseline and Post Intervention Data for Completers of Both Groups[11]

Measure	Nature Walking Group		Nature Walking Group		Urban Walking Group		Urban Walking Group	
	Baseline		Post Intervention		Baseline		Post Intervention	
	M	SD	M	SD	M	SD	M	SD
Depression	9.49	9.04	6.56	6.41	7.70	8.32	7.11	6.62
Anxiety	7.38	8.38	5.38	6.27	8.58	6.39	5.65	5.61
Stress	15.69	7.72	13.00	10.05	15.81	10.22	12.83	8.88
Burnout	39.85	5.88	40.44	6.19	39.72	6.91	37.39	6.34
Sleep Quality	4.63	2.17	5.28	2.22	4.22	2.17	5.27	2.32

Table 5. Recommended Cut – Off Points for DASS – 21 (Chin et al, 2019)

Measure	Normal	Mild	Moderate	Severe	Extremely Severe
Depression	0 – 9	10 -13	14 – 20	21 – 27	28+
Anxiety	0 – 7	8 – 9	10 – 14	15 – 19	20+
Stress	0 – 14	15 – 18	19 – 25	26 – 33	37+

Hypothesis 1: Healthcare workers who participate in the nature walking intervention will report lower levels of *depression, anxiety and stress* when compared with participants in the urban walking control group.

Depression

There was no statistically significant interaction found between group and time for depression, $F(1, 63) = 1.46$, $p = .23$. Despite mean depression scores reducing for both groups (see Table 4), the main effect of time showed that there was no statistically significant difference between mean depression scores at the different time points $F(1, 63) = 3.28$, $p = .08$.

[11] Note: 95% CI (confidence interval). Scores of the OLBI can be interpreted as low burnout = < 44, medium burnout = 44 – 59 and high burnout = > 59. Cut off scores for sleep quality were terrible = 0, poor = 1 – 3, fair = 4 – 6, good = 7 – 9, excellent = 10.

Anxiety

There was no statistically significant interaction found between group and time for anxiety $F(1, 63) = .41$, $p = .52$. A significant main effect of time was found for this measure. This suggest that that there was a statistically significant reduction in mean anxiety scores at the different time points for both groups $F(1, 63) = 11.77$, $p = <0.01$.

Stress

There was no statistically significant interaction found between group and time for stress $F(1, 63) =.03$, $p = .86$. A significant main effect of time was found for this measure. This suggested that there was a statistically significant reduction in mean stress scores across the different time points for both groups $F(1, 63) = 10.73$, $p = <0.05$.

Hypothesis 2: Healthcare workers who participate in the nature walking intervention will report lower levels of *burnout* when compared with participants in the urban walking control group.

Burnout

There was a statistically significant group x time interaction effect found for burnout $F(1, 63) = 7.38$, $p <0.05$. In particular, the urban walking group experienced a statistically significant decline in burnout symptoms between the 2 different time points $F(1, 31) = 8.53$, $p <0.05$ but the nature walking group did not $F(1, 31) = .67$, $p = .42$. This suggests that burnout scores reduced significantly following intervention for the urban walking group but not for the nature walking group (see Table 4).

Hypothesis 3: Healthcare workers who participate in the nature walking intervention will report better *sleep quality* when compared with participants in the urban walking control group.

Sleep Quality

There was no statistically significant interaction found between group and time for sleep quality $F(1, 63) = .72$, $p = .40$. A statistically significant main effect of time was found. This suggested that there was a statistically significant increase in mean sleep quality scores at the different time points for both groups $F(1, 63) = 13.56$, $p < .001$.

Discussion

Main Findings

In this study, a randomised controlled trial examined the effects of a green exercise intervention on healthcare workers' depression, anxiety, stress, burnout, and sleep quality. Outcomes for participants who were assigned to the nature walking group were compared with participants who walked in an urban setting. Contrary to the proposed hypotheses, there were no significant interaction effects between the nature and urban walk groups over time on depression, anxiety, stress, and sleep quality. Nevertheless, a main effect of time was found for anxiety, stress, and sleep quality, reflecting a significant reduction in mean scores for these variables over time for both conditions. These results indicate that engaging in both walking conditions improved anxiety, stress, and sleep quality for participants. Mean depression scores reduced for both groups over time, with a greater reduction observed for the nature group. However, these results were not statistically significant. Surprisingly, a significant interaction effect was found between group and time for burnout, with the urban group showing greater improvements in this variable when compared with the nature group.

The findings for depression in this study are somewhat consistent with previous studies which have compared nature walking with urban walking in non – clinical populations. Janeczko et al's (2020) study showed that depression was significantly reduced in their nature and urban walking group conditions in a sample of seventy-five university students. Three studies from Japan also found evidence that walking in nature reduced depression scores significantly more than walking in urban settings for their student participants (Song et al, 2015; Song et al, 2018; Song et al, 2019). Although no significant effects were found for depression within this study, mean depression scores for both conditions did reduce, with the nature group showing greater reductions. Potentially a larger sample size may have been required to detect any statistical significance for this variable.

The results for anxiety in the current study are in contrast with previous studies where nature walking reduced anxiety outcomes significantly more than urban walking for student samples (Bratman et al, 2015; Hassan et al, 2018; Song et al, 2013; Song et al, 2015; Song et al, 2018; Song et al, 2019). This discrepancy could be explained by different anxiety measures being used or that anxiety may present differently in healthcare workers than students.

RCTs which have examined the effects of workplace physical activity interventions on employee outcomes have found no significant differences between treatment and control groups for anxiety and stress in employee samples (Eriksen et al, 2002; Gronningeater et al 1992; Kerr & Marjolein 1993; Sjogren et al, 2006; Tveito et al, 2009). These results may contrast with the present study's findings due to their interventions consisting of indoor aerobic, resistance and weight training interventions as opposed to walking outdoors.

Kavanaugh et al (2022) appears to be the only other study which has examined the effects of a nature – based intervention (forest bathing including nature walk) on healthcare worker burnout. They assessed burnout using the same measure as the current study and found no statistically significant effects for the nature group compared with control. Taken together, the results of both studies possibly suggests that effects on burnout take longer to become apparent. It remains unclear why the urban group in the current study showed improvements in burnout when compared with the nature group. This surprising result raises the question of how burnout differs from other symptoms such as depression, stress, and anxiety in healthcare workers. It is possible that the result for burnout can be attributed to being a chance effect.

The present study findings for sleep quality are consistent with findings from a recently published study of a similar design by Ma et al (2022). These researchers also randomised participants into nature or urban walk conditions and found significant improvements for sleep quality following the

intervention for both groups. They also found that walking in nature did not provide additional benefits to this variable when compared with walking in urban settings. Consistent with the current study's results, Hori et al (2016) found that a 4 – week walking intervention improved both PSQI scores and perceived sleep quality in a large sample of healthy adults (n = 490).

Study Implications

The findings of this study are especially important because brief walking interventions are simple and practical solutions for improving workplace mental health and wellbeing. Interventions such as a short outdoor walking break circumvent traditional barriers to workplace mental health and wellbeing interventions such as high cost and loss of work time. Additionally, a 10-minute outdoor walk requires less effort and commitment on the part of the employee rather than engaging in structured wellbeing initiatives such as mindfulness programmes.

Importantly, not all workplace sites will have easy access to green spaces, and break times are often limited, especially for healthcare workers. Thus, the finding that urban walking is similarly beneficial to walking in nature is promising for work sites situated in built up or industrial sites.

When considering the implementation of physical activity interventions within the NHS workforce, health boards and trusts could offer suggestions for workplace physical activity within their induction programmes. Route maps for walks could be distributed throughout teams and movement breaks actively encouraged by management. Employees who are likely to stay within the one environment for entire shifts (e.g., ward nurses) could be encouraged to use their breaks to move to an outdoor space, mitigating the effects of being indoors throughout the working day.

Constraints such as weather conditions and perceived safety are important when considering employee participation in outdoor exercise interventions (Lee & Maheswaran, 2011). Some employees may feel more comfortable and safer having the option to exercise indoors. It is therefore important to consider these factors when implementing physical activity interventions in the

workplace. Employers could encourage walking groups to form or organise physical activities as one-off events with the aim of encouraging employees to manage their own activity levels during the working day. Furthermore, if the research evidence indicates that different symptoms are reduced by certain types of physical activity or walking interventions, NHS occupational health departments could tailor the type of intervention dependant on the specific complaint of the employee.

Strengths and Limitations

This study's potential limitations included the self-administered nature of the intervention which poses issues related to adherence. Although the hypothesised results were not disclosed, the underlying research question was roughly outlined which could have led to a self – selection phenomenon i.e., individuals who were already interested in participating in a walking intervention agreed to participate. It was deemed ethically necessary to provide such details ahead of asking employees to commit time and energy within their working day to the study. It is possible that some spill over or contamination effects occurred due to participants from both groups working together within each of the sites. They may have discussed walks or joined other walks with colleagues in the different group.

This study had a relatively small sample size and did not include a no treatment control group which reduces the strength of the findings. Due to these limitations, it is possible that the study outcomes reflect regression to the mean. Additionally, the lack of follow – up data means that it is unclear whether the effects of participating in the walks continue or whether participants continue to engage in this type of behaviour beyond the study.

Although common in organisational research, this study's sample consisted of mostly women, limiting the external validity of the findings to male dominated sectors. Gender effects have been found in previous research into nature connection and psychological outcomes. For example, Plante

et al (2006) found evidence that the effects of walking outdoors increased energy levels significantly more for females when compared with males (Plante et al, 2006).

A final limitation is that the study was conducted in the summer months in Scotland, which are significantly warmer and drier than other months of the year. This is likely to have led to greater adherence and participation than if the study had been conducted in the autumn/winter months. Hence, the generalisability of the study results to less favourable weather conditions present another possible limitation.

Despite the challenges of setting up an experimental study of this nature in organisational settings, the present study demonstrated several strengths. The use of a randomised controlled design enabled similar baseline characteristics and measurements between participants in each of the groups. Furthermore, similar attrition rates were observed for both groups leading to comparable amounts of post intervention data for each group. This study also used repeated exposure instead of single exposure within the interventions and used validated measures to capture data.

Suggestions for Future Research

Future studies into the benefits of green exercise for healthcare workers and other employees may benefit from implementing additional measures to encourage and monitor adherence. Longer interventions with more frequent exposure to green environments may lead to more positive effects. It may be that the benefits of physical activity are observed after a shorter period yet the benefits of exposure to nature are observed over a longer period. Future studies would benefit from capturing follow – up data to examine whether employees continue to engage in walking breaks during their working day following participating in this type of study. A rigorous RCT including four levels (walking in urban environment, urban exposure without walking, walking in natural environment, and nature exposure without walking) would allow more confident conclusions to be drawn about the mechanisms of benefits of this type of intervention.

Perceived control over one's break activities has been proposed as a key element which supports people to recover from stress (Trougakos et al, 2013). This leads to the hypothesis that high autonomy over break times may lead to more benefits than people being randomly assigned to different groups. Hence, future studies into workplace green exercise interventions could also include a group which can freely decide which walk they would prefer to engage in.

Due to the limitations of the current literature into green exercise and employee mental health and wellbeing, researchers should consider conducting more studies which explore factors such as mechanisms and dose before carrying out fully powered RCTs. Drawing on the NIHR/MRC Framework for Developing and Evaluating Complex Interventions ((Skivington et al, 2021), outcomes from these studies could inform the theoretical underpinnings in this area and lead to a greater understanding of how context shapes the outcomes for these types of interventions. These types of studies could also help to refine research questions and support the development of more feasible interventions which could be evaluated more effectively.

Conclusions

In this study, anxiety, stress, and sleep quality showed statistically significant improvements for both the nature and urban walking groups. Burnout only showed a statistically significant improvement for the urban group. No statistically significant effects were found for depression scores for either group yet means depression scores reduced for both conditions.

This study points to several implications for the NHS and other healthcare providers. Brief walking interventions are relatively easy to implement and are a cost-effective solution that could enhance wellbeing and reduce mental health difficulties amongst healthcare workers. Alongside the benefits of enhanced wellbeing for staff and patient care, this could have economic benefits via reduced sickness absences and staff turnover rates.

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Appendices

Appendix A: Author Guidelines (Journal of Environmental Psychology)

GUIDE FOR AUTHORS

INTRODUCTION
The *Journal of Environmental Psychology* is the premier journal in the field, serving individuals in a wide range of disciplines who have an interest in the scientific study of the transactions and interrelationships between people and their surroundings (including built, social, natural, and virtual environments, the use and abuse of nature and natural resources, and sustainability-related behavior). The journal publishes internationally contributed empirical studies and systematic and meta-analytic reviews of research on these topics that advance new insights.

As an important forum for the field, the journal publishes some of the most influential papers in the discipline that reflect the scientific development of **environmental psychology**. Contributions on theoretical, methodological, and practical aspects of all **human-environment interactions** are welcome, along with innovative or interdisciplinary approaches that have a psychological emphasis.

Research areas include:

•Psychological and behavioral aspects of people and nature
•Cognitive mapping, spatial cognition and wayfinding
•Ecological consequences of human actions
•Theories of place, place attachment, and place identity
•Environmental risks and hazards: perception, behavior, and management
•Perception and evaluation of buildings and natural landscapes
•Effects of physical and natural settings on human cognition, health, and well-being
•Theories of proenvironmental behavior, norms, attitudes, and personality
•Psychology of sustainability and climate change
•Psychological aspects of resource management and crises
•Social use of space: crowding, privacy, territoriality, personal space
•Design of, and experiences related to, the physical aspects of workplaces, schools, residences, public buildings and public space

The journal does not typically publish highly exploratory, descriptive case studies, narrative reviews, or rapid scoping reviews. The desk rejection rate of the *Journal of Environmental Psychology* is about 75%.
Submission checklist
You can use this list to carry out a final check of your submission before you send it to the journal for review. Please check the relevant section in this Guide for Authors for more details.

Ensure that the following items are present:

One author has been designated as the corresponding author with contact details:
- E-mail address
- Full postal address

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Manuscript:
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- All tables (including titles, description, footnotes)

- Ensure all figure and table citations in the text match the files provided.
- Indicate clearly if color should be used for any figures in print *Graphical Abstracts / Highlights files* (where applicable) *Supplemental files* (where applicable)

Further considerations

- Manuscript has been 'spell checked' and 'grammar checked.'
- All references mentioned in the Reference List are cited in the text, and vice versa.
- Permission has been obtained for use of copyrighted material from other sources (including the Internet)

- A competing interest's statement is provided, even if the authors have no competing interests to declare
- Journal policies detailed in this guide have been reviewed.
- Referee suggestions and contact details provided, based on journal requirements.

For further information, visit our Support Center.

BEFORE YOU BEGIN

Ethics in publishing

Please see our information on Ethics in publishing.

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Submission declaration and verification

Submission of an article implies that the work described has not been published previously (except in the form of an abstract, a published lecture or academic thesis, see 'Multiple, redundant or concurrent publication' for more information), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright- holder. To verify compliance, your article may be checked by Crossref Similarity Check and other originality or duplicate checking software.

Use of inclusive language

Inclusive language acknowledges diversity, conveys respect to all people, is sensitive to differences, and promotes equal opportunities. Content should make no assumptions about the beliefs or commitments of any reader; contain nothing which might imply that one individual is superior to another on the grounds of age, gender, race, ethnicity, culture, sexual orientation, disability or health condition; and use inclusive language throughout. Authors should ensure that writing is free from bias, stereotypes, slang, reference to dominant culture and/or cultural assumptions. We advise to seek gender neutrality by using plural nouns ("clinicians, patients/clients") as default/wherever possible to avoid using "he, she," or "he/she." We recommend avoiding the use of descriptors that refer to personal attributes such as age, gender, race, ethnicity, culture, sexual orientation, disability or health condition unless they are relevant and valid. When coding terminology is used, we recommend avoiding offensive or exclusionary terms such as "master", "slave", "blacklist" and "whitelist". We suggest using alternatives that are more appropriate and (self-) explanatory such as "primary", "secondary", "blocklist" and "allowlist". These guidelines are meant as a point of reference to help identify appropriate language but are by no means exhaustive or definitive.

Reporting sex- and gender-based analyses

Reporting guidance

For research involving or pertaining to humans, animals or eukaryotic cells, investigators should integrate sex and gender-based analyses (SGBA) into their research design according to funder/ sponsor requirements and best practices within a field. Authors should address the sex and/or gender dimensions of their research in their article. In cases where they cannot, they should discuss this as a limitation to their research's generalizability. Importantly, authors should explicitly state what definitions of sex and/or gender they are applying to enhance

the precision, rigor and reproducibility of their research and to avoid ambiguity or conflation of terms and the constructs to which they refer (see Definitions section below). Authors can refer to the Sex and Gender Equity in Research (SAGER) guidelines and the SAGER guidelines checklist. These offer systematic approaches to the use and editorial review of sex and gender information in study design, data analysis, outcome reporting and research interpretation - however, please note there is no single, universally agreed-upon set of guidelines for defining sex and gender.

Definitions

Sex generally refers to a set of biological attributes that are associated with physical and physiological features (e.g., chromosomal genotype, hormonal levels, internal and external anatomy). A binary sex categorization (male/female) is usually designated at birth ("sex assigned at birth"), most often based solely on the visible external anatomy of a newborn. Gender generally refers to socially constructed roles, behaviors, and identities of women, men and gender-diverse people that occur in a historical and cultural context and may vary across societies and over time. Gender influences how people view themselves and each other, how they behave and interact and how power is distributed in society. Sex and gender are often incorrectly portrayed as binary (female/male or woman/man) and unchanging whereas these constructs actually exist along a spectrum and include additional sex categorizations and gender identities such as people who are intersex/have differences of sex development (DSD) or identify as non-binary. Moreover, the terms "sex" and "gender" can be ambiguous—thus it is important for authors to define the manner in which they are used. In addition to this definition guidance and the SAGER guidelines, the resources on this page offer further insight around sex and gender in research studies.

Author contributions

For transparency, we encourage authors to submit an author statement file outlining their individual contributions to the paper using the relevant CRediT roles: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Roles/Writing - original draft; Writing - review & editing. Authorship statements should be formatted with the names of authors first and CRediT role(s) following. More details and an example.

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MANUSCRIPT ELEMENTS AND FORMATTING REQUIREMENTS

All manuscripts must contain the essential elements needed to convey your manuscript, including Abstract, Keywords, Introduction, Materials and Methods, Results, Conclusions, References, Appendices, Tables and Figures with Captions, and any Relevant Artwork.

In addition, we encourage all original submissions to conform to the American Psychological Association style (see the Publication Manual of the American Psychological Association, 6th ed., 2009). Figures and Tables should be embedded in the main manuscript file next to the relevant text (not separately at the end).

METHODS AND RESULTS

To ensure high reproducibility standards in the field of environmental psychology, whenever possible, all manuscripts should include and report; a) confidence intervals, b) effect-sizes, c) appropriately visualize raw (experimental) data with error bars, d) include a power analysis or discussion of how sample size was determined, and e) include a clear statement or discussion of institutional ethics review and approval.

In addition, descriptive statistics must be clearly reported, including standard deviations, correlations, and exact sample sizes for each cell in experimental designs. In general, it is preferred that exact p-values are reported. Exploratory research is welcome but should be explicitly labelled as such to avoid Hypothesizing After Results are Known (HARKing). All submissions require a data availability statement. To further facilitate transparency, analyses should be reported with and without exclusion criteria, outliers, and covariates. Guidelines on mediation and moderation analysis are more complicated, please see our editorial on how to best report such results in the Journal of Environmental Psychology.

Manuscripts that do not conform to these (new) standards will be desk rejected. Please consult our Editorial (van der Linden 2019) for further guidance and details.

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References should also conform to the American Psychological Association guidelines (see the Publication Manual of the American Psychological Association, 6th ed., 2009). Numbered reference systems should be avoided. Use of DOI is generally encouraged. The reference style used by the journal will be applied to the accepted article by Elsevier at the proof stage. Note that missing data will be highlighted at proof stage for the author to correct.

Formatting requirements

All manuscripts must contain the essential elements needed to convey your manuscript, for example Abstract, Keywords, Introduction, Materials and Methods, Results, Conclusions, Artwork and Tables with Captions.
If your article includes any Videos and/or other Supplementary material, this should be included in your initial submission for peer review purposes.
Divide the article into clearly defined sections.

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Please ensure the figures and the tables included in the single file are placed next to the relevant text in the manuscript, rather than at the bottom or the top of the file. The corresponding caption should be placed directly below the figure or table.

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Authors may choose among five different types of submissions:

1. **Empirical research articles:** These submissions are complete reports of original research. Rationale, methods, findings, and conclusions discussed with limitations and potential real-world significance should be included.
   a. **Single-study articles:** The word limit for this submission type is 7,000 words.
   b. **Multiple-studies articles:** These submissions may involve experimental, meta-analytical, or cross-cultural research. The word limit for this submission type is 10,000 words.

2. **Review articles:** These submissions are substantial overviews of original research. While JEVP is open to narrative reviews, the journal prioritizes reviews that utilize meta-analytic techniques. The word limit for this submission type is 10,000 words.

3. **Brief empirical notes:** These submissions are often a brief report, or a commentary on an article, supported with data. The word limit is 3,000 words.

Replication notes: This submission type is for high-powered direct or close conceptual replication notes of either prior findings published in the journal, or important and major findings in the field of environmental psychology. The word limit is 3,000 words. **Note: Although not required, we encourage pre-registered replications.*

Registered Reports are submitted documents summarizing planned research questions and methodology that are peer reviewed prior to data collection. "High quality protocols are then provisionally accepted for publication if the authors follow through with the registered methodology" (quote from the Center for Open Science). For more information, click here. Authors interested in submitting a registered report should contact the editors.

Letters to the Editor: These are commentaries or short statements of thoughtful opinion that is meant to advance the field of environmental psychology and draw attention to a particular topic. The word limit is 1,000 words.

Please note that the word limit refers to the body of the manuscript and does not include references and other sections like figures and tables.

Please note that the word limit refers to the body of the manuscript and does not include references and other sections like figures and tables.

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This journal operates a double anonymized review process. All contributions will be initially assessed by the editor for suitability for the journal. Papers deemed suitable are then typically sent to a minimum of two independent expert reviewers to assess the scientific quality of the paper. The Editor is responsible for the final decision regarding acceptance or rejection of articles. The Editor's decision is final. Editors are not involved in decisions about papers which they have written themselves or have been written by family members or colleagues or which relate to products or services in which the editor has an interest. Any such submission is subject to all of the journal's usual procedures, with peer review handled independently of the relevant editor and their research groups. More information on types of peer review.

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Use of word processing software

Regardless of the file format of the original submission, at revision you must provide us with an editable file of the entire article. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the Guide to Publishing with Elsevier). See also the section on electronic artwork.

To avoid unnecessary errors, you are strongly advised to use the 'spell-check' and 'grammar-check' functions of your word processor.

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Divide your article into clearly defined and numbered sections. Subsections should be numbered.
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Introduction

State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

Material and methods

Provide sufficient details to allow the work to be reproduced by an independent researcher. Methods that are already published should be summarized and indicated by a reference. If quoting directly from a previously published method, use quotation marks and also cite the source. Any modifications to existing methods should also be described.

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A Theory section should extend, not repeat, the background to the article already dealt with in the Introduction and lay the foundation for further work. In contrast, a Calculation section represents a practical development from a theoretical basis.

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This should explore the significance of the results of the work, not repeat them. A combined Results and Discussion section is often appropriate. Avoid extensive citations and discussion of published literature.
Conclusions
The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a Discussion or Results and Discussion section.
Appendices
If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

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- ***Author names and affiliations.*** Please clearly indicate the given name(s) and family name(s) of each author and check that all names are accurately spelled. You can add your name between parentheses in your own script behind the English transliteration. Present the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lower- case superscript letter immediately after the author's name and in front of the appropriate address. Provide the full postal address of each affiliation, including the country name and, if available, the e-mail address of each author.
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Highlights are mandatory for this journal as they help increase the discoverability of your article via search engines. They consist of a short collection of bullet points that capture the novel results of your research as well as new methods that were used during the study (if any). Please have a look at the examples here: example Highlights.

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Abstract

A concise and factual abstract is required. The abstract should state briefly the purpose of the research, the principal results and major conclusions. An abstract is often presented separately from the article, so it must be able to stand alone. For this reason, References should be avoided, but if essential, then cite the author(s) and year(s). Also, non-standard or uncommon abbreviations should be avoided, but if essential they must be defined at their first mention in the abstract itself.

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Although a graphical abstract is optional, its use is encouraged as it draws more attention to the online article. The graphical abstract should summarize the contents of the article in a concise, pictorial form designed to capture the attention of a wide readership. Graphical abstracts should be submitted as a separate file in the online submission system. Image size: Please provide an image with a minimum of 531 × 1328 pixels (h × w) or proportionally more. The image should be readable at a size of 5 × 13 cm using a regular screen resolution of 96 dpi. Preferred file types: TIFF, EPS, PDF or MS Office files. You can view Example Graphical Abstracts on our information site.

Keywords

Immediately after the abstract, provide a maximum of 6 keywords, using British spelling and avoiding general and plural terms and multiple concepts (avoid, for example, 'and', 'of'). Be sparing with abbreviations: only abbreviations firmly established in the field may be eligible. These keywords will be used for indexing purposes.

Acknowledgements

Acknowledgements should be submitted in the title page of the submission. They should not be included in the main source file. List here those individuals who provided help during the research (e.g., providing language help, writing assistance or proofreading the article, etc.).

Formatting of funding sources

List funding sources in this standard way to facilitate compliance to funder's requirements:

Funding: This work was supported by the National Institutes of Health [grant numbers xxxx, yyyy]; the Bill & Melinda Gates Foundation, Seattle, WA [grant number zzzz]; and the United States Institutes of Peace [grant number aaaa].

It is not necessary to include detailed descriptions on the program or type of grants and awards. When funding is from a block grant or other resources available to a university, college, or other research institution, submit the name of the institute or organization that provided the funding.

If no funding has been provided for the research, it is recommended to include the following sentence:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Math formulae

Please submit math equations as editable text and not as images. Present simple formulae in line with normal text where possible and use the solidus (/) instead of a horizontal line for small fractional terms, e.g., X/Y. In principle, variables are to be presented in italics. Powers of e are often more conveniently denoted by exp. Number consecutively any equations that have to be displayed separately from the text (if referred to explicitly in the text).

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References

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Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full. Unpublished results and personal communications are not recommended in the reference list but may be mentioned in the text. If these references are included in the reference list, they should follow the standard reference style of the journal and should include a substitution of the publication date with either 'Unpublished results' or 'Personal communication'. Citation of a reference as 'in press' implies that the item has been accepted for publication.

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Examples:

Reference to a journal publication:

Van der Geer, J., Hanraads, J. A. J., & Lupton, R. A. (2010). The art of writing a scientific article. *Journal of Scientific Communications, 163*, 51–59. https://doi.org/10.1016/j.sc.2010.00372. Reference to a journal publication with an article number:

Van der Geer, J., Hanraads, J. A. J., & Lupton, R. A. (2018). The art of writing a scientific article. *Heliyon*, *19*, Article e00205. https://doi.org/10.1016/j.heliyon.2018.e00205. Reference to a book:

Strunk, W., Jr., & White, E. B. (2000). *The elements of style* (4th ed.). Longman (Chapter 4). Reference to a chapter in an edited book:

Mettam, G. R., & Adams, L. B. (2009). How to prepare an electronic version of your article. In B. S. Jones, & R. Z. Smith (Eds.), *Introduction to the electronic age* (pp. 281–304). E-Publishing Inc.

Reference to a website:

Powertech Systems. (2015). *Lithium-ion vs lead-acid cost analysis*. Retrieved from http://www.powertechsystems.eu/home/tech-corner/lithium-ion-vs-lead-acid-cost-analysis/. Accessed January 6, 2016

Reference to a dataset:

[dataset] Oguro, M., Imahiro, S., Saito, S., & Nakashizuka, T. (2015). *Mortality data for Japanese oak wilt disease and surrounding forest compositions*. Mendeley Data, v1. https://doi.org/10.17632/ xwj98nb39r.1.

Reference to a conference paper or poster presentation:

Engle, E.K., Cash, T.F., & Jarry, J.L. (2009, November). *The Body Image Behaviours Inventory-3: Development and validation of the Body Image Compulsive Actions and Body Image Avoidance Scales*. Poster session presentation at the meeting of the Association for Behavioural and Cognitive Therapies, New York, NY.

Reference to software:

Coon, E., Berndt, M., Jan, A., Svyatsky, D., Atchley, A., Kikinzon, E., Harp, D., Manzini, G., Shelef, E., Lipnikov, K., Garimella, R., Xu, C., Moulton, D., Karra, S., Painter, S., Jafarov, E., & Molins, S. (2020, March 25). *Advanced Terrestrial Simulator (ATS) v0.88 (Version 0.88)*. Zenodo. https:// doi.org/10.5281/zenodo.3727209.

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Bibliographical references should be cited in the text by giving the last name of the author (or authors) followed by the year of publication in parentheses, e.g., Gray (1998). Gray and Regan (1998) or (Gray & Regan, 1998). If there are three or more authors, citations should read Brandstatter, Koulen, and Wassle (1997), first citation; Brandstatter et al. (1997), second citation. If there is more than one work by an author (or authors) in a given year, then they should be labelled alphabetically within each year (e.g. Gray, 1998a, b).

The full references should be typed on a separate page and placed at the end of the article. They should not be given as footnotes. References should include the names of all the authors and their initials, the year of publication, the full title of the article or book, name of the journal, the volume number and the pages. For books, the city of publication and the publisher should be given.

The following may serve as illustrations:

Cronkite, R. W. (1976). *Weather and personality*. Maidenhead: McGraw-Hill.

Sellars, N. (1978). Laughter and room colour: Effects of context on humour. *Journal of Environmental Psychology*, 51, 259-270.

Canter, D. (1983). Intention, meaning and structure: Social action in its physical context. In M. von Cranach, G. P. Ginsburg and M. Brenner (Eds.), *Discovery strategies in the psychology of social action* (pp. 1-34). New York: Academic Press.

Pedersen, D. M. (1999). Model for types of privacy-by-privacy functions. *Journal of Environmental Psychology*, 19, 397-406, https://doi.org/10.10.1006/jevp.1999.0140.

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Appendix B: NHS Ethical Approval

Carseview House
Castle Business Park
Stirling
FK9 4SW

Telephone:
Fax:

Miss Leona Cunningham Trainee Clinical Psychologist NHS Forth Valley
Falkirk Community Hospital
Administration Offices Westburn Avenue
Falkirk FK1 5SU

Date	17th March 2022
Your Ref	
R&D Ref	FV1365
Enquiries to	Fv.randd-depart@nhs.scot
Extension	
Direct Line:	

Dear Miss Cunningham,

Study title: Nature-based intervention for healthcare staff
V1 REC reference: N/A

Following the Organisation Information Document site agreement authorised by myself on 17th March 2022, I am pleased to confirm that I formally gave Management Approval to the study above on 17th March 2022.

This approval is granted subject to your compliance with the following:

1. Any amendments to the protocol or research team must have Ethics Committee (where required) and R&D approval (as well as approval from any other relevant regulatory organisation) before they can be implemented. Please ensure that the R&D Office and (where appropriate) NRS-PCC are informed of any amendments as soon as you become aware of them.

2. You and any local Principal Investigator are responsible for ensuring that all members of the research team have the appropriate experience and training, including GCP training if required.

3. If someone working within NHS Forth Valley is recruiting participants, those figures MUST be recorded on the EDGE research management system. If recruitment is all being handled outside Forth Valley, you will be contacted monthly for the latest recruitment figures.

4. All study activity must also be recorded on EDGE, to ensure that we receive the appropriate funding for each study.

All relevant study staff should have been added to EDGE by the R&D Office and received a New Users Guide and Researchers' Guide. Please follow the instructions in these documents to record the required information.

5. All those involved in the project will be required to work within accepted guidelines of health and safety and data protection principles, any other relevant statutory legislation, UK Policy Framework for Health and Social Care Research and IHC-GCP guidelines. A copy of the Framework can be accessed at: http://www.nhsresearchscotland.org.uk/uploads/tinymce/uk-policy-framework-health-social-care- research%20v1.1.pdf
and ICH-GCP guidelines may be found at http://www.ich.org/LOB/media/MEDIA482.pdf

6. As custodian of the information collected during this project you are responsible for ensuring the security

   of all personal information collected in line with NHS Scotland IT security policies, until the destruction of this data.

7. You or the local Principal Investigator will be required to provide the following reports and information during the course of your study:

   - Copies of any sponsor monitoring reports (the R&D Office may request further information after each report) OR Quality Check information requested by the R&D office either annually or 6- monthly.
   - Report on SAEs and SUSARs if your study is a Clinical Trial of an Investigational Medicinal Product
   - Any information required for the purpose of internal or external audit and monitoring.
   - Notification of the end of recruitment and the end of the study
   - A copy of the final report, when available.
   - Copies of or full citations for any publications or abstracts

The appropriate forms will be provided to you by the Research and Development office when they are needed. Other information may be required from time to time.

Yours sincerely,

MR. ANDREW MURRAY

Medical Director

CC:

Appendix C: University Ethical Approval

School of Health in Social Science Research Ethics Application

The supervisor or primary investigator must complete and sign this form after checking that all relevant sections are completed, and relevant documents are attached. For all undergraduate (UG) and MSc student projects, it is the supervisor's responsibility to submit this form and all attachments. Please note that failure to do this will result in the application being returned (and not processed) causing your research to be delayed.

Supervisor (name and UUN: Dr. Paul Graham Morris	
Primary Investigator (name and UUN): Leona Cunningham s1253870	
List of all collaborators (with affiliated institutions in brackets): Dr Edel McGlanaghy	
Student's programme of study (if applicable): Doctorate in Clinical Psychology	
Project Title: The effects of a nature – based intervention for healthcare staff in Scotland: A randomised controlled trial	
Case Number (if known – assigned by Administrator at time of 1st submission):	
Proposed Project Start Date: 1/06/2022	**Proposed Project End Date: 02/08/2022**

To be completed by primary investigator or project supervisor
By signing this front sheet, I confirm that I have prepared and/or reviewed this ethics application and related documents in accordance with ethical guidelines. I also confirm I have checked that all relevant sections of the application form are completed, and relevant documents are attached. **Supervisor or/PI Signature: Leona Cunningham** **Student signature: Leona Cunningham** **Date: 13/07/2021**

CONCLUSION TO ETHICAL REVIEW OF AMENDMENT – <u>to be completed by Ethics Lead</u>
The requested amendment satisfies the requirements for ethical practice, and it has therefore received a favourable opinion. **Signature:** Ingrid Obsuth **(sig)** **Position: Ethics & Integrity Lead** **Date: 13 July 2022**

Appendix D: Study Documentation

PARTICIPANT INFORMATION

You are being invited to take part in because you are a healthcare worker who works in one of the following sites:

Forth Valley Royal Hospital
Lochview and the Bungalows
Falkirk Community Hospital
Stirling Health and Care Village
Clackmannanshire Community Healthcare Centre
Bo'ness Community Hospital
Bellsdyke Hospital

The study is being conducted to establish whether a nature – based/walking intervention would be useful for improving outcomes for healthcare staff. Leona Cunningham (Clinical Psychology Doctoral Student) at the University of Edinburgh is leading this research.

Before you decide whether to take part it is important you understand why the research is being conducted and what it will involve. Please take time to read the following information carefully and take a screen shot of the information for future reference.

WHAT WILL HAPPEN IF I DECIDE TO TAKE PART?

You will be asked whether you meet criteria, and you will be asked to complete a consent form.

You will enter your email address and complete some questionnaires about your demographics, mental health, burnout levels and sleep quality (5 – 20 minutes).

You will enter then enter site you work in and be randomised into one of two groups. Instructions will be given to you to walk for 10 minutes, twice a week, for 4 consecutive weeks. Walking routes will be described, and maps provided.

After the 4 weeks, you will be sent an email asking you to follow a link to complete similar questions.

POSSIBLE BENEFITS/RISKS

By participating, you will be helping us to better understand the effects of this type of intervention on healthcare's staff mental health and wellbeing.

By being asked personal information about your mental health, levels of burnout or quality of sleep may make you feel upset. The time you are being asked to participate in the study may also be viewed as a disadvantage.

CONFIDENTIALITY/INFORMATION HANDLING

We will keep all information confidential and secure and adhere to the laws which safeguard your privacy. We will not use any additional information about you apart from the information collected as part of the study.

Your email address will be collected only for the purpose of sending out the link to complete the second set of questions. Your email address and participant ID will be stored in an encrypted file on the University server and a separate file will store the raw data and participant ID. Your email address will never be stored with the raw data and will be deleted as soon as the second survey is completed.

Once we have finished the study, we will keep some of the data so we can check the results. We will write our reports in a way that no-one can work out that you took part in the study. The results of this study may be published but you will not be identifiable from any published results. You won't be able to see or change the data we hold about you. Find out more about this at https://www.ed.ac.uk/records-management/privacy-notice-research or by emailing dpo@ed.ac.uk.

You can withdraw from the study by clicking the withdraw button at any point on both surveys. If you do not want to be sent the second survey, please email the lead researcher to request this (details below). You will not be able to withdraw once the data is fully anonymised (approximately September 2022).

The School of Health in Social Science Ethics Committee at The University of Edinburgh and NHS management have ethically approved this study.
The University of Edinburgh is the sponsor for this study, and they will act as the data controller. This means that we are responsible for looking after your information and using it properly. They will keep the anonymised data for a minimum of 10 years. Your anonymised data may be used in future ethically approved research.

A summary of the findings from the study will be made available to participants on a wiki page that can be accessed by anyone who is interested from approximately December 2022 by following this link: https://www.wiki.ed.ac.uk/x/IEe9Hg

Non-CTIMP Study Protocol

	The University of Edinburgh College of Arts, Humanities and Social Sciences 55 George Square Edinburgh EH8 9JU
Protocol authors	Leona Cunningham
Chief Investigator	Leona Cunningham (Doctoral Candidate: Clinical Psychology)
Sponsor number	CAHSS2110/01
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LIST OF ABBREVIATIONS

ACCORD	Academic and Clinical Central Office for Research & Development - Joint office for The University of Edinburgh and Lothian Health Board
CI	Chief Investigator
CRF	Case Report Form
GCP	Good Clinical Practice
ICH	International Conference on Harmonisation
PI	Principal Investigator
QA	Quality Assurance
REC	Research Ethics Committee
SOP	Standard Operating Procedure
NBI	Nature – based intervention

Introduction

Background

Mental Health and Wellbeing of Healthcare Staff

Depression, anxiety, and stress

Although the mental health of healthcare workers has long been considered within psychological literature, earlier studies into this area were criticized for not using reliable and valid measures or for discounting certain healthcare professions (Caplan, 1994). As more credible research emerged, it became evident that levels of depression, anxiety and stress were higher than expected in this population. Caplan (1994) conducted a study in the UK on 65 hospital consultants, 257 general practitioners and 67 senior and middle managers which revealed that 47% of the sample displayed high levels of stress. This study also found that only 46% of the sample were not experiencing anxiety, and 27% of general practitioners were displaying symptoms suggesting that they were either borderline or likely to be depressed (Caplan, 1994). Findings such as these raised questions about the nature and extent of mental health difficulties amongst healthcare staff.

Burnout

Burnout is considered as being the opposite of wellbeing and is defined as the behavioural and emotional responses to occupational stress (Maslach et al, 2001). Most of the early research into burnout defines the symptoms as being depersonalisation (also known as cynicism), reduced professional efficacy and emotional exhaustion (Maslach et al, 2001). Emotional exhaustion refers to the depletion of emotional resources, depersonalisation refers to a detached approach to recipients and personal efficacy is the positive evaluation of one's work with recipients (Salanova et al, 2005). Maslach's original conceptualisation of burnout has been challenged by writers over the years. For example, Salanova et al (2005) argued that depersonalisation and cynicism should be collapsed into separate categories as they play a different role for individuals. Furthermore, the Maslach's measures have been criticised for only including negatively worded items. In response to this, The Oldenburg Burnout Inventory was constructed and includes positively and negatively framed items to assess the two core dimensions of burnout, exhaustion and disengagement from work.

Research has provided evidence that there exists a strong relationship between burnout and mental health issues, substance misuse problems, suicidal ideation, type 2 diabetes, coronary heart disease and musculoskeletal pain (Salvagoni et al, 2017). Rates of burnout amongst healthcare staff are concerning. Aitken et al (2012) conducted a survey of 61, 168 nurses across 12 counties which revealed that a quarter or more of the nursing workforce were displaying symptoms of burnout in 9 of the countries in the study. In the USA, a survey of 6880 physicians showed that burnout rates increased from 46% to 54% from 2011 to 2014 (Shanafelt et al, 2016). However, the findings of both of these studies are somewhat limited due to their reliability on cross – sectional data, which cannot definitively establish causality.

Poor sleep quality

Sleep provides a restorative function for the human brain and body (Vandekerckhove & Cluydts, 2010). Both sleep quality and quantity affect an individual's ability to cope with emotional demands, especially when they are required to deal with particularly painful events (Vandekerckhove & Cluydts, 2010). In a recent meta – analysis of 52 studies and 31,749 by Qiu et al (2020), the pooled prevalence rates of sleep disturbances amongst Chinese healthcare professionals were found to be 39.2%. Another recent meta – analysis by Zeng et al (2020) examined 53 studies of Chinese nursing staff and found that the pooled prevalence of poor sleep quality was 61%. These prevalence rates are much higher than the ones found in the general population (Qiu et al, 2020). However, more prospective studies would be helpful to support the findings of these meta -analytic studies as they only rely on aggregated published data.

Studies suggest that healthcare workers experience high levels of stress and are more likely to work irregular shift patterns, which could explain the higher levels of poor sleep quality in this population (Ferri et al, 2016; Jahrami et al, 2020). Poor sleep quality has been related to negative mental health outcomes including anxiety and depression (Brubaker et al, 2020). Using a prospective design, Soderstrom et al (2012) found evidence that a relationship exists

between poor sleep quality and clinical levels of burnout, which adds more credibility to similar findings of earlier cross – sectional studies into this area (Melamed et al, 1999; Grossi et al, 2003).

COVID-19 and Healthcare Professionals

The COVID-19 pandemic has become the most significant health crisis of the present day (Rothan & Byrareddy, 2020). Healthcare professionals are one of the major groups affected by the pandemic. They have been required to continue to care for patients making profound ethical and moral decisions whilst risking exposure to the virus for themselves and their families. Research is emerging showing increasingly concerning rates of depression, anxiety, and stress, burnout and poor sleep quality amongst this population as the pandemic has progressed (Chew et al, 2020; Yang et al, 2021; Tsan et al, 2020; Jahrami et al, 2020).

Promoting Positive Mental Health and Wellbeing for Healthcare Workers

The mental health of healthcare professionals affects their decision-making abilities, long term well – being and the quality-of-service delivery (Xiang et al, 2020). Many researchers argue that working environments are a crucial context for promoting positive mental health and well – being and the field of occupation health psychology is trending more towards what can foster positive mental health and well – being amongst employees (Avey et al, 2010; Sanderson & Andrews, 2006).

Nature – Based Interventions (NBIs)

NBIs involve individuals interacting with natural or virtual nature for the purpose of improving aspects of functioning, health and wellbeing and evidence base for their effectiveness is growing (Gritza et al, 2020). A widely accepted definition of NBIs has yet to be proposed within the literature, with certain terms being used interchangeably, including nature – assisted intervention, green care, nature – based therapeutic interventions and ecotherapy (Gritza et al, 2020).

The theoretical underpinnings for NBIs are derived from two main theories: The Attention Restoration Theory (ART) and the Stress Reduction Theory (SRT). ART posits that natural environments and objects enable a process of cognitive restoration, which leads to higher levels of positive emotions and lower levels of stress and arousal (Kaplan, 1995). Considering the context of the working environment and ART, The Job – Demands Resource Model asserts that individuals can draw on personal resources to reduce the negative effects of adverse job demands (Bakker & Demerouti, 2016). These personal resources can be effectively restored by engaging in certain activities that promote relaxation and psychological detachment (Sonnentag et al, 2007).

According to SRT, exposure to nature has a restorative effect on both eudaimonic and hedonic well – being due to it reducing psychophysiological stress responses (Ulrich et al, 1991). Evolutionary perspectives assert that nature exposure increases positive affect due to natural environments being associated with access to water and vegetation, which equates to survival for our species (Gritza et al, 2020). Positive affect then influence stress responses and prepares the organism to engage in adaptive behaviours, which is particularly important when doing things that regularly activate stress responses, such as working in a demanding job (Meidenbauer et al, 2020). Hence, NBIs can activate the psychological detachment and relaxation required for attention restoration and stress reduction which can in turn foster more positive mental health and wellbeing.

Green Exercise

Green exercise is physical activity in a natural environment and is considered as being a type of NBI. Earlier studies have provided evidence to suggest that physical activity in natural environments is associated with reduced risk of poor mental health outcomes (Mitchell, 2013; Coon et al, 2011). However, studies into this area have been criticised for failing to provide information on the quantity, duration, and form of physical activity. A more recent systematic review by Gritza et al (2020) identified five intervention studies which have investigated the effects of green exercise on employee mental health and wellbeing (Brown et al, 2014; Bang et al, 2016; Calogiuri et al, 2016; de

Bloom et al, 2017; Sianoja et al, 2018). These studies provided evidence that participants within the green exercise groups scored higher in quality of life, positive affect, mean mental health scores, concentration and restoration when compared with control groups. They also scored lower in levels of afternoon strain and fatigue (Brown et al, 2014; Bang et al, 2016; Calogiuri et al, 2016; de Bloom et al, 2017; Sianoja et al, 2018). Hence, the evidence in support of green exercise positively effecting the mental health and wellbeing outcomes of workers is promising. Nevertheless, Gritza et al (2020) noted substantial differences between control group and experimental group conditions in some of these studies alongside low adherence rates, which are significant limitations. Additionally, all five of the green exercise intervention studies were assessed as being at high risk of bias (Gritza et al, 2020). Hence, although there is evidence to support the connection between green exercise and improved mental health outcomes for workers, more robust research into the area is needed. It should also be highlighted that none of the studies included only healthcare staff in their sample, presenting a significant gap in the literature.

Rationale for Study

The primary research questions are:

1) Do healthcare staff who participate in an NBI (walking in nature) experience decreases in levels of stress when compared with an active control group (walking in an urban environment)?
2) Do healthcare staff who participate in an NBI (walking in nature) experience decreases in levels of burnout when compared with an active control group (walking in an urban environment)?

The secondary research questions are:

1) Do healthcare staff who participate in an NBI (walking in nature) experience decreases in levels of anxiety when compared with an active control group (walking in an urban environment)?
2) Do healthcare staff who participate in an NBI (walking in nature) experience decreases in levels of depression when compared with an active control group (walking in an urban environment)?
3) Do healthcare staff who participate in an NBI (walking in nature) experience improvements in sleep quality when compared with an active control group (walking in an urban environment)?
4) Do healthcare staff who spend more time in nature score lower in levels of burnout/stress/anxiety/depression and higher in levels of sleep quality?

The primary hypotheses are:

1) H1: Participants in the NWG will show lower levels of stress following intervention when compared with participants in the UWG.
2) H2: Participants in the NWG will show lower levels of burnout following intervention when compared with participants in the UWG.

The secondary hypotheses are:

3) H3: Participants in the NWG will show improvements in anxiety levels when compared with participants in the UWG.
4) H4: Participants in the NWG will show improvements in depression levels when compared with participants in the UWG.
5) H5: Participants in the NWG will show improvements in sleep quality when compared with participants in the UWG.
6) H7: Participants who spend more time in nature score lower in levels of burnout/stress/depression/anxiety and higher in sleep quality.

Potential Study Benefits

Improved mental health and well – being of NHS employees/ Prevention of Staff Sickness

NBIs have been shown to increase the mental health and well – being of participants. The intervention included in this study would be designed to improve the mental health and well – being of NHS employees.

Staff shortages due to sickness is costly for the NHS and adds pressure to an already overwhelmed healthcare system. Data from NHS Digital revealed that from December 2014 to November 2015, 17% of absence days for UK trust doctors and 26% for mental health doctors were due to depression, anxiety stress or other psychiatric illnesses (NHS Digital, 2017). Studies have also demonstrated a link between higher burnout levels, poor sleep quality and greater sickness rates (Shaufeli et al, 2009; Sagherian et al, 2017). Hence, intervention in this study could improve these symptoms for healthcare staff, reducing staff shortages due to sickness absence and protecting the NHS from becoming more overwhelmed.

Improved Patient Safety and Satisfaction

Ensuring the well – being of healthcare staff is essential and prioritising this can also positively affect patient's safety and satisfaction (Hall et al, 2016). Research has shown that stress and burnout amongst healthcare professionals has led to compromised patient safety and satisfaction as well as reduced quality of care and professionalism (Panagioti et al, 2018). Hence, by using an NBI to improve mental health and well – being for healthcare workers, this could positively affect patient safety and satisfaction.

Relevance to Current Policies

The Scottish Governments Mental Health Strategy 2017-2027 is committed to working with employers on how they can protect and improve mental health and well – being of workers as well as how to respond to staff experiencing mental health issues.

Due to the impact of the COVID-19 pandemic on healthcare staff, the Scottish government announced £500, 000 of funding in January 2021 towards supporting the mental health and well – being of healthcare staff in Scotland. Further services such as the Well – Being Hub have been launched ensuring accessible support to Scottish healthcare staff.

This study is relevant to current policies as it is investigating cost effective ways of supporting healthcare staff with their mental health and wellbeing in Scotland.

Study Objectives

The primary objective of the study is to investigate the effects of a nature – based intervention on healthcare worker's stress and burnout levels.

The secondary objective of the study is to investigate the effects of a nature – based intervention on healthcare worker's anxiety, depression, emotional exhaustion and sleep quality. It is also to investigate whether time in nature is related to lower levels of burnout/stress/depression/anxiety and higher levels of sleep quality.

STUDY DESIGN

This study will be a randomised controlled trial. The intervention will take 4 weeks and the participants will be involved for an additional 2 weeks as data will be collected a week before and a week after participating in the study. NHS staff who work in the following hospital sites in Forth Valley Health Board will be invited to participate:

Forth Valley Royal Hospital (including Lochview and the Bungalows), Falkirk Community Hospital, Stirling Health and Care Village, Clackmannanshire Community Healthcare Centre, Bo'ness Hospital, Bellsdyke Hospital.

Study Population

102 participants would be required for this study. Recruitment would begin once ethical approval and NHS management approval has been gained and will start approximately 2 months prior to the study commencing. Participants will be healthcare staff working in the sites mentioned in section 2.

Inclusion Criteria

NHS staff:

- Who work in the following hospital sites in Forth Valley Health Board:

Forth Valley Royal Hospital (including Lochview and the Bungalows), Falkirk Community Hospital, Stirling Health and Care Village, Clackmannanshire Community Healthcare Centre, Bo'ness Hospital, Bellsdyke Hospital.

- Are able to complete speak and read English.
- Able to complete study questionnaires.
- Age 18 or over

Exclusion Criteria

- Individuals with a cognitive deficit or diagnosis that would limit ability to understand procedures.
- Individuals unable to give informed consent.

Participant Selection and Enrolment

The chief investigator will identify participants by advertising the study at the NHS sites via posters. The posters will ask potential participants to contact them for more information. Additionally, emails will be sent through forth valley mailing lists including the same advert as the poster and the study poster will be advertised on forth valley intranet.

Participants will have up to a week to consider the information sheet before consenting. If they decide to take part, they will be asked to complete an online consent form.

Participants are free to withdraw from the study at any point or a participant can be withdrawn by the Investigator. If withdrawal occurs, the primary reason for withdrawal will be documented in the participant's case report form, if possible. The participant will have the option of withdrawal from:

(i) all aspects of the trial but continued use of data collected up to that point. To safeguard rights, the minimum personally identifiable information possible will be collected.

STUDY ASSESSMENTS

Assessment	Screening	Pre Intervention (1/2 week prior to participation)	Post Intervention(up to one week/2 weeks after participation)
Assessment of Eligibility Criteria	□		
Written informed consent	□		
Demographic data, contact details	□		
Depression, Anxiety and Stress Scale (DASS-21)		□	□
Single Item Sleep Quality Measure		□	□

The Oldenburg Burnout Inventory		□	□
Additional pre question (how much time do you spend in nature?) See document "Demographics and additional pre questions"		□	
Additional post questions (did you complete the walks? Did you complete the walks on your own?) See document "Post Intervention Questions"			□

Data Collection
Participants will be asked to input their email address at the beginning of Survey 1.
A participant ID will be generated for each participant when they enter their email address.
The researcher will then export the data from this survey into a secure file on the university server – at this stage the researcher will manually separate their email address from the raw data into 2 separate files –1 file will have the raw data and anonymised participant ID and the other file will have email addresses, participant ID and date of Survey 1 completion. The email addresses will be deleted from the Qualtrics data file as soon as these separate files have been set up.

The researcher will keep the email addresses in the separate encrypted secure file and use this to then send out Survey 2 for the post intervention data.

In Survey 2, participants will re – enter their email address and complete the survey. Once again the researcher will then export this information and will immediately replace the email addresses with the participant numbers, allowing them to match up the pre and post data and delete the email addresses as they will not longer be needed.

The following standardised tools will be used:

The Depression, Anxiety and Stress Scale (DASS-21)

The Oldenburg Burnout Inventory (OBI)

Single Item Sleep Quality Measure

Source Data Documentation

All questionnaires will be completed online using JISC Qualtrics and this is where the source documents will be stored.

Data Management

The demographic questionnaire will include information about age, gender, number of weekly working hours, occupation and number of hours spent in nature per week.

Email addresses will only be used for the purpose of sending out the link for the second survey. They will be stored on an encrypted file on secure University servers alongside the participant ID. They will never be stored with raw data and will be deleted as soon as the second survey has been completed.

Personal data will be collected approximately 2 weeks prior to participating in the study and will be stored during the study (4 weeks) and then 1 year after the study is completed.

Data collected or generated by the study (including personal data) will not be transferred to any external individuals or organisations outside of the Sponsoring organisation(s).

A data controller is an organisation that determines the purposes for which, and the manner in which, any personal data are processed.

The University of Edinburgh and NHS Forth Valley are joint data controllers along with any other entities involved in delivering the study that may be a data controller in accordance with applicable laws (e.g., the site)

Any data breaches will be reported to the University of Edinburgh and NHS Forth Valley Data Protection Officers who will onward report to the relevant authority according to the appropriate timelines if required.

STATISTICS AND DATA ANALYSIS

The trainee chose Cohen's f=0.25, as this is considered as being a moderate effect size (Cohen, 2013) and MANOVA as this was the most appropriate statistical analyses. Relevant information was inputted to G*Power 3 programme to calculate the sample size required for the study (Faul et al, 2007).

Power = 0.8
Number of measurements = 2
Number of groups = 2

The programme indicated that a sample of 73 participants would be required for this study. The trainee considered that some participants may not comply with the study protocol or drop – out and also some data might be unusable. Brown et al (2014) discussed that a 40% drop out rate may have been more appropriate for their sample size calculations due to lack of adherence and higher attrition rates than expected. Hence, by estimating a 40% drop out rate the trainee calculated that n = 102 would be an appropriate sample size for the proposed study (51 participants per group).

Proposed Analysis

Means, standard deviations and medians for both groups will be reported.

Data will be inputted into SPSS after being collected. The trainee will perform repeated measures, within – between interaction Multivariate Analysis of Variance. This type of analysis can be used to compare the pre and post means of each of the measures within each of the groups. It can also be used to compare the pre and post measures of the experimental group with the pre and post measures of the control group.

OVERSIGHTS ARRANGEMENTS

1 INSPECTION OF RECORDS

Investigators and institutions involved in the study will permit trial related monitoring and audits on behalf of the sponsor, REC review, and regulatory inspection(s). In the event of audit or monitoring, the Investigator agrees to allow the representatives of the sponsor direct access to all study records and source documentation. In the event of regulatory inspection, the Investigator agrees to allow inspectors direct access to all study records and source documentation.

2 STUDY MONITORING AND AUDIT

The ACCORD Sponsor Representative will assess the study to determine if an independent risk assessment is required. If required, the independent risk assessment will be carried out by the ACCORD Quality Assurance Group to determine if an audit should be performed before/during/after the study and, if so, at what frequency.

Risk assessment, if required, will determine if audit by the ACCORD QA group is required. Should audit be required, details will be captured in an audit plan. Audit of Investigator sites, study management activities and study collaborative units, facilities and 3rd parties may be performed.

Risks

Inconvenience of completing the questionnaires - this has been minimised by choosing questionnaires which are quick to administer and easy to understand.

Inconvenience of completing the walks - this has been minimised by choosing short walks which would be achievable within break times of the participants working day.

Burden of time spent on study - this has been minimised by ensuring walks can be completed but still enough time for additional break during working hours.

Risk of participants becoming upset as they will be asked about mental health - this will be minimised by ensuring a disclaimer is included in participant information sheet.

GOOD CLINICAL PRACTICE

ETHICAL CONDUCT

The study will be conducted in accordance with the principles of the International Conference on Harmonisation Tripartite Guideline for Good Clinical Practice (ICH GCP).

Before the study can commence, all required approvals will be obtained and any conditions of approvals will be met.

3 INVESTIGATOR RESPONSIBILITIES

The Investigator is responsible for the overall conduct of the study at the site and compliance with the protocol and any protocol amendments. In accordance with the principles of ICH GCP, the following areas listed in this section are also the responsibility of the Investigator. Responsibilities may be delegated to an appropriate member of study site staff.

4 Informed Consent

The Investigator will be responsible for ensuring informed consent is obtained before any protocol specific procedures are carried out. The decision of a participant to participate in the study is voluntary and will be based on a clear understanding of what is involved. Qualtrics will not let participants proceed in the study unless informed consent is obtained.

Participants will receive adequate oral and written information – appropriate Participant Information and Informed Consent Forms will be provided. The oral explanation to the participant will be performed by the Investigator and will cover the elements specified in the Participant Information Sheet and Consent Form.

The participant will be given every opportunity to clarify any points they do not understand and, if necessary, ask for more information. The participant will be given sufficient time to consider the information provided. It will be emphasized that the participant may withdraw their consent to participate at any time without loss of benefits to which they otherwise would be entitled.

The Investigator or delegated member of the trial team and the participant will sign and date the Informed Consent Form(s) to confirm that consent has been obtained. The participant will receive a copy of this document and a copy filed in the Investigator Site File (ISF).

5 Study Site Staff

The Investigator will be familiar with the protocol and the study requirements. It will be the Investigator's responsibility to ensure that all staff assisting with the study are adequately informed about the protocol and their trial related duties.

6 Data Recording

The Principal Investigator is responsible for the quality of the data recorded in the CRF at each Investigator Site.

7 Investigator Documentation

- The Principal Investigator will ensure that the required documentation is available in local Investigator Site files ISFs.

8 GCP Training

For non-CTIMP (i.e., non-drug) studies all researchers are encouraged to undertake GCP training in order to understand the principles of GCP. However, this is not a mandatory requirement unless deemed so by the sponsor. GCP training status for all investigators should be indicated in their respective CVs.

9 Confidentiality

All records will be identified in a manner designed to maintain participant confidentiality. All records will be kept in a secure storage area with limited access. Clinical information will not be released without the written permission of the participant. The Investigator and study site staff involved with this study will not disclose or use for any purpose

other than performance of the study, any data, record, or other unpublished information, which is confidential or identifiable, and has been disclosed to those individuals for the purpose of the study. Prior written agreement from the sponsor or its designee will be obtained for the disclosure of any said confidential information to other parties.

10 Data Protection

All Investigators and study site staff involved with this study will comply with the requirements of the appropriate data protection legislation (including the General Data Protection Regulation and Data Protection Act) with regards to the collection, storage, processing, and disclosure of personal information.

Computers used to collate the data will have limited access measures via usernames and passwords.

Published results will not contain any personal data and be of a form where individuals are not identified, and re-identification is not likely to take place.

STUDY CONDUCT RESPONSIBILITIES

11 PROTOCOL AMENDMENTS

Any changes in research activity, except those necessary to remove an apparent, immediate hazard to the participant in the case of an urgent safety measure, will be reviewed and approved by the Chief Investigator.

Amendments will be submitted to a sponsor representative for review and authorization before being submitted in writing to the appropriate REC, and local R&D for approval prior to participants being enrolled into an amended protocol.

12 MANAGEMENT OF PROTOCOL NON-COMPLIANCE

Prospective protocol deviations, i.e., protocol waivers, will not be approved by the sponsors and therefore will not be implemented, except where necessary to eliminate an immediate hazard to study participants. If this necessitates a subsequent protocol amendment, this will be submitted to the REC, and local R&D for review and approval if appropriate.

Protocol deviations will be recorded in a protocol deviation log and logs will be submitted to the sponsors every 3 months. Each protocol violation will be reported to the sponsor within 3 days of becoming aware of the violation. All protocol deviation logs, and violation forms should be emailed to QA@accord.scot

Deviations and violations are non-compliance events discovered after the event has occurred. Deviation logs will be maintained for each site in multi-center studies. An alternative frequency of deviation log submission to the sponsors will be agreed in writing with the sponsors.

13 SERIOUS BREACH REQUIREMENTS

A serious breach is a breach which is likely to effect to a significant degree:

(a) the safety or physical or mental integrity of the participants of the trial; or

(b) the scientific value of the trial.

If a potential serious breach is identified by the Chief investigator, Principal Investigator or delegates, the co-sponsors (seriousbreach@accord.scot) will be notified within 24 hours. It is the responsibility of the co-sponsors to assess the impact of the breach on the scientific value of the trial, to determine whether the incident constitutes a serious breach and report to research ethics committees as necessary.

14 STUDY RECORD RETENTION

All study documentation will be kept for a minimum of 3 years from the protocol defined end of study point. When the minimum retention period has elapsed, study documentation will not be destroyed without permission from the sponsor.

15 END OF STUDY

The end of study is defined as the last participant's last visit.

The Investigators or the sponsor have the right at any time to terminate the study for clinical or administrative reasons.

The end of the study will be reported to the REC, and R+D Office(s) and sponsor within 90 days, or 15 days if the study is terminated prematurely. The Investigators will inform participants of the premature study closure and ensure that the appropriate follow up is arranged for all participants involved. End of study notification will be reported to the co-sponsors via email to resgov@accord.scot

A summary report of the study will be provided to the REC within 1 year of the end of the study.

16 INSURANCE AND INDEMNITY

The sponsor is responsible for ensuring proper provision has been made for insurance or indemnity to cover their liability and the liability of the Chief Investigator and staff.

The following arrangements are in place to fulfil the sponsors' responsibilities:

- The Protocol has been designed by the Chief Investigator and researchers employed by the University and collaborators. The University has insurance in place (which includes no-fault compensation) for negligent harm caused by poor protocol design by the Chief Investigator and researchers employed by the University.
- Sites participating in the study will be liable for clinical negligence and other negligent harm to individuals taking part in the study and covered by the duty of care owed to them by the sites concerned. The co-sponsors require individual sites participating in the study to arrange for their own insurance or indemnity in respect of these liabilities.
- Sites which are part of the United Kingdom's National Health Service will have the benefit of NHS Indemnity.
- Sites out with the United Kingdom will be responsible for arranging their own indemnity or insurance for their participation in the study, as well as for compliance with local law applicable to their participation in the study.

17 REPORTING, PUBLICATIONS AND NOTIFICATION OF RESULTS

18 AUTHORSHIP POLICY

Ownership of the data arising from this study resides with the study team.

19 REFERENCES

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Appendix E: Example Walk Instructions

Instructions

Please read the following instructions carefully:

Follow the walk description and map provided. Walk the following route at a normal pace for **twice a week for the next 4 weeks.** This will be **8 walks in total**. Each walk will take approximately **10 minutes.**

To take part in the study, you must complete the walks during your working day. You can choose to walk alone or with other people. You can also choose what days you would like to complete your walks and may wish to plan these days in advance considering weather conditions and work commitments for the week ahead. Consider taking suitable footwear and clothing to work for the walks.

Walk Description

1) Begin the walk by facing away from the entrance to Russell Park and walking forward on the path.
2) Turn right on the path and follow this straight until you can turn right again.
3) Keep following the path as it curves right past the bench and salt container.
4) Once you get to the grey lamppost, turn around and walk back to the entrance of Russell Park following the exact same route that you came.

Map

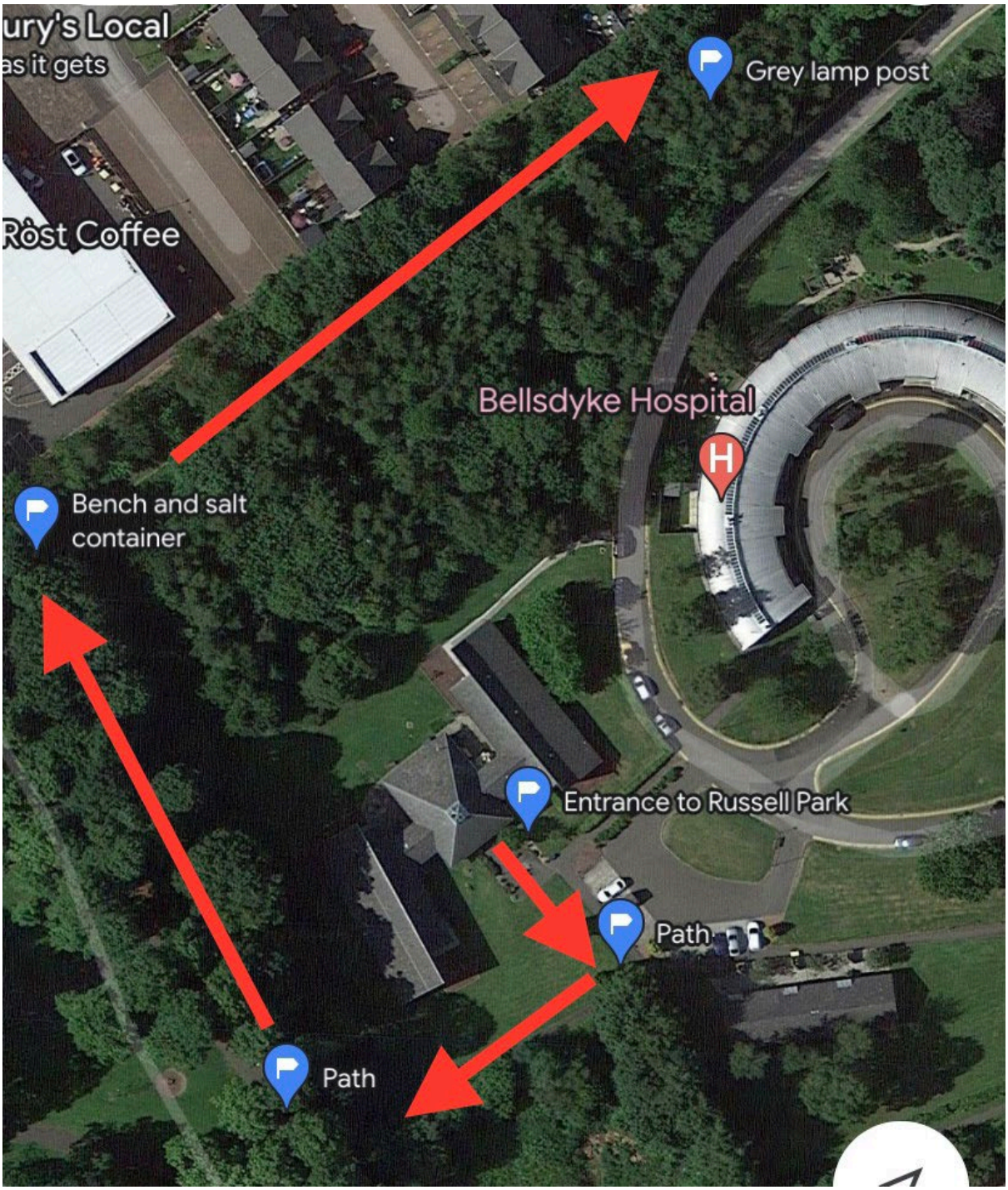
Map Key:
Red arrows = route
Blue flags = landmarks (e.g., "bench and salt container").

Please scroll down to view the map of the walk.

Please take a screen shot of the instructions, walk description and map if you are using your phone.

If you are using a laptop or computer, you use your phone to take a picture of the information on the screen. Alternatively, you can screenshot by pressing the Windows Key + Prt Sc buttons together on your keyboard and it will be saved under documents – pictures - screenshots.

If you have any questions about your walk or if you would like a printable copy of the information sent to you, please call or email Leona Cunningham on 07929730056 or leona.cunningham2@nhs.scot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