Growing Resilience through Interaction with Nature (GRIN): The well-being benefits of outdoor group walks

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Abstract

Well-being is fundamental for health. However, health and well-being are under threat by increased prevalence of depression and physical inactivity. Interaction with the natural environment may prevent these critical health issues, as research has shown that walking outdoors contributes to better well-being than walking indoors. The aim of this thesis was to investigate outdoor group walks as a potential public health intervention to enhance positive mental and emotional well-being, reduce stress, and foster resilience.

This thesis evaluated Walking for Health, a national group walking programme in England using a nonexperimental, longitudinal design. Individuals who did (Group Walkers) and did not (Non-Group Walkers) take part in outdoor group walks completed two online questionnaires about their mental and emotional well-being, and covariates. To gain a broader understanding of how outdoor group walks may contribute to positive well-being, integrations were proposed between the Attention Restoration Theory and the psycho-evolutionary model, and the theories of coping and resilience.

Findings show that Group Walkers had greater mental well-being and positive affect, and less negative affect, depression and perceived stress than Non-Group Walkers. Group walking had no affect on social well-being, connectedness to nature or resiliency. Outdoor group walk participation affected positive well-being through a decrease in perceived stress, and an increase in physical activity. Group Walkers demonstrated resilience against adversity on negative affect. No evidence of resilience from outdoor group walks was found for mental well-being, positive affect or depression. Group walks in farmland and green corridor environments may further boost mental well-being, and reduce negative affect and perceived stress, when compared to group walks in the urban environment.

This research suggests that outdoor group walks are effective at improving mental and emotional well-being, and could be a useful public health intervention to reduce stress and foster resilience. Implications for theory are discussed.

Publications arising from this thesis

The following peer-reviewed journal article, based upon the work reported in Chapter 9 of the present thesis, was published prior to its submission:

Marselle, M.R., Irvine, K.N., Warber, S.L. (2013). Walking for well-being: Are group walks in certain types of natural environments better for well-being than group walks in urban environments? *International Journal of Environmental Research and Public Health*, Special Issue Health Benefits of Nature, 10 (11), 5603-5628.

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Abbreviations, acronyms and statistical symbols

ANOVA	Analysis of Variance
ART	Attention Restoration Theory
B	Unstandardised regression coefficient
CD-RISC	Connor-Davidson Resilience Scale
CNS	Connectedness to Nature Scale
CVD	Cardio-vascular disease
DEFRA	Department for Environment, Food and Rural Affairs
df	Degrees of freedom
DMU	De Montfort University
DV	Dependent variable
IESD	Institute of Energy and Sustainable Development
IMD	Index of Multiple Deprivation
ISEL	Interpersonal Support Evaluation List
IV	Independent variable
LNP	Local Nature Partnership
log-10	Logarithmic transformation
M	Mean
Mdn	Median
MDI	Major Depression Inventory
n	Number in a subsample
N	Total number in a sample
NA	Negative Affect
NE	Natural England
NHS	National Health Service
OECD	Organization for Economic Co-operation and Development
OHQ	Outdoor Health Questionnaire
p	Probability value
PA	Positive Affect
PSM	Propensity score matching
PSS	Perceived Stress Scale
r	Pearson product coefficient; effect size estimate
R^2	Multiple correlation squared; measure of strength of a relationship
RPT	Retrospective Pre-test
SD	Standard Deviation
SE	Standard Error of the Mean
t	Outcome statistic of the independent or dependent *t*-test
T1	Time 1 online questionnaire
T2	Time 2 online questionnaire
UK	United Kingdom
UN	United Nations
US	United States
V	Cramer’s statistic; effect size estimate for chi-square
VAS	Visual Analogue Scale
WEMWBS	Warwick Edinburgh Mental Well-being Scale

WfH	Walking for Health
WHO	World Health Organization
α	Alpha; probability of a Type 1 error; Cronbach's alpha of internal consistency (reliability)
β	Beta; Standardised regression coefficient
Δ	Delta; increment of change
χ^2	Outcome statistic of a Chi-square test

Chapter 1 Introduction

"Everyday I walk myself into a state of well-being and walk away from every illness. I have walked myself into my best thoughts and I know of no thought so burdensome that one cannot walk away from it. But by sitting still, and the more one sits still, the closer one comes to feeling ill." - *Søren Kierkegaard*

"I have two doctors, my left leg and my right." - *G. M. Trevelyan*

1.1 Introduction

Well-being is a fundamental for health. The World Health Organisation (WHO) defines health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (World Health Organization, 1946). The inter-relationship between health and well-being is made explicit by the UK government's definition of well-being as "a positive state of mind and body, feeling safe and able to cope, with a sense of connection with people, communities and the wider environment" (HM Government, 2011, p. 90). This thesis investigates whether connection with the wider natural environment, through outdoor group walking, influences well-being.

Health and well-being are under threat by increases in the prevalence of depression, physical inactivity, obesity and cardio-vascular disease (CVD) (Department of Health, 2011; Health and Social Care Information Centre, Lifestyle Statistics, 2013; World Federation for Mental Health, 2012; World Health Organization, 2008b; World Health Organization, 2013). The increase in mental and physical ill health places even greater demands on health services (UK Government, 2012; US Government, 2009). Prevention of these critical health issues is necessary in order to reduce healthcare demands and treatment costs (UK Government, 2012; US Government, 2009). The costs of ill health in the UK are already substantial: depression, in England alone, cost an estimated £9 billion in 2000 (Knapp, 2008); obesity currently costs £4 billion per year (UK Government, 2012); and CVD treatment cost £8.6 million in 2009 (British Heart Foundation, 2012). To reduce the burden on healthcare institutions, an action plan for the prevention of depression, physical inactivity, obesity and CVD is essential (World Federation for Mental Health, 2012; World Health Organization, 2008a).

A novel approach for the prevention of these critical health issues involves the use of the natural environment for physical activity (Bird, 2007; Frumkin & Fox, 2011; Maller, Townsend, Pryor, Brown, & St Leger, 2005). Walking is an accessible, low risk and inexpensive form of physical exercise (Department of Health, 2011) that can reduce symptoms of depression (Robertson, Robertson, Jepson, & Maxwell, 2012; World Federation for Mental Health, 2012), and prevent obesity (Morabia & Costanza, 2004; Pucher, Buehler, Bassett, & Dannenberg, 2010) and CVD (Boone-Heinonen, Evenson, Taber, & Gordon-Larsen, 2009; World Health Organization, 2013). Walking outdoors in a natural environment may provide additional benefits to well-being than walking indoors (Bowler, Buyung-Ali, Knight, & Pullin, 2010; Thompson Coon et al., 2011) or in an urban environment (Bowler et al., 2010). For example, a walk in a natural environment has shown greater improvements in attention (Berman, Jonides, & Kaplan, 2008; Hartig, Evans, Jamner, Davis, & Garling, 2003) and positive emotions (Baker et al., 2008; Berman et al., 2008; Focht, 2009; Hartig et al., 2003), and greater reductions in negative emotions (Berman et al., 2008; Hartig et al., 2003; Park et al., 2011) and physiological stress (Hartig et al., 2003) compared to a walk in an urban environment. Use of natural environments could save the UK's National Health Service (NHS) an estimated £2.1 billion per year (DEFRA, 2011, p. 46).

Whilst, walking is the most common form of physical activity in the US and the UK (Centers for Disease Control and Prevention, 2012a; Hillsdon & Thorogood, 1996; National Institute for Health and Clinical Excellence, 2012), less than half of adults in both countries meet the recommended levels of physical activity (Centers for Disease Control and Prevention, 2012b; Department of Health, 2011). Finding a way to increase uptake in walking is thus of critical importance.

Walking in a group is a recommended intervention to increase physical activity in the general population (Centers for Disease Control and Prevention, 2012a; Kahn et al., 2002; Kassavou, Turner, & French, 2013). Walking group interventions are cost-effective; every £1 spent on a group walk programme could save the NHS £7 (Walking for Health, 2013a). The Walking for Health (WfH) programme is the largest group walk intervention and one of the largest public health interventions for physical activity in the UK (Fitches, 2011). It provides free, short, led health walks throughout all of England (Walking for Health, 2013a). The majority of WfH group walks occur in natural environments (Hynds & Allibone, 2009, p. 10). Between 2009-2011, approximately 80,000 people participated in 1.49 million WfH group walks (Coleman, Kokolakakis, & Ramchandani, 2011). As such, WfH has the potential to improve population public health through improved physical, mental, emotional, and social well-being. However, the majority of WfH evaluations have concentrated on physical health (Brown, Johnston, Currie, & Muñoz, 2011; Dawson, Boller, Foster, & Hillsdon, 2006; Phillips, Knox, & Langley, 2012; Walking for Health, 2013e). To date, only one quantitative evaluation of the emotional well-being benefits of WfH has been conducted (Pretty et al., 2007), a study whose limitations have been noted (Bird, 2007; Newton, 2007). There is thus a clear need for further research into the mental and emotional well-being benefits from WfH participation.

The aim of this thesis is to evaluate outdoor group walks as a potential public health intervention for positive mental and emotional well-being. WfH will be used as the case study from which to investigate this aim. The remainder of this chapter sets out the research and current UK policy on well-being, the literature and current UK policy on the use of nature for well-being, and previous research on outdoor group walks and well-being. The chapter will close with a brief summary of the content of each chapter of the thesis.

1.2 Health and well-being – research context

The 1946 WHO definition of health is important for two reasons. First, it declares that health is more than "the absence of disease or infirmity" (World Health Organization, 1946). Second, it identifies that multiple dimensions of well-being – physical, mental and social well-being – constitute health. Both aspects of the WHO definition of health are common to the field of positive psychology, which is the scientific study of optimal human functioning (Seligman & Csikszentmihalyi, 2000). Like the WHO definition of health, positive psychology also considers that psychology is more than curing mental illness – it is also about improving normal lives (Synder & Lopez, 2009). Positive psychology does this by identifying the psychological factors that help individuals live normal, flourishing lives (Synder & Lopez, 2009). Positive psychology defines well-being as multi-dimensional consisting of mental, emotional and social aspects (see Gallagher, 2009; Keyes, 2002). Although, other theories of well-being in positive psychology exist beyond this tripartite model of well-being. For example, the Values in Action Inventory of Strengths (Peterson, 2006; Linley et al., 2007) identifies 24 strengths of character that contribute to a good life (e.g. fairness, kindness, humour). Fredrickson's Broaden-and-Build Theory of positive emotions (Fredrickson, 2006) posits that positive emotions broaden one's cognitive thought processes, behaviours, and available resources for optimal functioning.

This thesis will investigate the influence outdoor group walks have on multiple dimensions of well-being, specifically mental, emotional and social well-being. These three dimensions of well-being are the most extensively studied dimensions of positive psychology (Gallagher, 2009), which has also been identified to occur following contact with nature (Keniger, Gaston, Irvine, & Fuller, 2013; Irvine & Warber, 2002; Irvine, Warber, Devine-Wright, & Gaston, 2013). Physical well-being will not be discussed in this thesis because it has been extensively researched in the area of outdoor group walks (see Chapter 2).

Table 1.1 provides a definition for each dimension of well-being that is investigated in this thesis; it also details the origins and common measurement of each well-being dimension. In general, mental well-being is concerned with purpose in life, emotional well-being is concerned with affect and satisfaction with life, and social well-being is concerned with social experiences.

Mental well-being and mental health are often used interchangeably (Foresight Mental Capital and Wellbeing Project, 2008; HM Government, 2011). The WHO (2007) defines mental health as both the presence of mental well-being and the absence of a mental disorder. However, mental well-being and mental disorder are not opposite ends of a continuum, but separate, negatively correlated, constructs (Keyes, 2002). The absence of a mental disorder does not necessarily imply the presence of high levels of mental well-being (Friedli, 2009; Keyes, 2002). In order to obtain a holistic understanding of mental health, it is important that both mental well-being and mental disorder are measured (Keyes, 2002).

Table 1.1. Summary of the dimensions of well-being investigated in this thesis.

Dimension of well-being	Definition	Origin	Measurement
Mental well-being	• Mental well-being is about one's sense of purpose and meaning in life, and realising one's potential (Newton, 2007). • Concerned with eudaimonic or positive functioning in life (Huppert et al., 2009; Keyes, Shmotkin, & Ryff, 2002; Tennant et al., 2007).	It has its roots in Aristotle's work on the life well lived (Huppert et al., 2009) and the psychological theories of Abraham Maslow, Carl Rogers and Carl Jung (Keyes et al., 2002) and Ryan and Deci (Ryan & Deci, 2000).	• Psychological well-being (Ryff 1989; Ryff and Keyes 1995; Ryff and Singer 2005) • Warwick Edinburgh Mental Wellbeing Scale (WEMWBS) (Tennant, Hiller et al. 2007; Stewart-Brown, Tennant et al. 2009) • European Social Survey on Well-being Module (Huppert, Marks et al. 2006; Huppert, Marks et al. 2009)
Emotional well-being	• Emotional well-being is concerned with hedonic experiences of happiness, pleasure and enjoyment (Huppert et al., 2009; Keyes et al., 2002). • It is the most extensively studied component of well-being (Gallagher, 2009).	Origins include theories of Hedonism and Utilitarianism (Boniwell, 2012) and research into subjective well-being(Diener, Suh, Lucas, & Smith, 1999).	• Presence of positive feelings and the absence of negative feelings (Keyes, 2002; New Economics Foundation, 2009, p. 4) • Positive and negative affect are two independent constructs (Kok, Catalino, & Fredrickson, 2008; Watson, Clark, & Tellegen, 1988). Both constructs should be measured. • Life satisfaction (Newton, 2007).
Social well-being	• Social well-being measures people's social experiences and supportive relationships (New Economics Foundation, 2009). • Social well-being is an extension of mental well-being (Ryan & Deci, 2001; Ryff, 1989) and correlated with emotional well-being (Boniwell, 2012; Office for National Statistics, 2012). • Although, social well-being has been shown to contribute to health and well-being independently (Cohen & Wills, 1985).	Research into social well-being started with Émile Durkheim's hypothesis that social relationships could prevent suicide (Brissette, Cohen, & Seeman, 2000).	• Social support (Cohen, 2004) • Social interaction (Brissette et al., 2000) • Social participation (Bowling & Grundy, 2009; O'Brien, 2008) • Social connectedness (Krieger, Rabkin, Sharify, & Song, 2009; Ong & Allaire, 2005; Ryff, 1989; Segrin & Rynes, 2009) • Loneliness (Russel, 1996), • Social relatedness (Ryan & Deci, 2001) • Social capital (Edinburgh Health Inequalities Standing Group, 2010; McKenzie, Whitley, & Weich, 2002).

1.3 Health and well-being – policy context

Well-being has become an international priority at the same time mental and physical ill health are increasing. The United Nations (UN), Organisation for Economic Co-operation and Development (OECD), World Bank and individual countries (OECD, 2011) are currently interested in national well-being as a measure of a country's progress beyond the economy (New Economics Foundation, 2011; OECD, 2011). In 2010, the UK Government made well-being a priority with the launch of the Measuring National Well-being programme, whose aim was to develop national indicators of well-being (Office for National Statistics, 2012) to measure the current Government's success (HM Government, 2011, p. 2).

The UK Government's mental health strategy 'No Health Without Mental Health' wants more people to have better well-being and good mental health (HM Government, 2011, p. 6). To achieve this, the Government needs to improve the mental well-being of the general population and increase resilience to adversity through public health interventions (HM Government, 2011, p. 19-20). Mental health interventions that have a small improvement in the average level of mental well-being across the population could result in a large decrease in the percentage of individuals with mental illness (Foresight Mental Capital and Wellbeing Project, 2008; Friedli, 2009; Huppert, 2008). For example, a one-point decrease on a mental illness scale was associated with a 6% reduction in mental illness for the population (Huppert, 2008). Could outdoor group walk programmes be such a public health intervention?

The UK Foresight mental capital and well-being project (2008) highlighted five ways to improve mental well-being: (i) connect; (ii) be active; (iii) take notice; (iv) keep learning; and (v) give (p. 23). Group walks outdoors can contribute to mental well-being through 'being active' and 'taking notice', as individuals on a group walk may take notice of the surrounding environment. Local public health bodies in England are currently organising interventions around these five ways to improve mental well-being (HM Government, 2011, p. 31). Can outdoor walking groups be one of these interventions?

Local authorities in England are currently responsible for improving the health and well-being of their local populations (Department of Health, 2012a). A local authority's

Health and Well-being Board will consider the health needs of its local population, agree priorities and invest funds to improve the health of its people (Department of Health, 2012a). The Health and Well-being Boards are responsible for commissioning public health (HM Government, 2011, p. 50). Can outdoor group walks help local authorities address their public health targets?

To understand the extent to which outdoor group walks can facilitate local and national well-being policy initiatives and targets, further research on outdoor group walk programmes is needed. This thesis will examine whether participating in an outdoor walking group programme can help the UK Government achieve its objective to improve the well-being of the general population and build resilience. The results from the thesis may be used as evidence of the value of outdoor group walks for public health.

1.4 Nature for health and well-being – research context

For centuries, people have used the natural environment as a place for health and well-being (Ward Thompson, 2011). Empirical research has shown that contact with nature is associated with multiple dimensions of health and well-being (Irvine & Warber, 2002; Irvine, Warber, Devine-Wright, & Gaston, 2013), including better mental health and well-being (de Vries, Verheij, Groenewegen, & Spreeuwenberg, 2003; van den Berg, Maas, Verheij, & Groenewegen, 2010; Ward Thompson et al., 2012), positive emotions (Hartig, Mang, & Evans, 1991; Hartig et al., 2003; Hinds & Sparks, 2011), and attention (Berman et al., 2008; Hartig et al., 2003; Irvine, 2004). Interaction with nature has also been shown to reduce stress (Hartig et al., 2003; Stigsdotter et al., 2010; Stigsdotter & Grahn, 2011; Ulrich, 1979; Ulrich, 1983; Ulrich et al., 1991; Valtchanov, Barton, & Ellard, 2010) and foster resilience against adversity (Corraliza & Collado, 2011; de Vries et al., 2003; Kuo, 2001; Maas, Verheij, Groenewegen, de Vries, & Spreeuwenberg, 2006; Maas et al., 2009; Mitchell & Popham, 2008; van den Berg et al., 2010; Ward Thompson et al., 2012; Wells & Evans, 2003).

Two theories explain how interacting with a natural environment can positively influence health and well-being by restoring directed attention or reducing physiological stress. The first theory, Attention Restoration Theory, posits that natural environments contain stimuli that allow for the restoration from mental fatigue, a consequence of prolonged concentration and inhibition in order to direct attention (R. Kaplan & Kaplan, 1989; S. Kaplan, 1995). The second theory, the psycho-evolutionary model (Hartig & Evans, 1993; Ulrich, 1983; Ulrich et al., 1991), hypothesizes that natural environments foster recovery from physiological stress. Restoration of directed attention and physiological stress reduction have been identified as key mechanisms linking nature to health (Hartig, 2011; Health Council of the Netherlands and Dutch Advisory Council for Research on Spatial Planning, Nature and the Environment, 2004).

1.5 Nature for health and well-being – policy context

Various UK Government policy documents acknowledge that natural environments are important for health. The UK Government's mental health strategy recognises "access to green spaces is associated with better mental health" (HM Government, 2011, p. 19). Use of the outdoor environment for exercise is currently listed as a wider determinant of health by the Department of Health (Department of Health, 2012b). The Department for Environment, Food and Rural Affairs (DEFRA) policy document on the natural environment (DEFRA, 2011) "wants everyone [in the UK] to be able to make the most of 'nature's health service'" (p. 46) and identifies that the quality and availability of green space affects people's health and well-being (DEFRA, 2011). In England, there exist Local Nature Partnerships – associations of local government departments, organisations and businesses – who raise awareness of the benefits and services of the natural environment (Department of Health, 2012a). It is through such partnerships that the health benefits of nature can be advocated to Health and Wellbeing Boards (DEFRA, 2011, p.46).

1.6 Walking, natural environments and well-being

A number of researchers have investigated the synergistic benefits of physical activity and the natural environment (Barton, Griffin, & Pretty, 2012; Barton & Pretty, 2010; Hawkins, Thirlaway, Backx, & Clayton, 2011; Hug, Hartig, Hansmann, Seeland, & Hornung, 2009; Mackay & Neill, 2010; Mitchell, 2013; Pretty et al., 2007; van den Berg & Custers, 2011); an area of research called 'green exercise' (Pretty et al., 2005). Studies of group walks in the natural environment fall under this area of research. The following details the well-being benefits from participating in a walking group.

1.6.1 Outdoor group walking and well-being

Group walks in natural environments have been shown to reduce stress (Roe & Aspinall, 2011), negative affect (Hine, Wood, Barton, & Pretty, 2011; Peacock, Hine, & Pretty, 2007) and depression (Armstrong & Edwards, 2003; Armstrong & Edwards, 2004; Gusi, Reyes, Gonzalez-Guerrero, Herrera, & Garcia, 2008; Robertson et al., 2012; Roe & Aspinall, 2011) and increase positive affect (Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009; Nisbet & Zelenski, 2011), feelings of self-confidence (O'Brien, 2008; Wensley & Slade, 2012), enjoyment (Phillips, Knox, & Langley, 2011; South, Giuntoli, & Kinsella, 2013), relaxation (South et al., 2013) and social well-being (Dawson et al., 2006; Hynds & Allibone, 2009; South et al., 2013; Villalba van Dijk et al., 2012; Wensley & Slade, 2012). Walking in a group may also foster resilience (Hynds & Allibone, 2009; Priest, 2007; South et al., 2013).

The well-being benefits of outdoor group walks may be a result of the synergistic benefits of physical activity, social contact, and interaction with the natural environment (Ward Thompson & Aspinall, 2011). The well-being effects of all three mechanisms may be additive and have a greater effect on group walkers' well-being than any one mechanism alone (Holmes & Evans, 2011; Priest, 2007; Wensley & Slade, 2012). The following subsections will outline the evidence which supports the idea that outdoor group walks might be a public health intervention to improve population well-being through a) increased physical activity, b) social interaction and support, and c) interaction with nature.

<u>Group walking facilitates physical activity in the natural environment</u>

The first pathway through which outdoor group walks have an impact on positive well-being is through physical activity (Boniwell, 2012). Meeting the national recommendations[1] for physical activity can improve mood (Biddle & Mutrie, 2008; Department of Health, 2011; Hendrickx & van der Ouderaa, 2008; Mata et al., 2012), diminish levels of stress and anxiety (Biddle, Fox, & Boutcher, 2000; Department of Health, 2011) and reduce the risk of obesity (Department of Health, 2011; Health and Social Care Information Centre, Lifestyle Statistics, 2013) and CVD (Department of

[1] The UK national physical activity recommendation for adults and older adults is a minimum of 150 minutes (2.5 hours) of moderate intensity physical activity per week (Department of Health, 2011).

Health, 2011; World Health Organization, 2013). Physical activity has been shown to be an effective treatment for major depression, comparable to medication (Blumenthal et al., 1999); moderate intensity exercise can reduce symptoms of depression for individuals with major depressive disorder (Dunn, Trivedi, Kampert, Clark, & Chambliss, 2005).

Group walk exercise programmes are a low-cost intervention with a high retention rate (Gusi et al., 2008) that can increase walking behaviour (Kassavou et al., 2013), and the proportion of participants meeting the national requirements for moderate intensity physical activity (Krieger et al., 2009). Indeed, WfH "is a tried and tested way to get more people walking" (Walking for Health, 2013e, p. 27). Previous research found that WfH increased physical activity levels for the most sedentary participants and helped physically active individuals maintain their level of physical activity (Phillips et al., 2012).

Participation in a walking group programme may reverse the negative national trend for physical activity. The national trend for walking in England is that women walk less than men, and participation in walking decreases with age for both sexs (Craig, Mindell, & Hirani, 2009, p. 32). However, this is not the case if an individual participates in WfH, as the majority of participants in WfH are women and individuals aged 55 or older (Coleman et al., 2011; Fitches, 2011). A typical WfH walker is "a white, non-disabled female in her early 60s" (Fitches, 2011, p. 3).

Three studies have isolated the effects of physical activity from the social or physical environment. Emotional well-being significantly improved after a group walk – irrespective of the social (alone vs. with others) or physical environment (urban vs. natural) (Johansson, Hartig, & Staats, 2011; Plante et al., 2007). Issacs et al. (2007) found no significant difference between an outdoor group walking condition and indoor gym exercise condition on measures of depression and anxiety. The above results suggest that physical exercise only may be the mechanism for positive emotional and mental well-being.

<u>Group walking provides social interaction and support</u>

The social environment of a walking group can promote and sustain walking (Kahn et al., 2002; South et al., 2013; Wensley & Slade, 2012). People are more likely to walk in the company of another person or a pet (Ball, Bauman, Leslie, & Owen, 2001; Toohey, McCormack, Doyle-Baker, Adam, & Rock, 2013), and both prefer (Johansson et al., 2011) and enjoy (Plante et al., 2007) walking with others outdoors more than walking outdoors alone. Walking groups can sustain walking by providing companionship, supportive relationships (Kahn et al., 2002), and social cohesion (Kwak, Kremers, Walsh, & Brug, 2005).

Qualitative research of outdoor walking groups found that walking in a group can increase social interaction and social connectedness (Holmes & Evans, 2011; Jackson, 2011; South et al., 2013; Villalba van Dijk et al., 2012; Wensley & Slade, 2012), and reduce social isolation (Dawson et al., 2006; Hynds & Allibone, 2009; South et al., 2013). A quantitative study found that social connectedness increased following participation in an outdoor walking group (Krieger et al., 2009). Participating in a walking group also engenders a sense of social identity and sense of belonging – people feel part of the group (Priest, 2007; Wensley & Slade, 2012). This feeling of being part of a group may reduce social isolation (Priest, 2007) and engender social support for individuals who were becoming sociable again after a time of social isolation or bereavement (Dawson et al., 2006; Hynds & Allibone, 2009).

<u>Group walking provides interaction with nature</u>

Participating in a walking group in the natural environment may engender restoration of directed attention fatigue and stress reduction. Qualitative research suggests that a group walk in the natural environment may result in attention restoration (Holmes & Evans, 2011; Priest, 2007), an experience of 'being away' (Holmes & Evans, 2011; Priest, 2007; Wensley & Slade, 2012), stress reduction (Holmes & Evans, 2011; Priest, 2007; Wensley & Slade, 2012), and a sense of calm or relaxation (Holmes & Evans, 2011; Priest, 2007; South et al., 2013; Wensley & Slade, 2012).

Four studies of outdoor group walks isolated the effects of the natural environment from the effects of walking or the social environment. A group walk in the natural environment significantly improved emotional well-being compared to a group walk indoors (Peacock et al., 2007) or in an urban environment (Roe & Aspinall, 2011). Self-esteem significantly increased following a group walk in the natural environment compared to either a group walk indoors (Peacock et al., 2007) or a sedentary social group (Barton et al., 2012). Sugiyama et al. (2008) found the 'greenness' of the environment was strongly associated with mental health, over and above the effects of walking and social coherence (e.g. a sense of community, and trust and help neighbours).

1.7 Thesis aims and objectives

This chapter has set out the importance of the chosen topic by detailing group walks in natural environments as a potential public health intervention to help the UK government achieve its current policy objectives to improve the health and well-being of the nation.

This thesis is an evaluation of outdoor group walking programmes for their contribution to positive well-being. It uses the Walking for Health (WfH) programme as a case study from which to compare the well-being of individuals who do and do not take part in an outdoor walking group.

The aim of this thesis is to:

Evaluate outdoor group walks as a potential public health intervention for positive mental and emotional well-being.

This research aim is explored through 4 objectives:

1. Evaluate if individuals who take part in outdoor group walks have better mental and emotional well-being than individuals who do not take part in outdoor group walks.
2. Explore the mechanisms that contribute to the relationship between outdoor group walk participation and positive mental and emotional well-being.
3. Investigate whether outdoor group walks facilitate resilience by moderating the effects of adversity on mental and emotional well-being.
4. Explore whether different types of natural environments for a group walk are associated with positive mental and emotional well-being compared to group walks in the urban environment.

1.8 Thesis structure

This thesis has 10 chapters. Each chapter is summarised below.

Chapter 2. Literature review

This chapter discusses the theories of coping, resilience, and restorative environments to understand how taking part in an outdoor walking group may generate or maintain positive well-being. Integrations of the restorative environments frameworks with the theories of coping and resilience are proposed in order to gain a broader understanding how interacting with nature can contribute to positive well-being. An overview of the Walking for Health programme is provided and previous research on outdoor walking groups critiqued and gaps identified.

Chapter 3. Methods

This chapter presents the research methodology, measures and data collection procedures used to address the aim of this thesis. The limitations with regard to validity and reliability of the research design are discussed.

Chapter 4. Group Walkers and Non-Group Walkers at the start of the study

This chapter describes the quantitative analyses undertaken to assess similarity of Group Walkers and Non-Group Walkers on demographics, covariates, and well-being at the start of the study. Results are presented and discussed with regards to their limitations. This chapter forms part of Objective 1.

Chapter 5. Improving causal associations with statistical matching

This chapter describes a statistical matching procedure – propensity score matching – and its application to improve internal validity by statistically removing confounding factors. The literature of statistical matching in general, and the propensity score matching procedure in particular are discussed. Results from the propensity score matching are presented. This chapter forms part of Objective 1.

Chapter 6. The well-being benefits from outdoor group walk participation

This chapter presents quantitative analyses conducted on the propensity matched sample of Group Walkers and Non-Group Walkers on measures of well-being and covariates. This chapter addresses Objective 1.

Chapter 7. How does participating in an outdoor walking group effect well-being?

This chapter explores the underlying mechanisms that might explain the relationship between outdoor group walk participation and positive mental and emotional well-being. A literature review begins the chapter, discussing the previous research into the mediators of restorative environments. Mediation analysis is described. Preliminary analyses are conducted to reduce potential variables before mediation analyses are conducted on 4 mediator variables. Results are discussed. This chapter addresses Objective 2.

Chapter 8. Group walks as a buffer between adversity and well-being

This chapter investigates whether the negative effects of adversity on mental and emotional well-being can be moderated or buffered by participating in outdoor group walks. A literature review of previous research of nature as a buffer of stressful life events or social deprivation on well-being is presented. Moderation analysis is described and conducted. The results are discussed, and limitations and further research identified. This chapter addresses Objective 3.

Chapter 9. The well-being benefits from group walks in different types of environments

This chapter explores whether different types of natural environments for a group walk have an effect on well-being. The chapter begins with a review of the previous literature on the influence of different types of nature on health and well-being. Results are presented from a sub-sample of Group Walkers who frequently attend WfH walks. The chapter ends with a summary, discussion, limitations, and identification of further research. This chapter addresses Objective 4.

Chapter 10. Discussion and conclusion

This chapter summarises the key findings from this research as they relate to the thesis objectives and previous research. Implications to policy are outlined. The limitations of the research are highlighted, along with suggestions for further research.

Chapter 2 Literature review

A literature review was undertaken to appraise the state of the knowledge regarding well-being and group walking. This chapter has 4 sections. The first section discusses stress. The second section discusses three theoretical frameworks used to maintain and generate health and well-being in the face of stress – coping, resilience, and restorative environments. Integration of these frameworks are presented in an illustrative fashion in order to gain a broader understanding how interacting with nature can contribute to positive well-being. The third section critiques the literature centred on outdoor group walking and well-being. The chapter concludes with a summary.

2.1 Stress

Stress is a public health concern (Beil & Hanes, 2013). It can have a negative impact on physical and mental health, and is a risk factor for depression, CVD, and autoimmune disease (Cohen & Janicki-Deverts, 2012). As such, reducing stress is important for the maintenance of mental and physical health.

'Stress' is a process through which external, environmental stressors exceed one's adaptive ability resulting in psychological, behavioural and physiological changes that may lead to physical and mental ill health (Cohen, Kessler, & Underwood Gordon, 1997). Figure 2.1 illustrates the unified model of stress – an integration of the environmental, psychological and biological approaches to stress measurement (Cohen et al., 1997). The unified model of stress details a sequential process in which the experience of environmental demands, or stressors, threatens health (Cohen et al., 1997).

The environmental approach measures the environmental demands (aka stressors) that may require adaptive demands (Cohen et al., 1997; Paradies, 2011). Stressors are usually described as acute or chronic. Acute stressors are discrete events that require major adjustment in a short period of time, such as stressful life events (Paradies, 2011). Chronic stressors are enduring, persistent and reoccurring demands that require adjustment for a longer period of time (Paradies, 2011), such as work or marital roles, crowding or crime (Lepore, 2011). Other researchers, however, have a more sensitive approach to the role of stress duration, acknowledging that an acute event can have long-term impact (e.g. childhood abuse, traumatic event), whilst a chronic stressor may not be appraised as stressful or require a stress response (e.g. urban stressors) (Cohen et al., 1997, p 14-15; Turner & Wheaton, 1997).

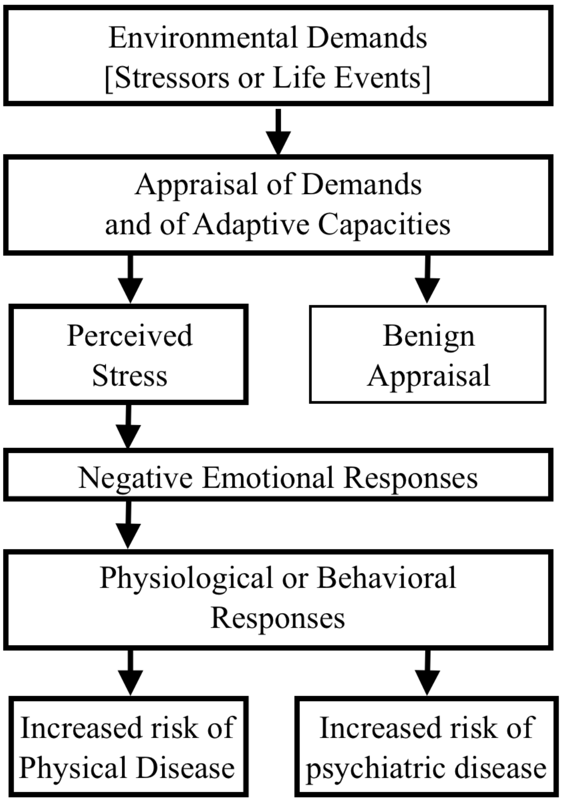
The psychological approach to stress focuses on the individual's perception and evaluation of a stressor as harmful (Cohen et al., 1997). If an individual appraises the stressor as damaging and exceeding his or her ability to cope, then stress is perceived (Lazarus & Folkman, 1984). This process is the same irrespective of whether the stressor is acute or chronic (Monroe & Kelley, 1997). Perceived stress results in negative emotional stress responses, which then contribute to physiological (e.g. cortisol) and behavioural (e.g. exercise less, drink more) stress responses that increase the risk of physical and psychiatric ill health (Cohen et al., 1997).

The biological approach to stress measurement concerns the activation of the physiological stress responses following the perception of stress, and its concomitant emotional reaction (Cohen, et al., 1997). The automatic nervous system is divided into the parasympathetic and sympathetic nervous systems. The main function of the parasympathetic nervous system is 'rest and digest'; it is relaxed, calm, digesting food, storing energy, and not alarmed (Guttman, 1999). The sympathetic nervous system's main function is 'fight or fight' and arises when one is threatened (Guttman, 1999). The sympathetic nervous is further divided into two physiological stress responses that differ based on the duration of the stressor: the sympathetic-adrenal medullary system (SAM) is activated in response to acute stressors; and the hypothalamic-pituitary-adrenocortical axis (HPA) which is activated in response to chronic stressors (Paradies, 2011). Activation of the SAM system leads to secretion of adrendaline and norepinephrine, and increased blood pressure, heart rate and sweating (Cohen et al., 1997; Paradies, 2011). Consequences of the HPA system are the secretion of hormones, importantly the stress hormone cortisol (Cohen et al., 1997). Prolonged or repeated activation of these systems may place one at risk for physical and psychological disorders (Cohen et al, 1997, p. 8).

Each preceding component in the unified model is a greater predictor of the component that follows (Cohen et al., 1997). For example, negative emotional responses should be a greater predictor of physiological stress responses than perceived stress (see Figure

2.1). Mediators are also identified in the unified model of stress, such as coping variables, perceived stress or negative affect (Schwarzer & Schultz, 2003).

Figure 2.1. Unified model of the stress process illustrating the integration of environmental, psychological and biological approaches to stress measurement.



Note. From *Measuring stress: A guide for health and social scientists* (p. 11) by Cohen, R.C. Kessler and L. Underwood Gordon, 1997, New York: Oxford University Press. Copyright 1997 by Oxford University Press. Reprinted with permission.

2.2 Theories for maintaining and generating well-being

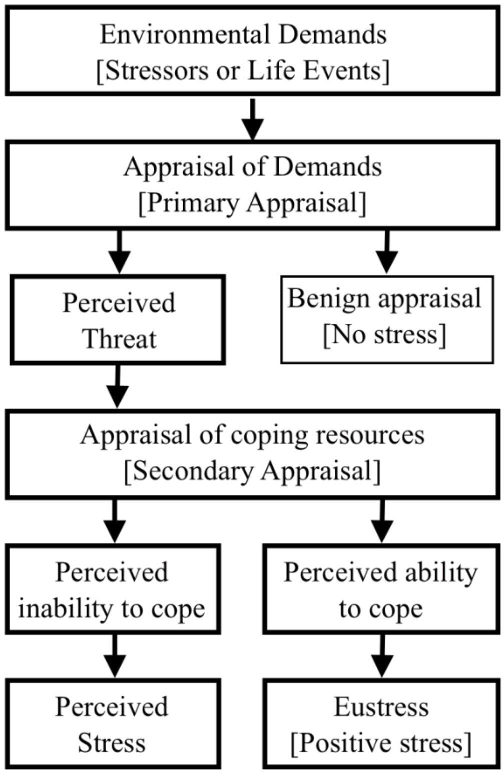
There are several theories that can be applied to the maintenance and generation of positive well-being (Harrop, Addis, Elliott, & Williams, 2007; Synder & Lopez, 2005; Synder & Lopez, 2007). This thesis focuses on three theories: coping, resilience, and restorative environments. The three approaches are similar in that they each focus on how people deal with and respond to stress. The following will introduce each theory separately. An integration of each theory of restorative environments to the theories of coping and resilience will be presented in an illustrative fashion in order to understand how outdoor group walks can affect well-being.

2.2.1 *Coping with stress for maintaining and generating well-being*

Coping with stressors is a transactional process between the demands of the stressor and the individual's assessment of his or her resources to deal with those demands (Harrop et al., 2007; Lazarus & Folkman, 1984). Figure 2.2 demonstrates the transactional model of stress (Lazarus & Folkman, 1984), a psychological approach to stress measurement (Cohen et al., 1997). The experience of a stressor triggers a cognitive appraisal process called primary appraisal. Primary appraisal assesses characteristics of the stressor (e.g. its' impact, duration, perceived control) and whether it poses a threat to one's well-being (Cohen et al., 1997; Lazarus & Folkman, 1984). If the stressor is deemed harmful, then physiological stress responses (Bell et al., 2001) and the secondary appraisal process commence. The secondary appraisal process considers the availability of coping resources to deal with the stressor (Cohen et al., 1997; Lazarus & Folkman, 1984). Coping resources can be internal (e.g. self-esteem, problem solving skills (Harrop et al., 2007), resiliency[2] (Block & Kremen, 1996; Ong, Bergeman, Bisconti, & Wallace, 2006)) or external to the individual (e.g. social support (Harrop et al., 2007), exercise (Boniwell, 2012), natural environment (Kuo, 2001)). Coping strategies to deal with the stressor can be problem-focused or emotion-focused (Harrop et al., 2007) (not shown in Figure 2.2). Problem-focused coping are behaviours to modify or change the stressor (e.g. information processing, problem solving) (Harrop et al., 2007). Emotion-focused coping consists of behaviours to regulate the stress response (e.g. meditation, acceptance of the stressor) (Cohen et al., 1997; Harrop et al., 2007). There are two outcomes following secondary appraisal (see Figure 2.2). If the individual perceives they do not have the resources to cope with the stressor, then perceived stress is experienced, which can result in negative emotional, physiological and behaviour responses, as well as disease (see Figure 2.1). However, if the individual perceives they have the resources to cope with the stressor, then eustress or "good stress" is experienced (Lazarus & Folkman, 1984).

[2] The term 'resiliency' will be used when discussing a personality trait and the term 'resilience' used when referring to an outcome or process (Luthar, Cicchetti, & Becker, 2000, Masten, 1994)

Figure 2.2. Transactional model of coping with stress by Lazarus and Folkman (1984).



2.2.2 Resilience for maintaining and generating well-being

Resilience is the maintenance or recovery of well-being following exposure to adversity or risk (Bonanno, 2004; Mancini & Bonanno, 2010; Ryff, Singer, Love, & Essex, 1998). As such, resilience is important for maintaining mental and emotional well-being and mental health (Foresight Mental Capital and Wellbeing Project, 2008; Friedli, 2009; HM Government, 2011). The field of positive psychology studies the theories of coping and resilience because managing stress and adversity can contribute to optimal human functioning (Boniwell, 2012). The theories of coping and resilience are similar, in that both theories deal with the management of stressors. The main difference between the two theories is time (Harrop et al., 2007) and severity of the stressor. Coping is more short term than resilience (Harrop et al., 2007), as resilience is concerned with functioning over several weeks or months (Bonanno, 2005). Resilience deals with adversity, a severe acute stressor that can bring upon major and undesired changes upon the person (Turner & Wheaton, 1997).

Unlike coping, resilience "lacks an established theoretical framework" (Harrop et al., 2007, p. 69) and has been conceptualised as a personality trait, an outcome or a process (Ahern, Kiehl, Sole, & Byers, 2006; Block & Kremen, 1996; Gillespie, Chaboyer, & Wallis, 2007; Harrop et al., 2007; Jacelon, 1997; Luthar, Cicchetti, & Becker, 2000; Masten & Obradovic, 2006; Rutter, 2006). Consensus is however emerging that resilience is a process, comprised of three components: adversity, positive adaptation and protective factors (Harrop et al., 2007; Masten, 2001). Conceptualising resilience as a process means that resilience can only occur following exposure to adversity (Kumpfer, 1999; Luthar et al., 2000; Synder & Lopez, 2007) and can be developed at any point in the lifespan (Gillespie et al., 2007; Masten & Wright, 2009; Reich, Zautra, & Hall, 2010; The Academy of Medical Sciences, 2007; Werner & Smith, 1982; Werner & Smith, 1992).

Adversity

For resilience to be studied, adversity needs to be present (Harrop et al., 2007). Adversity is defined as a threat to individual functioning and development that could result in a negative outcome (Masten & Reed, 2005). In adults, adversity has been measured as social deprivation (Davidson, 2008), racial discrimination (Keyes, 2009), loss of resources due to old age (Boerner & Jopp, 2010), exposure to a single traumatic event (e.g. terrorist attack, natural disaster, conjugal loss) (Bonanno, 2005; Mancini & Bonanno, 2010), cumulative stressful life events (Ryff et al., 1998; Seery, Holman, & Silver, 2010; Singer, Ryff, Carr, & Magee, 1998; Tusaie & Dyer, 2004) or daily stressors (Almeida, 2005; Ong et al., 2006). Adversity does not appear to be very different from stressors, as the above describe acute (i.e. traumatic event, stressful life events), chronic (i.e. social deprivation, racial discrimination) and daily stressors.

Positive adaptation

Positive adaptation is identified as: i) maintenance of functioning despite exposure to adversity; ii) recovery following adversity and/or; iii) at-risk individuals who demonstrate better than expected outcomes (Harrop et al., 2007, p. 32). In adults, positive adaptation is generally defined as the maintenance of health and well-being following adversity (Zautra, Hall, & Murray, 2010, p. 11). Self-report psychological measures of well-being or distress are typically used to assess positive adaptation in adults (Atkinson, Martin, & Rankin, 2009; Ryff et al., 1998; Seery et al., 2010; Steinhardt & Dolbier, 2008).

Post-traumatic growth is related to positive adaptation. Post-traumatic growth is an increase in social and psychological functioning following adversity (Helgeson & Lopez, 2010; Joseph, 2012). It is manifest by a change in one's self (e.g. development of wisdom, gratitude, personal acceptance, personal strength), enhanced social relationships, or a new life philosophy (e.g. evaluating what matters in life) (Joseph, 2012). A person may feel stronger, have more confidence or self-belief, improved relationships, appreciate the small things in life or develop spirituality following an adverse experience (Boniwell, 2012). Post-traumatic growth is a process that starts with understanding the impact of the event and cognitive restructuring to remake sense out of life following the adverse event (Boniwell, 2012).

<u>Protective factors</u>

Protective factors are measurable characteristics that moderate the effect of adversity on outcomes in order to make positive adaptation more likely (Werner, 1995; Yates & Masten, 2004). Protective factors are key to resilience research (Harrop et al., 2007); they identify interventions to encourage resilience in at-risk individuals. In adults, protective factors occur at three different levels: individual (e.g. personality characteristics), family (e.g. social support) and community (e.g. community organisations; public safety) (Harrop et al., 2007; Luthar et al., 2000; Zautra et al., 2010). Individual level protective factors are psychological factors that facilitate the interpretation of, coping with, and reaction to adversity (Harrop et al., 2007; Ryff et al., 1998), such as: resiliency (Block & Kremen, 1996; Ong et al., 2006); positive emotions (Fredrickson, Tugade, Waugh, & Larkin, 2003; Tugade & Fredrickson, 2004); cognitive functioning (Zautra et al., 2010); previous mental health (Boerner & Jopp, 2010) and demographic variables of age, income, education, and occupational status (Almeida, 2005; Ryff et al., 1998; Synder & Lopez, 2007). Family level protective factors include warm, supportive relationships with family (Friedli, 2009; Harrop et al., 2007; Singer et al., 1998) and social support from friends (Zautra et al., 2010). Social support has been shown to moderate the effect of adversity (Harrop et al., 2007, p. 80) and stress (Cohen, 2004). Community level protective factors include supportive neighbourhood and community organisations (Harrop et al., 2007; Luthar et al., 2000; Ryff et al., 1998) and urban security and public safety (Masten & Reed, 2005).

Interacting with natural environments has been mentioned as a potential protective factor in the resilience literature. Zautra et al. (2010) identified "green space and engaging in the natural environment through community gardening" (p. 10) as a community level protective factor. Wilderness camps were suggested as a resilience promoting intervention for children and adolescents (Masten & Reed, 2005). Wilderness experiences provide children and adolescents with the opportunity to master new skills and succeed at a task – actions which develop feelings of self-confidence and self-efficacy (Masten & Reed, 2005). Natural environments may also foster post-adversity growth by promoting hope or the belief that life has meaning (Masten & Wright, 2009). Masten and Wright (2009) describe the experience of a young Cambodian woman who endured horrors from the Pol Pot regime and transformed her experience from "despair to hope as she watched a beautiful sunrise and realised that the Khmer Rouge did not control nature or the meaning of her life" (p. 227).

2.2.3 Interaction with nature for maintaining and generating well-being

Many people seek out natural environments in times of stress (Stigsdotter et al., 2010) suggesting natural places could be a coping resource against stress or a protective factor against adversity. Two theories explain how interacting with the natural environment can maintain and generate well-being. The following will describe each restorative environment theory.

Attention Restoration Theory

Attention Restoration Theory (ART) posits natural environments contain stimuli that allow for the restoration from mental fatigue, which is the depletion of one's ability to direct attention (R. Kaplan & Kaplan, 1989; S. Kaplan, 1995). Based on the work of William James, ART describes two kinds of attention that differ in the amount of cognitive effort required: directed attention, which requires considerable cognitive effort, and involuntary attention requiring no cognitive effort (R. Kaplan & Kaplan, 1989).

The ability to direct attention requires inhibition in order to avoid distractions (R. Kaplan & Kaplan, 1989; S. Kaplan, 1995). As such, it can become fatigued due to continuous and prolonged use (R. Kaplan & Kaplan, 1989). Kaplan (1995) argues that directed attention is important to human functioning because it is responsible for "executive functioning" (S. Kaplan, 1995, p. 170), the ability to process information and utilize inhibition to manage behaviour. Ottosson and Grahn (2008) detail the abilities of executive cognitive functions (p. 55):

- Ability to see one's own situation and what one wishes or needs to do
- Ability to prioritize among what one wishes or needs to do
- Motivation to carry the behaviours through
- Ability to plan how to do it
- Manage behaviour to actually carry it through.

Consequences of mental fatigue include the inability to solve problems, impaired perception, impulsive behaviour, irritability with others and errors in one's work (R. Kaplan & Kaplan, 1989; S. Kaplan, 1995).

ART is related to stress in two main ways. First, mental fatigue can lead to the physiological and psychological experience of stress (S. Kaplan, 1995). Kaplan (1995) suggests that "when someone states that they just don't have what it takes to deal with some forthcoming challenge" (p. 177) they are speaking about mental fatigue. Second, mental fatigue can be a consequence of sustained psychological or physiological stress responses (S. Kaplan, 1995). This can also be understood as a cognitive "stage of exhaustion", in which resource depletion occurs after failing to cope with a stressor (Bell et al., 2001, p. 120).

The only way to recover from mental fatigue is to rest directed attention (R. Kaplan & Kaplan, 1989; S. Kaplan, 1995), which can come from sleep or using involuntary attention (S. Kaplan, 1995). Natural environments contain stimuli that effortlessly attract involuntary attention, allowing for the restoration of directed attention (R. Kaplan & Kaplan, 1989; S. Kaplan, 1995). Experimental research has shown interacting with natural environments improves cognitive functioning (Berman et al., 2008; Hartig et al., 2003).

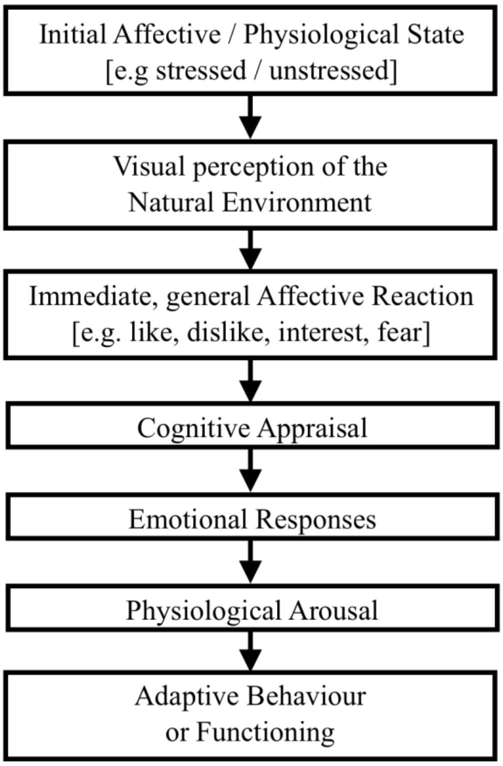
A restorative experience requires four co-acting components: fascinating stimuli, a sense of being away, extent and compatibility (R. Kaplan & Kaplan, 1989; S. Kaplan, 1995). Natural environments are hypothesized to have a high level of these four restorative components (R. Kaplan & Kaplan, 1989; S. Kaplan, 1995). According to ART, there are four cognitive benefits from interacting with a natural environment, which occur in sequence of deepening restorativeness based on increased time in and quality of the natural environment (R. Kaplan & Kaplan, 1989). In sequence, these benefits are: clearing one's head, restoration of directed attention, thinking about life matters and self-reflection (R. Kaplan & Kaplan, 1989, p. 196).

Psycho-evolutionary model

Contrary to ART, which focused on the cognitive impact from interactions with nature, the psycho-evolutionary model (Ulrich, 1983; Ulrich et al., 1991) discusses the physiological impact from interacting with natural environments (Irvine et al., 2013). The psycho-evolutionary model is a theory of stress recovery (Ulrich et al., 1991). The benefits of natural environments to health are reduced stress responses of negative affect and physiological arousal, and enhanced positive affect and attention (Ulrich et al., 1991). According to the theory, properties of the natural environment that facilitate an restorative response have moderate complexity and depth, a focal point, deflected vistas, a ground surface conducive to movement, lack of threat, and water (Ulrich, 1983, p. 105).

Figure 2.3 details a simplified version of the psycho-evolutionary model. The model details a sequential process in which interacting with nature has an effect on one's feelings and behaviour, largely through the sympathetic nervous system (i.e. fight or flight response) (Irvine et al., 2013). At the start of the model is the individual's affective and physiological state (e.g. stressed/unstressed) prior to interacting with nature. This initial state "directs and sustains attention" (Ulrich, 1983, p. 90) onto the natural environment. According to the theory, interacting with the natural environment will initiate an immediate, general affective reaction (e.g. like/dislike) (Ulrich, 1983). This immediate emotional reaction subsequently influences cognitive appraisals, emotional response, physiological arousal, and adaptive behaviours or functioning, in sequence (Ulrich, 1983).

Figure 2.3. Simplified version of the psycho-evolutionary model of affective/arousal response to a natural environment (Ulrich, 1983).



2.2.4 Relation of both theories of restorative environments to coping and resilience

The previous sections described the theories of coping, resilience, and restorative environments as ways to maintain and generate health. This section will demonstrate how these theories may fit together in order to gain a broader understanding how interacting with nature can contribute to positive mental and emotional well-being (Irvine et al., 2013). The purpose is to illustrate how the restorative benefits of nature – attention restoration and physiological stress reduction – contribute to health and well-being. No testable predictions arising from these integrations will be made in the thesis. How the ART and the psycho-evolutionary may relate to coping with stress are presented first, followed by proposed integrations of each theory of restorative environments to the theory of resilience. Each proposed integration demonstrates that relationship between the different theories of maintaining and generating well-being

Proposed integration of both nature-health theories with coping

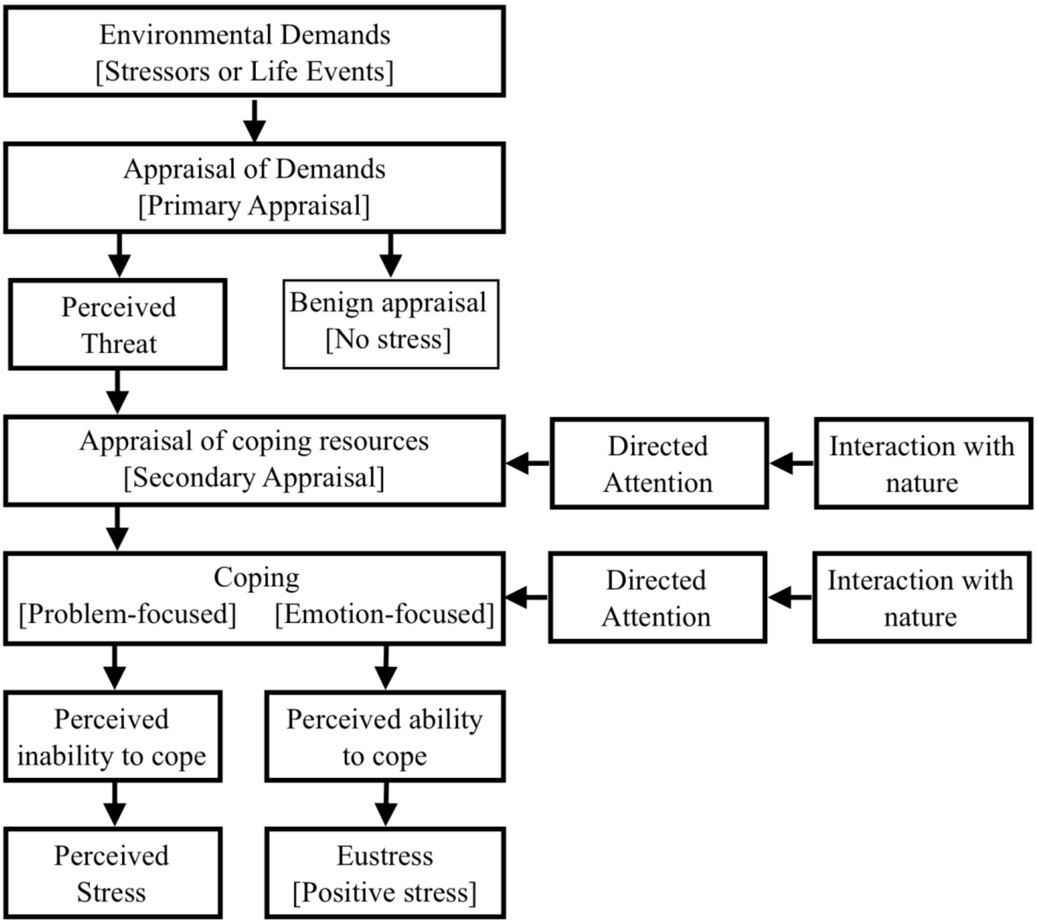
The study of restorative environments can be understood as "a complement to the study of stress and coping" (Hartig, 2011, p. 41). The following attempts to illustrate how each theory of restorative environments might relate to coping from stress; no tests of their validity are made in the thesis.

Neither restorative environment theory make a distinction that about the type of stressor - acute or chronic - from which one requires restoration (Kaplan, 1995; Ulrich et al, 1991). In other words, the restorative benefits of natural environments occur irrespective of whether an individual experiences an acute or chronic stressor. Previous studies have found nature to be restorative from both acute and chronic physiological stress responses. Experimental studies that induced an acute stressor found a reduction in SAM physiological stress responses (e.g. blood pressure, heart rate, sweating) following exposure to a restorative environment (Hartig et al., 2003; Ulrich et al., 1991). A naturalistic study found that the effects of experiencing a chronic stressor on cortisol - a measure of the HPA stress responses -was less for individuals who lived in a greener environment (Ward Thompson et al, 2012). Thus, the chronicity of the stressor experienced has no effect on the restorative environments theories; nature is restorative irrespective of the type of stressor experienced.

The importance of ART to coping was acknowledged by Kuo (2001), who stated "attentional resources play an important role in effective coping" (p. 26). Figure 2.4 shows how ART may integrate into the transactional model of stress (Lazarus & Folkman, 1984). ART could play a role in coping by preventing and mitigating stress (S. Kaplan, 1995, p. 180). First, directed attention can prevent psychological stress through the secondary appraisal process, because its "executive functioning" (S. Kaplan, 1995, p. 170) abilities of selection and thought are important for appraising one's coping resources. The secondary appraisal process of the transactional model of stress is an evaluation of the available coping options, the likelihood any one coping option will be successful, and the likelihood that an the individual can apply a particular strategy effectively (Monroe & Kelley, 1997). Mentally fatigued individuals will likely conclude they have insufficient resources to cope with the stressor, or have the ability to apply an strategy effectively (S. Kaplan, 1995), thus leading to the perceived inability to cope and perceived stress. Thus, ART may prevent the experience of stress by integrating into the secondary appraisals stage of coping (see Figure 2.4).

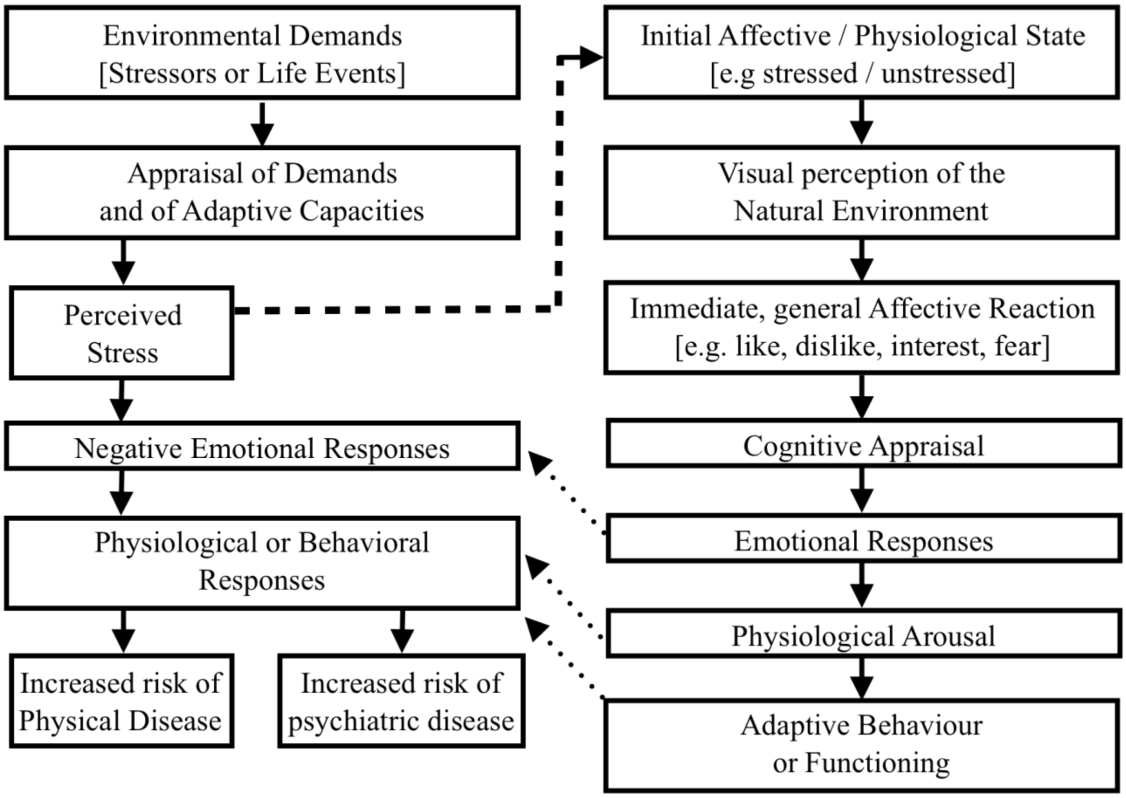
Second, directed attention may mitigate psychological stress through problem-focused coping. Problem-focused coping relies on directed attention; the ability to solve problems, set goals and plan actions in order to cope with a stressor all require directed attention (S. Kaplan, 1995, p. 171; Kuo, 2001). If the problem-focused coping strategies facilitated by directed attention are successful, then the individual will perceive himself or herself as able to cope and will not experience perceived stress (see Figure 2.4). However, if problem-focused coping resources are not available, for example due to mental fatigue, then an individual will conclude they do not have the ability to cope and will experience perceived stress. The reduction in perceived stress is used in this thesis as an indicator of successful coping facilitated by directed attention from interaction with the natural environment.

Figure 2.4. Integration of the transactional model of stress (Lazarus & Folkman, 1984) and ART (Kaplan, 1995).



The psycho-evolutionary model is a theory of stress recovery (Ulrich et al., 1991). Therefore, the benefits of natural environments occur *after* the experience of psychological and physiological stress responses (Ulrich et al., 1991). Figure 2.5 shows how the psycho-evolutionary model may integrate into the unified model of stress (Cohen et al., 1997). The unified model of stress is used because it describes a holistic model of stress that includes physiological approaches to stress measurement, whilst the latter is a wholly psychological model of stress. Both the psycho-evolutionary model and the unified model of stress describe a sequential process in which cognitive appraisals influence emotional responses, which in turn lead to physiological and behavioural responses.

Figure 2.5. Integration of the unified model of stress (Cohen et al., 1997) (left) and the psycho-evolutionary model (Ulrich, 1983) (right).



The first way the psycho-evolutionary model may integrate into the unified model of stress is after the experience of perceived stress. This is illustrated with a dashed line in Figure 2.5. The psycho-evolutionary model states that one's initial emotional or physiological state (i.e. stressed, unstressed) will influence how one is affected by the natural environment (Ulrich, 1983). It is hypothesised by Ulrich (1983) that the restorative benefits of nature are greater for individuals who experience stress:

> "Restorative influences of unspectacular natural scenes… may be most pronounced when the observer's initial state is one of stress and excessive arousal. For individual's experiencing stress or anxiety, most unthreatening natural views may be more arousal reducing and tend to elicit more positively toned emotional reactions ... and hence are more restorative in a psychophysiological sense" (p. 116).

The second way the psycho-evolutionary model may integrate into the unified model of stress is by mitigating emotional, physiological and behavioural stress responses. This is represented by dotted lines in Figure 2.5. Stressed individuals experience negative emotions, increased physiological arousal, and poor behavioural responses (Cohen et al., 1997). According to the psycho-evolutionary model, the benefits of natural environments for individuals' experiencing perceived stress following a stressor are "a shift towards more positively-toned emotional state, and in decreased levels of physiological arousal" (Ulrich et al., 1991, p. 208). The reductions in negative emotions and physiological arousal occur within minutes of exposure to the natural environment (Hartig et al., 2003; Ulrich et al., 1991). Moreover, the psycho-evolutionary model posits adaptive behaviour or functioning instigated by the natural environment following the experience of stress are "psychophysiological restoration and nonvigilant attention" (Ulrich, 1983, p. 94). These adaptive behaviours may counteract negative behavioural stress responses (Ulrich et al., 1991) – exactly how was not explained by the theory.

<u>Proposed integration of both nature-health theories to the resilience process</u>

The resilience process is an atheoretical, empirical endeavour (Luthar et al., 2000). Consequently, resilience research has been criticised for identifying protective factors that foster positive adaptation without any causal explanations (see Harrop et al., 2007, p. 54). There is a call for resilience research to account for the mechanisms between protective factors and positive adaptation (Harrop et al., 2007, p. 54). As such, the resilience process is often integrated into existing theories in order to identify causal mechanisms of positive adaptation (Luthar et al., 2000). The following illustrates a way in which the ART and the psycho-evolutionary model may integrate into the resilience process. These integrations are merely descriptive to describe how interacting with nature can contribute to resilience, and are not tested in thesis. This is may be one of the first times that the theories of restorative environments, and resilience have been brought together; resilience theory was not discussed in previous studies investigating natural environments as a protective factor against adversity (Corraliza & Collado, 2011; de Vries et al., 2003; Kuo, 2001; Maas et al., 2006; Maas et al., 2009; Mitchell & Popham, 2007; Mitchell & Popham, 2008; Ottosson & Grahn, 2008; Stuart, 2005; van den Berg et al., 2010; Ward Thompson et al., 2012; Wells & Evans, 2003).

ART may be related to the resilience process as a protective factor and facilitator of post-traumatic growth. Directed attention is essential for the cognitive abilities of selection, inhibition and thought, all of which are constituents of problem solving (S. Kaplan, 1995). Problem solving is essential for coping with adversity. The ability to think clearly is needed to work through a traumatic event (Joseph, 2012). For example, directed attention is necessary for "stepping back from the situation one is facing, for pausing to get a larger picture of what is going on….[and] deal with situations in which the appropriate action is not immediately obvious" (S. Kaplan, 1995, p. 171). It may be possible that the higher level restorative experiences of nature as theorised by ART– thinking about life matters and self-reflection – could facilitate the cognitive restructuring necessary for post-traumatic growth. Thinking about life matters helps people "take stock" of the traumatic event and its impact (Joseph, 2012, p. 818). Self-reflection of one's life, priorities and goals are necessary for identifying, valuing and expressing post-adversity change (Joseph, 2012, p. 818). It is speculated in this thesis that ART could facilitate resilience by managing one's life post-adversity and facilitating post-traumatic growth.

The psycho-evolutionary model may relate to the resilience process as a mechanism for recovery of functioning after adversity. After the cessation of a stressor, an individual may experience after-effects of stress – consequences of the stressor on psychological functioning and physiological health (Bell et al., 2001, p. 123). The recovery from the after-effects of stress appears to closely fit the definition of resilience as the recovery of well-being following exposure to adversity or risk (Bonanno, 2004; Mancini & Bonanno, 2010; Ryff et al., 1998). Recovery from the after-effects of adversity could be facilitated by spending time in the natural environment (Ulrich et al., 1991). For an individual who has experienced adversity, a natural environment may provide a psycho-physiological 'breather' from stress by holding one's interest to block out stressful thoughts and reduce physiological stress responses (Ulrich, 1983; Ulrich et al., 1991).

Interacting with natural environments may increase positive affect for individuals who have experienced adversity (Ulrich et al., 1991); positive affect has been shown to be an individual-level protective factor that fosters resilience (Fredrickson et al., 2003; Tugade & Fredrickson, 2004). The psycho-evolutionary model posits that interaction with natural environments can motivate adaptive behaviour (Ulrich, 1983; Ulrich et al., 1991). For example, the natural environment could motivate behaviour to explore the natural surroundings (Ulrich, 1983), a behaviour which could result in feelings of self-efficacy (Ulrich, 1983). Self-efficacy is an individual-level protective factor that can foster resilience (Masten & Reed, 2005).

In sum, this thesis has attempted to show that ART may facilitate resilience through the restoration of direction attention to assist with problem solving and post-adversity growth, and that the psycho-evolutionary model may facilitate resilience through the recovery of the after-effects of stress.

2.3 Walking in natural environments and well-being

2.3.1 Research context – The Walking for Health programme

The opportunity to conduct research into the well-being benefits of outdoor walking groups was presented by Walking for Health (WfH), a national led group walk programme in England aimed to increase people's levels of physical activity and improve their health (Fitches, 2011). WfH does this by providing free, short, led, health walks for groups of individuals (Walking for Health, 2013a). A health walk is a "purposeful, brisk walk undertaken on a regular basis and carried out for the purpose of improving health" (The Countryside Agency, 2006).

WfH health walks are delivered on a local level by WfH walk schemes. In 2012, there were 3,400 WfH led group walks per week delivered by 600 WfH walk schemes across England (Walking for Health, 2013a). Trained walk leaders lead all WfH group walks (South et al., 2013; Walking for Health, 2013a). A standard WfH health walk is a moderate intensity walk for less than an hour on flat ground without stiles for 1-3 miles (Walking for Health, 2013f). Walk schemes offer a variety of health walks based on distance, duration, terrain or pace in order to cater for a range of walkers' abilities.

A majority of WfH walks are outdoors in semi-natural or natural environments, such as a park, country park or nature reserve (Hynds & Allibone, 2009). However, WfH walks can also occur in urban environments - and at least one occurs indoors in a shopping mall (Walking for Health, 2013d). It has been suggested that WfH walks in parks attract more participants than WfH walks in other environments (Local Government Information Unit, 2010, p. 10). However, no data are available to determine attendance of WfH walks by environment type[3].

[3] Further research in this area may be possible with the national WfH database.

WfH has been running for the past 13 years. It started in 2000 by an English GP, Dr William Bird, the Countryside Agency and the British Heart Foundation (Walking for Health, 2010). In 2006, ownership of WfH transferred to Natural England (Fitches, 2011). In 2009, the Department of Health began working with Natural England to expand participation in WfH (Fitches, 2011). In April 2012, management of WfH was transferred to the Ramblers and Macmillian Cancer Support (Walking for Health, 2012).

The WfH management is responsible for evaluation and promotion of WfH, and non-financial support to local walk schemes and walk leaders. Evaluation of WfH is primarily conducted through the Outdoor Health Questionnaire (OHQ) - a one-page questionnaire about walkers' contact details, demographics, health status, physical activity and willingness to be contacted for evaluation purposes (Walking for Health, 2013c). All new WfH walkers must complete an OHQ (Walking for Health, 2013c). These data are stored on a national WfH database, along with data on walk attendance (Walking for Health, 2013b). Data for this thesis were collected with the support of Natural England, who provided access to participants and data from the WfH national database.

2.3.2 Critique of group walking studies

A review of the literature was conducted to identify studies in which participants walked in a group. Table 2.1 lists 29 studies about group walking and their research design, measures used, sample size and type of publication. Evaluations of WfH are listed above the solid black line in Table 2.1. A critique of the methodological and conceptual framework of these 29 studies will be discussed below.

Table 2.1. Group walking studies reviewed in this thesis, research design, measures used, and type of publication.

	Evaluation Design					Measures							Sample size	Type of Publication
	Qualitative	Quantitative	Pre-post single group	Comparison group	Experimental - RCT	Physical well-being[1]	Emotional well-being	Social well-being	Mental well-being	Mental health (depression, stress)	Self-esteem	Connectedness / Relatedness to Nature		
(Dawson et al., 2006)	✓		✓[2]			✓							750	Report
(Pretty et al., 2007)		✓		✓[4]			✓				✓		263	Peer
(Hynds & Allibone, 2009)	✓												29	Report
(Coleman et al., 2011)		✓	✓[2]										79,038	Report
(Fitches, 2011)		✓											50,000	Report
(Jackson, 2011)	✓	✓				✓							31	Report
(Phillips et al., 2011)	✓					✓							1,464	Report
(Phillips et al., 2012)		✓		✓[6]		✓							4,500	Report
(Villalba van Dijk et al., 2012)	✓	✓											5	Report
(South et al., 2013)	✓										✓		77	Report
(Armstrong & Edwards, 2003)		✓			✓					✓			20	Peer
(Armstrong & Edwards, 2004)		✓			✓					✓			19	Peer
(Kwak et al., 2005)		✓						✓					284	Peer
(Issacs et al., 2007)		✓			✓	✓				✓			943	Peer
(Priest, 2007)	✓												14	Peer
(Peacock et al., 2007)		✓		✓[3]			✓				✓		20	Report
(Plante et al., 2007) Study 2		✓			✓		✓						88	Peer
(Gusi et al., 2008)		✓			✓					✓			106	Peer
(Krieger et al., 2009)		✓	✓[2]				✓	✓					53	Peer
(Mayer et al., 2009) Study 1		✓		✓			✓					✓	76	Peer
(CLES Consulting, 2010)	✓	✓		✓[6]		✓							6,479	Report
(Hawkins et al., 2011)		✓		✓[7]		✓		✓		✓			94	Peer
(Hine et al., 2011)		✓	✓				✓					✓	61	Report
(Holmes & Evans, 2011)	✓												10	Report
(Johansson et al., 2011)		✓		✓[3]			✓			✓			20	Peer

	Evaluation Design					Measures							Sample size	Type of Publication
	Qualitative	Quantitative	Pre-post single group	Comparison group	Experimental - RCT	Physical well-being[1]	Emotional well-being	Social well-being	Mental well-being	Mental health (depression, stress)	Self-esteem	Connectedness / Relatedness to Nature		
(Roe & Aspinall, 2011) Study 1		✓		✓[5]			✓			✓	✓		123	Peer
(Roe & Aspinall, 2011) Study 2		✓		✓[3]			✓			✓	✓		24	*As above*
(Barton et al., 2012)		✓		✓[8]			✓				✓		53	Peer
(Wensley & Slade, 2012)	✓												6	Peer
Number of studies per category	10	22	4	10	5	7	10	3	0	8	6	2	-	-

Note. Studies above the dark line were evaluations of WfH.
RCT = randomised controlled trial. Peer = peer-reviewed. Report = non-peer reviewed document or 'grey literature'.
1 = physical activity measures.
2 = longitudinal.
3 = urban vs. nature.
4 = other types of green exercise, no control or non exercise group.
5 = mental ill vs. mentally healthy.
6 = users vs. non-users of the programme.
7 = allotment gardeners vs. home gardeners vs. group walkers vs. indoor exercisers.
8 = group walk vs. social sedentary vs. indoor swimming.

Methodological critique

Population

Ten of the 29 studies in Table 2.1 investigated WfH walks. The other 19 studies investigated another walking programme (e.g. Mind or Ramblers) or a walking group formed for the research study.

Research design

Three different types of research designs were used in the 30 group walking studies listed in Table 2.1: wholly quantitative; wholly qualitative; and mixed methods. Sixty-six percent (*n* = 19) of all 29 group walking studies were wholly quantitative, 17% were wholly qualitative (*n* = 5) and 17% (*n* = 4) were mixed methods.

Comparing the research designs of WfH and non-WfH evaluations, WfH evaluations conducted half as many wholly quantitative research as non-WfH group walk studies (see Table 2.1). Wholly quantitative studies comprised 40% of all WfH evaluations (*n* = 4) compared to approximately 80% of all non-WfH group walk studies (*n* = 15). The number of wholly qualitative research used in WfH and non-WfH walking group studies was approximately the same. Wholly qualitative studies accounted for 20% of all WfH evaluations (*n* = 2) and 16% of all non-WfH evaluations (*n* = 3). Considerably more WfH evaluations used mixed methods than non-WfH research. Forty percent (*n* = 4) of WfH studies used mixed methods compared to 5% of the non-WfH group walking studies (*n* = 1). Overall, it appears that more wholly quantitative research on WfH is necessary in order to keep pace with the wider group walking literature.

The evaluations of WfH could be strengthened to improve causality. Eighty percent of WfH evaluations listed in Table 2.1 (*n* = 8) did not have a comparison group, 20% had a non-randomised comparison group and none were a Randomised Controlled Trial (RCT). WfH studies without a comparison group were either descriptive surveys of WfH (Fitches, 2011; Jackson, 2011; Phillips et al., 2011; Villalba van Dijk et al., 2012) or a longitudinal panel design to discern change of a single group of participants over time (Coleman et al., 2011; Dawson et al., 2006). Non-randomised comparison studies compared current and lapsed WfH users (Phillips et al., 2012) or various types of green exercise (Pretty et al., 2007). A major limitation of the Pretty et al. (2007) was the lack of a non-exercise or non-nature control group (Bird, 2007; Newton, 2007); thus the positive emotional well-being and self-esteem effects from engaging in green exercise witnessed in Pretty et al. (2007) could have been due to the physical activity, the natural environment, or being in a research study.

The lack of methodological rigor in WfH studies becomes apparent when compared to the 19 non-WfH group walk studies listed in Table 2.1. Thirty-two percent of the non-WfH group walk studies (*n* = 6) did not have a comparison group, 42% (*n* = 8) had a non-randomised comparison group, and 26% were a RCT (*n* = 5). Seven studies took pre-test measurements prior to the group walk intervention which allowed for analysis of change over time (Armstrong & Edwards, 2003; Armstrong & Edwards, 2004; Gusi et al., 2008; Hine et al., 2011; Issacs et al., 2007; Krieger et al., 2009; Plante et al., 2007). However, two of these studies assessed change in a single group of participants (Hine et al., 2011; Krieger et al., 2009).

Overall, WfH group walking studies are mostly descriptive studies. Validity of these studies is questioned through the lack of a comparison group. Non-WfH group walk research is concerned more with demonstrating causality than current WfH research. Further research into WfH should at least have a comparison group.

Measures

Table 2.1 shows the types of measures used in group walking studies. Emotional well-being was the most common outcome measure across all 29 group walking studies (*n* = 11). Table 2.1 shows a clear research gap in the use of mental well-being measures, as none of the 29 group walk studies measured mental well-being. Social well-being measures were investigated in 3 group walk studies (10%).

Looking specifically at WfH and non-WfH studies, WfH studies used a limited selection of outcome measures, compared to non-WfH group walking studies which investigated a variety of well-being measures. Physical well-being was the most common quantitative outcome measure of WfH studies, used in 40% of all studies (*n* = 4) (see Table 2.1). Emotional well-being was assessed in only one WfH study (10%). Self-esteem measures were used in 20% of all WfH studies (*n* = 2). No WfH study quantitatively investigated mental or social well-being, mental health or connection to nature; these outcomes were investigated qualitatively.

In contrast, physical well-being was assessed in 15% of non-WfH group walking studies (*n* = 3) (see Table 2.1). Emotional well-being was the most common quantitative measure, assessed in 47% of all non-WfH group walking studies (*n* = 9). Measures of mental illness (e.g. depression, stress) were the second most common outcome measure, used in 40% (*n* = 8) of all non-WfH group walking studies. Self-esteem measures were used in 20% of all non-WfH studies (*n* = 4). Three non-WfH group (15%) walking studies quantitatively investigated social well-being, which was measured as social connectedness (Krieger et al., 2009), social support (Hawkins et al., 2011), or social cohesion (Kwak et al., 2005). Connection to nature measures were used in 11% of non-WfH group walk studies (*n* = 2). Mental well-being was not quantitatively measured in any of the 19 non-WfH group walking studies listed in Table 2.2; it was only investigated qualitatively (Holmes & Evans, 2011; Priest, 2007; Wensley & Slade, 2012).

Overall, with one exception, WfH studies did not use outcome measures of mental, emotional or social well-being. This is in contrast to the wider literature on outdoor group walks, which investigates mental health, and emotional and social well-being outcomes. There is a research gap in group walking studies in the use of mental well-being measures.

Sample size

Sample sizes in the 29 studies listed in Table 2.1 range from 5 to 79,038. The majority of WfH studies listed in Table 2.1 satisfies the call for larger samples in nature-health research (Bowler et al., 2010; Thompson Coon et al., 2011). Sixty percent (*n* = 6) of WfH studies had sample sizes over 100 participants, of which 4 studies had sample sizes greater than 1,000. The very large population of WfH walkers (~70,000) enables researchers to recruit a large sample. In contrast, 26% (*n* = 5) of non-WfH studies listed in Table 2.1 had sample sizes over 100 participants, of which only 1 study had a sample size greater than 1,000 (CLES Consulting, 2010). The CLES consulting study was able to achieve such a large sample size because it evaluated a national group walk scheme in England, entitled Get Walking Keep Walking, with a population over 64,000 individuals. Seventy-four percent of non-WfH studies (*n* = 14) had a sample size of less than 100 participants.

Overall, group walking studies that evaluate national group walking schemes are able to achieve very large general sample sizes, otherwise group walking studies have small sample sizes of less than 100 participants.

Publication type

Table 2.1 lists the publication type for each group walk study as either a peer-reviewed journal or a non-peer reviewed report. Studies which are published in peer-reviewed journals have been evaluated by other researchers for the robustness of the research, analysis and conclusions. The majority of the 29 group walking studies listed in Table 2.1 were published in peer-reviewed journals (55%, *n* = 16). However, this was mostly due to non-WfH group walking studies. Approximately 80% of all non-WfH group walking studies listed in Table 2.1 (*n* = 15) were published in a peer-reviewed journal. In contrast, 90% percent of all WfH studies listed in Table 2.1 (*n* = 9) were institutional reports. Overall, research on WfH is not being published in peer-reviewed journals, unlike the majority of group walking studies.

Country and environmental setting

Table 2.2 describes the country in which the walking group research was conducted. The majority of group walking studies (69%, *n* = 20) were conducted on UK samples, which is opposite to the research area five years ago in which there were few UK green exercise studies (Barton, 2008; Pretty et al., 2007). Both the US and Australia had three group walking studies each, and Sweden had one walk group study.

Table 2.2 details the types of environment(s) investigated in the 29 group walk studies. Environment types are based on the English Planning Policy Guidance on open space (Department for Communities and Local Government, 2002) and analysis conducted in Chapter 9. Fourteen group walk studies did not provide information about the environmental setting, of which 57% were WfH studies (*n* = 8) and 42% were of non-WfH studies (*n* = 6). Sixteen studies discussed the type of environment for an outdoor group walk. The most common types of natural environment analysed in group walking studies were natural and semi-natural areas (e.g. country park, nature reserve, woodland, lake) and urban green space (e.g. park, allotment). Other natural environments for a group walk were farmland (or countryside), green corridor and coastal (see Table 2.2).

Table 2.2. Environment type of group walk studies.

	Country	Environment Type								
		Not applicable / Not discussed	Natural & Semi-natural	Green corridor	Farmland	Urban green space	Urban environment	Indoors	Coastal	University campus
(Dawson et al., 2006)	UK	✓								
(Pretty et al., 2007)	UK		✓	✓	✓	✓			✓	
(Hynds & Allibone, 2009)	England		✓			✓				
(Coleman et al., 2011)	England	✓								
(Fitches, 2011)	England	✓								
(Jackson, 2011)	England	✓								
(Phillips et al., 2011)	England	✓								
(Phillips et al., 2012)	England	✓								
(Villalba van Dijk et al., 2012)	England	✓								
(South et al., 2013)	England	✓								
(Armstrong & Edwards, 2003)	Australia	✓								
(Armstrong & Edwards, 2004)	Australia	✓								
(Kwak et al., 2005)	Australia	✓								
(Issacs et al., 2007)	England					✓				
(Priest, 2007)	UK				✓					
(Peacock et al., 2007)	England		✓					✓		
(Plante et al., 2007) Study 2	USA							✓		✓
(Gusi et al., 2008)	Spain		✓			✓				
(Krieger et al., 2009)	USA		✓							
(Mayer et al., 2009) Study 1	USA		✓				✓			
(CLES Consulting, 2010)	England	✓								
(Hawkins et al., 2011)	Wales					✓		✓		
(Hine et al., 2011)	UK	✓								
(Holmes & Evans, 2011)	England			✓						
(Johansson et al., 2011)	Sweden					✓	✓			
(Roe & Aspinall, 2011) Study 1	Scotland				✓					
(Roe & Aspinall, 2011) Study 2	Scotland		✓				✓			
(Barton et al., 2012)	England		✓					✓		
(Wensley & Slade, 2012)	England	✓								
Number of studies per category	-	14	8	2	3	6	3	4	1	1

Note. Studies above the dark line were evaluations of WfH.

Nine group walking studies compared different environments, the majority of which (*n* = 7) analysed a non-natural environment as a comparator (see Table 2.2). Three studies compared the effect of a group walk in an urban or a natural environment (Johansson et al., 2011; Mayer et al., 2009; Roe & Aspinall, 2011). Four studies compared the difference between indoor physical activity to group walks in a natural environment (usually a gym or a shopping mall) (Barton et al., 2012; Hawkins et al., 2011; Peacock et al., 2007; Plante et al., 2007). Two walking studies compared different types of natural environments (Hawkins et al., 2011; Pretty et al., 2007), although neither study compared the same activity (group walking) in each environment.

Overall, the majority of group walking studies do not describe the environment type. The most common types of natural environment described in these 29 studies were natural/semi-natural or urban green space. Seven studies compared group walks in natural or indoor/urban environments. No studies compared the outcomes of group walks in different types of natural environments.

Conceptual critique

Table 2.3 presents a theoretical basis of the 29 group walking studies. Studies were investigated for the type of theory (or theories) used. Studies were labelled as 'atheoretical' on the following two conditions:

- Theory was not discussed in the article, or
- Theory was discussed in the introduction, *but* it did not inform measure selection (*if quantitative*), *and* research findings were not discussed in relation to theory in the conclusion section.

Fifty two percent of group walking studies were atheoretical (*n* = 15). Of which, eight were WfH studies and seven were non-WfH group walking studies (see Table 2.3). Thirty eight percent (*n* = 11) of group walking studies were grounded in one theory, of which the majority were non-WfH studies (*n* = 9). Three group walking studies were grounded in more than one theory. The two most commonly used theories were ART (*n* = 6) and/or the psycho-evolutionary model (*n* = 5). Personal project teaching was used by Roe and Aspinall (2011). Other theories (e.g. environmental justice, behavioural theory) were used in one study each.

Overall, it appears that the 29 group walk studies considered here are, on the majority, atheoretical. This is especially relevant for WfH studies. When a theory was used in a group walking study, it was likely to be ART or the psycho-evolutionary model. Multiple theories were rare, accounting for 10% of all group walking studies considered here.

Table 2.3. The theoretical basis of each group walking study.

	Theory									
	Atheoretical / Not stated / Programme evaluation	Attention Restoration theory	Psycho-evolutionary model	Environmental Justice	Behavioural theory	Theory of human occupation	Personal project teaching	Healing balm of nature	Distraction hypothesis	Theory of change
(Dawson et al., 2006)	✓									
(Pretty et al., 2007)			✓							
(Hynds & Allibone, 2009)	✓									
(Coleman et al., 2011)	✓									
(Fitches, 2011)	✓									
(Jackson, 2011)	✓									
(Phillips et al., 2011)	✓									
(Phillips et al., 2012)	✓									
(Villalba van Dijk et al., 2012)	✓									
(South et al., 2013)										✓
(Armstrong & Edwards, 2003)	✓									
(Armstrong & Edwards, 2004)	✓									
(Kwak et al., 2005)					✓					
(Issacs et al., 2007)	✓									
(Priest, 2007)		✓							✓	
(Peacock et al., 2007)			✓							
(Plante et al., 2007) Study 2	✓									
(Gusi et al., 2008)	✓									
(Krieger et al., 2009)				✓						
(Mayer et al., 2009) Study 1		✓								
(CLES Consulting, 2010)	✓									
(Hawkins et al., 2011)		✓								
(Hine et al., 2011)	✓									
(Holmes & Evans, 2011)								✓		
(Johansson et al., 2011)		✓								
(Roe & Aspinall, 2011) Study 1		✓	✓				✓			
(Roe & Aspinall, 2011) Study 2		✓	✓				✓			
(Barton et al., 2012)			✓							
(Wensley & Slade, 2012)						✓				
Number of studies per category	15	6	5	1	1	1	2	1	1	1

Note. Studies above the dark line were evaluations of WfH.

2.3.3 Research gaps

Research into the well-being benefits of outdoor group walks is relatively new and as such there are considerable methodological and theoretical gaps in knowledge. Future group walking studies should attempt to demonstrate causality, or the impact of the natural environment on health and well-being (Brown et al., 2011). The majority of green exercise evaluations did not have a control or comparison group (Brown et al., 2011). In their review of 40 green exercise studies in the UK, Brown et al. (2011) found 80% (n = 32) of green exercise studies did not have a comparison group, 10% (n = 4) of the studies had a non-randomised comparison group and 5% (n = 2) of studies were a RCT. To help demonstrate the impact of the natural environment on well-being, future research should investigate the mechanisms through which outdoor group walks affect well-being (Health Council of the Netherlands and Dutch Advisory Council for Research on Spatial Planning, Nature and the Environment, 2004; Maas, van Dillen, Verheij, & Groenewegen, 2009).

Future research should quantitatively assess the effects of a walking group on multiple dimensions of well-being (Newton, 2007). Emotional well-being is the most common quantitative outcome measure in nature and health studies, based on the results from three systematic reviews (Bowler et al., 2010; Brown et al., 2011; Thompson Coon et al., 2011). However, there is a lack of research on mental and social well-being outcomes in nature and health research (Newton, 2007). Mental well-being was not measured in any of the 24 nature-health studies investigated by Bowler et al. (2010), nor in any of the 11 nature-health studies reviewed by Thompson Coon et al. (2011), and only measured in two out for 40 (5%) UK green exercise studies reviewed by Brown et al. (2011). Social well-being was not measured in any of the studies reviewed by Bowler et al. (2010), Thompson Coon et al. (2011), and Brown et al. (2011).

There is a research gap on whether outdoor walking groups can foster resilience. Previous studies have shown that interaction with nature could foster resilience (e.g. Cimprich & Ronis, 2003; Kuo, 2001; Ottosson & Grahn, 2008; Stuart, 2005) . To date, only one study (Ottosson & Grahn, 2008) has investigated walking and resilience – and it is unclear whether participants were walking alone or with others. Qualitative research suggests that WfH outdoor walking groups may help people cope with adversity (Hynds & Allibone, 2009; South et al., 2013). Furthermore, no study has integrated the theories of restorative natural environments with the resilience process; this will be discussed in more detail in Chapter 8.

Future studies are also required to understand the well-being effects of group walks in different types of natural environments. The majority of nature and health research either investigates a single type of natural environment (Velarde, Fry, & Tveit, 2007) or compares a single type of natural environment to an urban or indoor environment (Bowler et al., 2010; Thompson Coon et al., 2011). There is a call for research that compares the well-being effects of different types of natural environments (Bowler et al., 2010; Croucher, Myers, & Bretherton, 2007; Jorgensen & Gobster, 2010; Lee & Maheswaran, 2011; Mitchell, 2013; Thompson Coon et al., 2011; Velarde et al., 2007).

Larger sample sizes are required in future nature-health studies (Bowler et al., 2010; Thompson Coon et al., 2011). The median number of participants from all studies included in each systematic review was 38 (Bowler et al., 2010) and 44 (Thompson Coon et al., 2011). Conceptually, the research of outdoor group walking can be strengthened, as the majority of studies were atheoretical.

To address some of these identified gaps, this thesis will compare the mental and emotional well-being of WfH group walkers and non-group walkers, increase the understanding of the possible mechanisms that explain the relationship between outdoor group walk participation and well-being, and investigate whether outdoor group walks foster resilience. Objectives 1, 2 and 3 of this thesis will address this research gap. Objective 4 will address a research gap about the effect of types of natural environments on mental and emotional well-being by comparing the mental and emotional well-being of group walkers who walk in six different types of natural environments to group walkers who walk in urban environments. Investigating the WfH programme provides access to a large population, which may facilitate recruitment of a large sample size.

2.4 Chapter summary

The purpose of this chapter was to present the three theories used in the thesis, propose relations between the theories of restorative environments and the theories of coping and resilience, and critique the outdoor group walks literature. This thesis draws on multiple theories to investigate the well-being of outdoor walking groups. It is proposed in this thesis that the Attention Restoration Theory and the psycho-evolutionary model integrate with the theories of coping and resilience in order to gain a broader understanding of the well-being benefits from interaction with natural environments.

Review of the group walking literature identified gaps in the research into Walking for Health, specifically, the lack of quantitative research on the impact WfH participation has on non-physical well-being, the dearth of studies that investigate mental or social well-being, the need to examine the causal mechanisms that account for the relationship between outdoor group walks and well-being, and whether outdoor group walks could foster resilience, and the call for research comparing different types of natural environments. Given these gaps in the literature, this study focuses on the effects of outdoor group walk participation on mental and emotional well-being. The next chapter describes the methodology by which this research was conducted.

Chapter 3 Methods

This chapter describes the methods used for the research conducted. The sections discuss the study design, participant recruitment and data collection procedure used in this thesis.

3.1 Study design

3.1.1 Nonexperimental research design

The aim of this study was to evaluate outdoor group walks as a potential public health intervention for positive mental and emotional well-being. A nonexperimental, longitudinal panel design was developed to explore the mental and emotional well-being from participating in an outdoor walking group. Two groups of individuals were assessed in this study: adults who were involved in WfH group walks (Group Walkers); and a comparison group of adults who were not involved in any walking group (Non-Group Walkers). Non-users of a programme have been used as a comparison group in previous green exercise evaluations (CLES Consulting, 2010; Milton, Kelly, & Foster, 2009; O'Brien & Morris, 2009; Phillips et al., 2012).

Nonexperimental studies collect data from pre-existing groups without manipulating any variables (Belli, 2009; Graziano & Raulin, 2007; Howitt & Cramer, 2008). Participants in a nonexperimental study are *ex post facto* groups of individuals that existed before the research study was conducted (Belli, 2009; Graziano & Raulin, 2007). Such studies are also known as 'observational', 'correlation' or 'non-manipulation' studies (Belli, 2009; Howitt & Cramer, 2008). Nonexperimental research differs from a quasi-experimental research design in that the latter assigns participants from pre-existing groups to different treatment conditions (Belli, 2009; Reichardt, 2009). This study therefore was nonexperimental because the 'treatment' variable – WfH group walk participation – was measured, not manipulated.

A nonexperimental design was preferred to either an experimental or quasi-experimental design for this study as it enabled the exploitation of a very large sample of available participants (over 100,000) who were involved or used to be involved in the WfH programme. Recent systematic reviews of nature and health have called for future studies with a large sample size comprised of individuals from the general population (Bowler et al., 2010; Thompson Coon et al., 2011). A large sample is beneficial for nonexperimental studies as it allows for the statistical control of multiple confounding variables (Tabachnick & Fidell, 2013) and provides the statistical power required to discern significant associations (Howitt & Cramer, 2008).

3.1.2 Epistemological approach to the thesis

An epistemological approach is the overarching context of the research; it influences the methodology, the methods selected for a study and analysis of data (Gray, 2009). Epistemology is the philosophical study of knowledge. As a study of knowledge, it is concerned with which kinds of knowledge are legitimate and adequate to investigate the nature of reality (Gray, 2009). This thesis has an objectivist epistemology, which assumes that there is an objective reality, independent of human consciousness (Gray, 2009). This differs from the social constructed or subjective epistemological perspectives, which claim reality is socially constructed or subjective (Gray, 2009).

The positivist paradigm is associated with an objectivist epistemology (Gray, 2009). The tenants of positivism are that reality is objective and knowledge about reality is derived from objective, observed facts (Robson, 2011). Facts are independent of the researcher, meaning the researcher does not influence observed reality (Gray, 2009; Robson, 2011). Positivist research approaches are often quantitative and involve hypothesis testing (Robson, 2011). A hypothesis is rejected if the facts do not support it. Facts are often collected with reliable and valid measures (Robson, 2011). The research presented in this thesis is based on the positivist paradigm using a quantitative method and valid and reliable measures to collect data about an objective and observable reality.

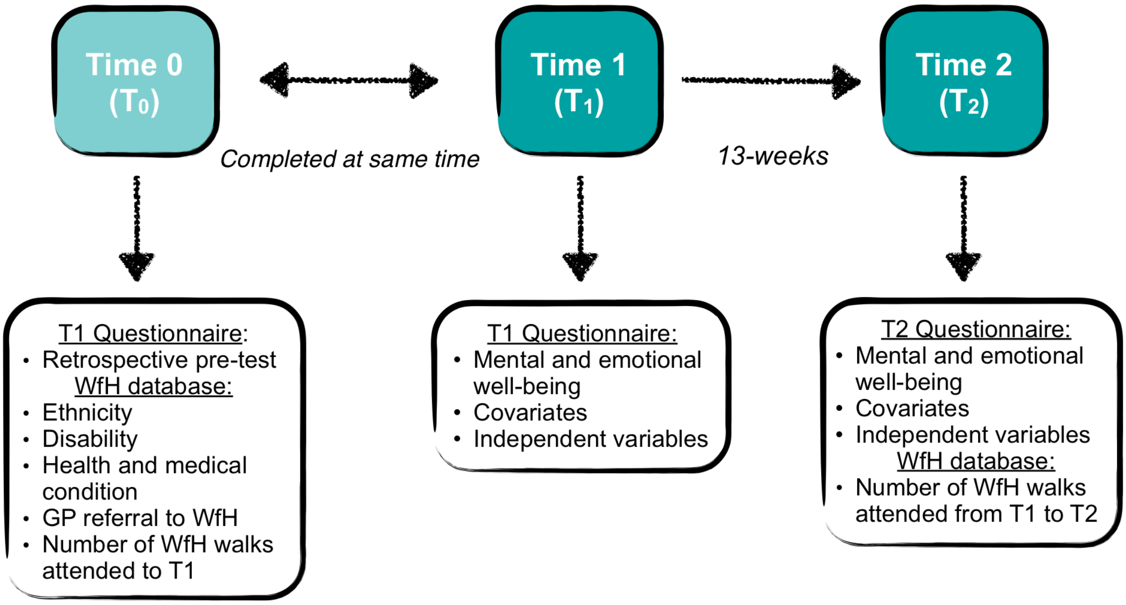
However, there are limitations to this positivist research approach. For example, facts could fail to be captured if the wrong quantitative measure is used. As such, a mix of both quantitative (or positivist) and qualitative research approaches is recommended for evaluating nature and health interventions to overcome the methodological limitations of each research approach (Brown et al., 2011). I decided against a mixed-methods approach in favour of an entirely positivist, quantitative method because of the need for wholly quantitative evaluations of WfH (see Section 2.3.2), the lack of comparison groups in the majority of nature-health interventions (Brown et al., 2011), and the desire to take advantage of the large WfH population.

3.1.3 Longitudinal research design

A longitudinal study collects data from individuals over time. This study is a longitudinal panel design, which means data were collected from the same participants over time (Belli, 2009; Howitt & Cramer, 2008). The longitudinal focus was important as the majority of research into the well-being benefits from walks in natural environments is of short-term exposure usually less than one hour (Bowler et al., 2010; Hartig et al., 2003; Martens, Gutscher, & Bauer, 2011; Thompson Coon et al., 2011). Collecting data at two or more time points captures the temporal ordering of potential causes and effects; as such the longitudinal design helps address some of the threats to internal validity from a nonexperimental research design. There are two ways in which the data from a longitudinal design can be analysed. The first is cross-sectional, in which differences between groups at either Time 1 or Time 2 are investigated (Lambe, 2007). The second is the analysis of individual change over time (Lambe, 2007).

Figure 3.1 shows the research design, time points and method of data collection and type of data collected. Data collection occurred at two time points: Time 1 at the start of the study; and Time 2. The duration of time between the time points was 13-weeks or 3 months. This time interval was based on the average duration of a walking intervention from 36 studies (see Appendix A). The average WfH group walker attends five WfH walks within a three-month period (Coleman et al., 2011). As participants were from pre-existing groups, retrospective pre-test measures were administered at Time 1 (T1) to assess participants' mental and emotional well-being (i.e. mental well-being, positive affect, negative affect and depression) in the past; this is 'Time 0' in Figure 3.1. The majority of data were collected with two online questionnaires, supplemented with data obtained from the national WfH database. Section 3.3 will detail the type of data collected.

Figure 3.1. Research design.



3.2 Participant recruitment

Participants for this thesis were recruited between 1 August and 10 October 2011 either as a convenience sample from a WfH sampling frame or through snowball sampling. Both recruitment methods are a type of non-probability sampling (Robson, 2011; Stangor, 2007). Figure 3.2 shows the flow of participants through the study.

In 14 June 2011, Natural England provided a sampling frame of 31,235 individuals involved in WfH walks who had provided an e-mail address and given their consent to be contacted for program evaluation purposes on their Outdoor Health Questionnaire (OHQ). To gain access to these 31,235 individuals, and adhere to the guidelines of the 1998 Data Protection Act (Great Britain, 1998), individuals involved in WfH were informed about the research project in March 2011, five months before participant recruitment commenced. This was done in order to allow individuals the opportunity change their consent status about being contacted for evaluation purposes prior to the start of the study[4]. Individuals involved in WfH were informed about the study prior to recruitment in three ways: a letter to WfH regional coordinators; a mention on the

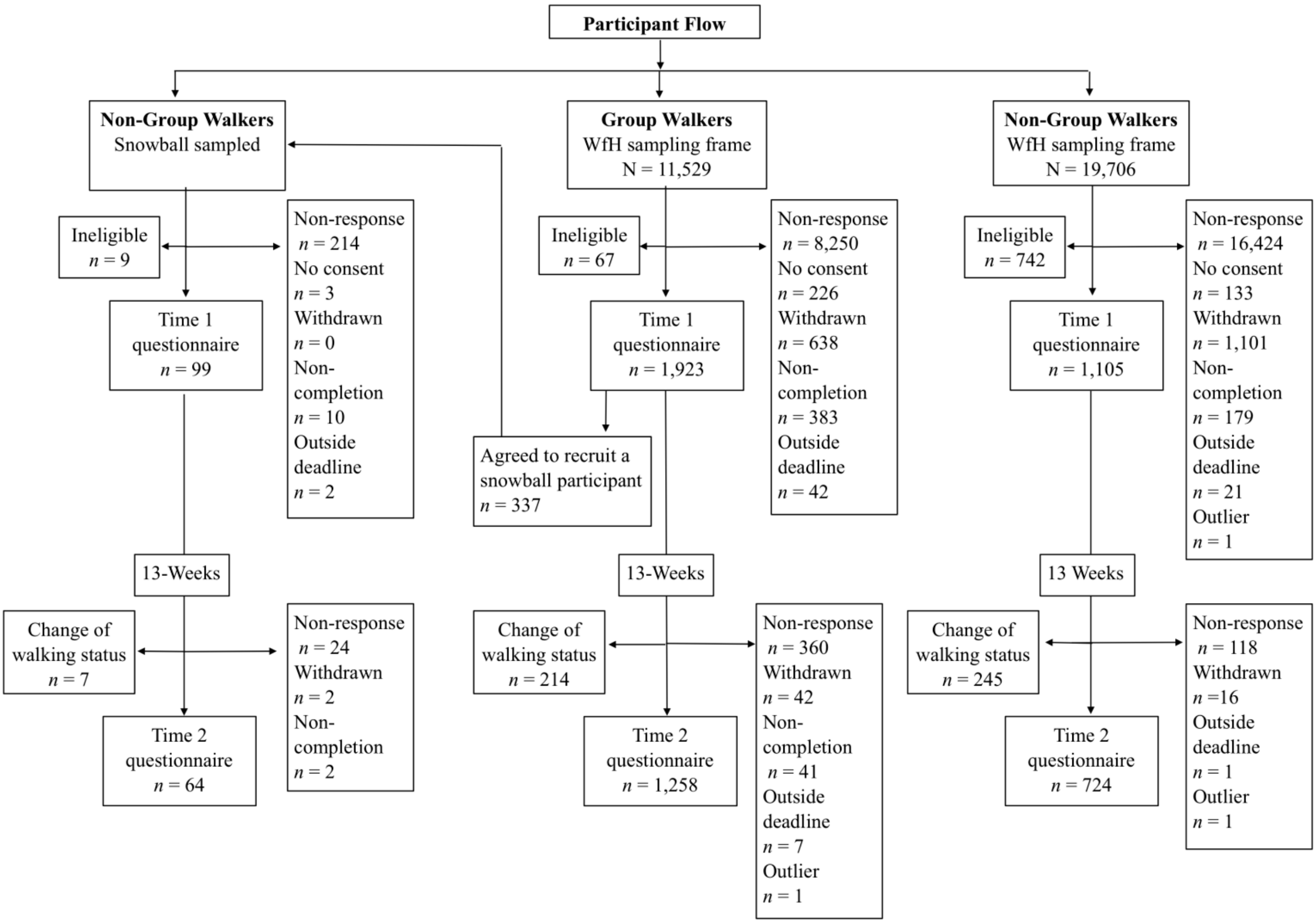
[4] Change of consent status prior to the start of participant requirement was handled by Natural England Walking for Health. Consequently, the number of individuals who changed their consent status at this time is not known.

‘research and evaluation’ webpage on the WfH website and a news article on the WfH website (see Appendix B).

An individual from the WfH sampling frame was defined as a Group Walker or Non-Group Walker based on the date of his or her most recent WfH walk recorded in the sampling frame. Based on a previous WfH evaluation (Phillips et al., 2011), individuals were classified as a Non-Group Walker if they had stopped participating in WfH walks for 6 months or more based on the date of their most recent WfH walk recorded in the sampling frame. For this study, this was calculated as not attending a WfH walk since 14 January 2011 – 6 months before receiving the sampling frame on 14 June 2011. 19,706 individuals recorded in the sample frame had not attended a WfH walk since 14 January 2011; these individuals were classed as an ‘inactive’ Non-Group Walker. 11,529 individuals recorded in the sampling frame had attended a WfH walk on or after 14 January 2011; these individuals were classed as a Group Walker. 1,995 Group Walkers consented to the study and 1,923 met eligibility criteria. 1,774 ‘inactive’ Non-Group Walkers consented to the study and 1,092 met eligibility criteria. Section 3.2.1 further details the eligibility criteria of Group Walkers and ‘inactive’ Non-Group Walkers.

Snowball sampling was the originally planned recruitment method for Non-Group Walkers because Natural England wanted to prevent individuals who were ‘inactive’ in WfH from excessive research recruitment. Snowball sampled participants were sought to be similar to a Group Walker in order to obtain a matched comparison for each Group Walker. Snowball sampling occurred at the end of the Group Walkers’ Time 1 questionnaire. Group Walkers were asked, *“Would you be willing to help me recruit someone who does not participate in Walking for Health to take this survey? This person should be your same sex, within 10 years of your age, and live near you.”* Group Walkers who agreed to recruit a friend for the Non-Group Walker group were sent an invitation e-mail, which they were to forward to their friend. This was done in order to retain snowball sampled individuals’ confidentiality. Unfortunately, this recruitment method was limited in its success; only 99 Non-Group Walkers were recruited through snowball sampling (see Figure 3.2). Because the snowball recruitment method was unsuccessful, Natural England agreed to the recruitment of ‘inactive’ individuals from the WfH sampling frame as an alternative source of participants for the Non-Group Walkers comparison group.

Figure 3.2. Flow diagram of participants through study.



3.2.1 Eligibility criteria and checks

This section details the eligibility criteria for recruitment of participants to the research study and the checks embedded into the questionnaire to ensure each participant met and continued to meet these criteria.

Eligibility criteria

All individuals were eligible to take part in the study if they were:

1. Aged 18 years or older
2. Provided an e-mail address
3. Resident in England and
4. Gave consent to participate in the study.

In addition to the above criteria, each group of participants – Group Walkers, 'inactive' Non-Group Walkers and snowball sampled Non-Group Walkers – had specific eligibility criteria. These criteria were utilized in order to ensure as 'pure' a sample within each group as was feasible within the nonexperimental design. Participants who meet the below eligibility criteria comprise the *as treated* sample. Study participants who did not meet the below criteria were included in the *intention to treat* sample. The intention to treat sample will not be analysed in this thesis. Table 3.1 details the specific eligibility criteria for Group Walkers, 'inactive' Non-Group Walkers and snowball sampled Non-Group Walkers.

Participants were excluded from the study if they withdrew from the study, did not fully complete the questionnaire[5] or completed the online questionnaire outside the completion deadline. Over the course of the study, a total of 1,799 participants withdrew[6] from the study, 615 participants did not fully complete an online

[5] Questionnaires that contained a substantial amount of missing data were considered to be not fully complete.

[6] An 'unsubscribe' web link was provided in all study materials (i.e. invitation and reminder e-mails, Informed Consent) to eligible individuals. This web link took individuals to an online survey developed especially for this study, in which they could choose to withdraw from the study, change their 'consent to be contacted' status in the WfH database and/or request to be removed from the WfH database altogether. Requests to change one's 'contact' status or removal from the WfH database were forwarded to a Natural England WfH staff member who processed the individuals' requests. Individuals could also withdraw by e-mailing the author.

questionnaire (‘non-completion’ in Figure 3.2), and 73 participants completed the questionnaire after the completion deadline (‘outside deadline’ in Figure 3.2).

Table 3.1. Eligibility criteria of Group Walkers, 'inactive' Non-Group Walkers, and snowball sampled Non-Group Walkers.

Group of participants	Eligibility criteria
Group Walkers	• Attended at least one WfH walk from 14 January 2011 to Time 1 • Attended at least one WfH walk between Time 1 to Time 2.
‘Inactive’ Non-Group Walkers	• Did not attend any walking group from 14 January 2011 to Time 1 • Did not attend any walking group between Time 1 to Time 2.
Snowball sampled Non-Group Walkers	• Same sex as the Group Walker participant • Within 10 years of age of the Group Walker participant • Lived in the same city, or same or adjacent boroughs within London, as the Group Walker participant • Did not attend any walking group from 14 January 2011 to Time 1 • Did not attend any walking group between Time 1 to Time 2.

Eligibility checks

The online questionnaires contained several eligibility checks. The first of which was the consent form in the Time 1 (T1) questionnaire. This ensured all participants gave their consent to participate in the study, were over 18 years of age and resident in England; 362 participants did not give consent to take part in the study (see Figure 3.2).

Group Walkers' eligibility check concerned their *frequency of group walk* participation. This was assessed with two items: date of last walk and frequency of taking part in the walking group. These questions were asked at both time points. A Group Walker was ineligible if he or she responded that their last WfH walk occurred before 14 January 2011 (T1) or before August 2011 (T2)[7], or responded *'never'* to the frequency of taking part in WfH question. These eligibility checks identified 67 Group Walkers as ineligible to take part in the study at T1 and a further 214 Group Walkers who changed their walking status at T2 (see Figure 3.2).

Non-Group Walkers had two eligibility checks. 'Inactive' Non-Group Walkers were asked a *WfH validation* question in both online questionnaires. At T1, the validation question asked, *"Can you please clarify whether you have taken part in a Walking for Health health walk since 14th January 2011?*". Response options and the number included in each category are detailed:

- *I have **not** taken part in a health walk since 14 January 2011.*
    - More than 1,105 individuals responded *'yes'* to the above statement and were included in the *as treated* sample
- *I have taken part in a health walk since 14 January 2011 - and it was a Walking for Health health walk.*
    - 421 individuals who responded *'yes'* to the above statement were ineligible and removed from the questionnaire; no data were collected.
- *I have taken part in a health walk since 14 January 2011 - and it was not a Walking for Health health walk.*
- *I have taken part in a health walk since 14 January 2011 – but don't know if it was a Walking for Health health walk or not.*
    - 196 individuals responded *'yes'* to the final two statements; these individuals are ineligible for the *as treated* sample. They are included in the *intention to treat* sample (not analysed here).

[7] Twenty Group Walkers did not answer the question about the date of their most recent WfH walk, but were retained in the *as treated* sample because they indicated their average frequency of attending a WfH walk in 2011.

In the Time 2 (T2) questionnaire, the *WfH validation* question was the same, except the date was changed to *"10th of October".* 'Inactive' Non-Group Walkers who stated they had *not* taken part in a health walk since this date were included in the *as treated* sample. 155 'inactive' Non-Group Walkers changed their walking status at T2; these individuals were included in the *intention to treat* sample.

All Non-Group Walkers were asked the second eligibility check, which assessed whether the participant was a member of an outdoor walking group. This question was asked in both questionnaires. Participants who responded *'no'* to both questions were included in the *as treated* sample, those who responded with *'yes'* to either question were included in the *intention to treat* sample. The question and the number of participants who answered *'yes'* at T1 and T2 are detailed below:

At T1, all Non-Group Walkers were asked, *"Are you currently attending an outdoor walking group (such as the Ramblers or a private walking group)?"*

- 134 Non-Group Walkers (125 'inactive' Non-Group Walkers and 9 snowball sampled Non-Group Walkers) answered *yes* to the above question.

At Time 2, all Non-Group Walkers were asked "*Have you walked with an outdoor walking group (such as the Ramblers Association or a local walking group) since [the end of Time 1 survey]*[8]*?"*

- 97 Non-Group Walkers (90 were 'inactive' Non-Group Walkers and 7 snowball sampled Non-Group Walkers) answered *yes* to the above question.

3.2.2 Response rate

Calculation of a response rate is difficult because it is not known how many invitation e-mails were unable to be delivered or how many were read by potential participants. A response rate at the start of the study was based upon the *intention to treat* sample of all participants who consented to take part in the study.

[8] The date of the end of the Time 1 questionnaire differed between snowball sampled Non-Group Walkers and 'inactive' Non-Group Walkers. As such, the specific date is not entered above.

The response rate at the T1 questionnaire was:

- 21% for the Group Walkers (2,415/11,529),
- 10% for 'inactive' Non-Group Walker participants recruited through the WfH sampling frame (2,048/19,706)[9] and
- 36% for snowball sampled Non-Group Walkers (120/337).

The response rate for the T2 questionnaire was:

- 63% of Group Walkers (1,521/2,415),
- 47% 'inactive' Non-Group Walker participants recruited through the WfH sampling frame (971/2,048), and
- 61% for the snowball sampled Non-Group walkers (73/120).

The response rates presented here are considerably higher than the expected response rate of 4% based on a previous Natural England survey of WfH participants (F. Taylor, personal communication, 20 January 2011). Previous research has shown that a response rate of 24.5% can be expected from an online survey that is 15-30 minutes in length (Deutskens, De Ruyter, Wetzels, & Oosterveld, 2004).

3.2.3 Power analyses

Statistical power is the ability to reliably detect a statistically significant result (Tabachnick & Fidell, 2013, p. 36). It helps to avoid a Type 2 error – failing to find a significant effect when one exists. Power is associated with sample size. *A priori* power analyses were run in order to determine how many participants were required for this study in order to have enough power to detect a significant result (Tabachnick & Fidell, 2013). *A priori* power analyses were conducted with G*Power 3 power analysis programme (Faul, Erdfelder, Lang, & Buchner, 2007; Faul, Erdfelder, Buchner, & Lang, 2009) [10]. Four power analyses were conducted for each type of planned statistical analysis. In all four power analyses, alpha was set at .05, power at .90 and a small effect

[9] Response rate is unadjusted for the number of undeliverable e-mail addresses from the sampling frame. It is likely the response rate would be greater if the number of valid e-mails were used in the response rate calculations.

[10] In G*Power 3, standard multiple regression is assessed through the "Linear multiple regression: Fixed model, R^2 deviation from zero" procedure (see Faul et al., 2009). Hierarchical multiple regression is assessed through the "Linear multiple regression: Fixed model, R^2 increase" procedure (see Faul et al., 2009).

size was entered, as it was expected that participating in an outdoor walking group would have a small effect on well-being. Table 3.2 lists the total sample size required for each type of statistical analysis to have sufficient power to avoid a Type 2 error. The hierarchical multiple regression *a priori* power analysis assessed the power needed to reject the null hypothesis that group walk participation does not increase the proportion of variance in the outcome variable, after controlling for 10 covariates (Faul et al., 2009).

Table 3.2. Sample size calculations based on *a priori* power analyses for a specific type of analysis.

Statistical test	Total sample size required
Dependent samples *t*-test	327
Independent samples *t*-test	1,054
Standard multiple regression	2,063
Hierarchical multiple regression	1,053

The total *as treated* sample size at Time 1 contained 3,015 participants (1,923 Group Walkers and 1,092 Non-Group Walkers), which would provide sufficient power to detect a small effect for all *t*-test and both multiple regression analyses. A total of 1,991 *as treated* participants took part (1,258 Group Walkers and 788 Non-Group Walkers) in the study at Time 2. The loss of participants meant the target sample size was not met for standard multiple regression. The sample size at Time 2 had sufficient power for hierarchical multiple regression.

3.3 Online questionnaires

All data were collected by quantitative methods through two online questionnaires administered at Time 1 and 13-weeks later at Time 2. The online questionnaires were hosted by Qualtrics (www.qualtrics.com).

The Time 1 questionnaire contained 120 items, which assessed participants':

- Retrospective pre-test measures of mental well-being, depression and positive and negative affect
- Mental well-being, depression and positive and negative affect, social well-being, perceived stress, resiliency and connectedness to nature at the start of the study

- Stressful life events in the past year
- Frequency of outdoor walk behaviour
- Basic demographic information.

The Time 2 contained 109 items and assessed:

- Repeat measurements of mental well-being, depression and positive and negative affect, social well-being, perceived stress, resiliency and connectedness to nature
- Stressful life events in the previous 13-weeks
- Frequency of outdoor walk behaviour in previous 13-weeks,
- New items on physical activity, information about the walking group, type of environment for a group walk, and average duration of group walks and non-group walks in the previous 13-weeks.

Valid, reliable scales were used for all psychological constructs. Psychometric measures were selected based on evidence of their robust psychometric properties, uni-dimensionality, previous use in a British sample, and relevance to the research hypothesis and each group of participants. The measures used are listed in Table 3.3. The following sections describe the constructs and the measures used.

Table 3.3. List of constructs, measures, and scales investigated in the two online questionnaires.

Variable	Construct	Measure	Scale	Score Range
Outcome variables	Mental well-being	Mental well-being	Warwick Edinburgh Mental Well-Being Scale	Total Scale Score: 14-70
		Depression	Major Depression Inventory	Total Scale Score: 0-50
	Emotional well-being	Positive affect	PANAS	Total Scale Score: 10-50
		Negative affect	PANAS	Total Scale Score: 10-50
Independent variables	Adversity	Stressful life events	List of Threatening Experiences	Total Score: 0-11
		Socio-economic status	English Indices of Multiple Deprivation	Tertiles^: 1 = most deprived, 2 = Medium deprived, 3 = least deprived
	Group Walk behaviour	Length of time involved in group walk	Duration in years spent walking with a walking group	Number of years: 0-11
		Frequency of group walks	Average frequency of walking with walking group (WfH or otherwise)	Range at T1: 1 = Never; 9 = Daily Range at T2: 1 = Never; 7 = Daily
		Duration of group walks	Duration of all group walks in 13-week 'intervention' period	Range at T2 only: 0 minutes to 195 minutes (greater than 3 hours)
		Main type of environment walked in with walking group	Eight different categories	Natural/semi-natural place; green corridor; urban public space; urban green space; farmland; coastal; mixture of two or more environments^
Covariates	Social well-being	Social support	Interpersonal Support Evaluation List – Appraisal subscale	Total Scale Score: 0-30
	Nature connectedness		Connectedness to Nature	Total Scale Score: 14-70
	Perceived stress		Perceived Stress Scale	Total Scale Score: 0-40
	Resiliency	Psychological resiliency	Connor-Davidson resilience scale-10	Total Scale Score: 0-40
	Physical Activity		Single-item physical activity measure	Range at T2 only: 0 = 0 days; 7 = 7 days
	Non-Group walk behaviour	Frequency of non-group walks in green space	Average frequency of non-group walks in green space	Range at T1: 1 = Never; 9 = Daily Range at T2: 1 = Never; 7 = Daily
	Non-Group walk behaviour	Duration of non-group walks in green space	Duration of all non-group walks in green space in 13-week 'intervention'	Range at T2 only: 0 minutes to 195 minutes (greater than 3 hours)
	Demographics	Age	Categories of age in 10-year increments from 18-85+	Dichotomized^ age 18-54 (0) and 55+ (1)
	Demographics	Sex	Two categories	Woman = 0, Men = 1
	Demographics	Marital status	Seven categories of relationship status	Dichotomized^ status single, divorced, widowed (0), married, civil partnered, cohabiting (1)
	Demographics	Education	Highest level of education attained from full range of English qualifications	Tertiles^: 1= No education, 2 = Secondary education, 3 = Tertiary education

^ = Score range after data manipulation; not score range used in the online questionnaires.

3.3.1 Outcome variables

Mental and emotional well-being were assessed with psychometric measures of *mental well-being, depression,* and *positive* and *negative affect*. *Mental well-being* was assessed using the 14-item Warwick Edinburgh Mental Well-being Scale (WEMWBS) (Tennant et al., 2007), which measures both hedonic and eudaimonic aspects of positive mental well-being (Tennant et al., 2007). Participants rated each statement in relation to their experience in the past two weeks on a 5-point Likert scale (1 = *none of the time*; 5 = *all of the time*), resulting in a minimum score of 14 and maximum score of 70. A higher score indicates a higher level of mental well-being. The WEMWBS is "suitable for measuring well-being at the population level" (Tennant et al., 2007, p. 10), and has been recommended for use by the UK government (HM Government, 2011). This measure has been used in previous nature and health studies in the UK (Hine et al., 2011; Mitchell, 2013; Ward Thompson et al., 2012).

Depression was measured with the 10-item Major Depressive Inventory (MDI) scale (Olsen, Mortensen, & Bech, 2004). The MDI assesses depression according to Diagnostic and Statistical Manual (DSM) and the International Classification of Diseases 10 symptoms of moderate to severe depression (ICD-10) (Bech, Rasmussen, Olsen, Noerholm, & Abildgaard, 2001). The MDI can be scored as either a diagnostic instrument or as a general depression rating scale (Olsen et al., 2004). The general depression rating scale was used here. Participants rated how frequently they felt a certain way in the past two weeks on a 6-point Likert scale (0 = *at no time*; 5 = *all the time*), resulting in a total score range from 0 (no depression) to 50 (extreme depression) (Olsen et al., 2004). The MDI has been used with the general population in Denmark (Munir, Nielsen, & Carneiro, 2010; Olsen et al., 2004) and Sweden (Forsell, 2005). The measure has been used in the UK on specific populations (Powell, McCarthy, & Eysenbach, 2003; Taylor, Wicks, Leigh, & Goldstein, 2010); this is the first time the measure has been used in nature and health research.

Positive and *negative affect* were measured with the Positive and Negative Affect Schedule (PANAS) (Watson et al., 1988). Participants rated the frequency of experiencing 10 positive and 10 negative emotions in the past two weeks on a 5-point Likert scale (1 = *very slightly or not at all*; 5 = *extremely*). Each scale is scored separately; total scores of each scale range from 10 to 50 with higher scores demonstrating greater positive or negative affect. The PANAS has been used on the UK general population (Crawford & Henry, 2004) and in previous nature and health studies (Berman et al., 2008; Berman et al., 2012; van den Berg & Custers, 2011).

Retrospective pre-test (RPT)

A retrospective pre-test is a pre-test assessment administered *after* the introduction of an intervention. The RPT asks participants to recall their attitudes, behaviour or experience prior to the introduction of an intervention (Howard et al., 1979), and assess their attitudes, behaviour or experience in the present, following exposure to an intervention (Lamb, 2005; Nimon, 2007). The RPT method has been used in nonexperimental research designs to establish a baseline when it is not possible to administer a pre-test measure (Campbell & Stanley, 1963; Kreulen, Stommel, Gutek, Burns, & Braden, 2002; Watson, Ozanne-Smith, & Richardson, 2007). RPT scores do not significantly differ from pre-test scores (Kreulen et al., 2002; Lamb, 2005) and have been used in programme evaluation (Lamb & Tschillard, 2005; Moore & Tananis, 2009; Pratt, McGuigan, & Katzev, 2000), health (Kreulen et al., 2002; Sprangers et al., 1999; Watson et al., 2007), complementary and alternative medicine (Ritenbaugh et al., 2011; Thompson et al., 2011), and green exercise (Peacock et al., 2007) research studies.

Participants' mental well-being, depression and affect were assessed retrospectively with specifically created items based upon the WEMWBS, MDI and PANAS measures. Word pairs were used to represent the positive and negative aspects of each item (Ritenbaugh et al., 2011; Thompson et al., 2011). All items were measured on a 100-point visual analogue scale (VAS) (Ritenbaugh et al., 2011; Thompson et al., 2011). *Retrospective mental well-being* was measured with two items: relaxed (0 = *anxious,* 100 = *relaxed*) and thinking clearly (0 = *not thinking clearly, 100 = thinking clearly*). *Retrospective depression* was assessed with a single item ranging from 0 (*not depressed*) to 100 *(severely depressed*). *Retrospective emotional well-being* was measured with a single item ranging from 0 (*negative mood*) to 100 *(positive mood*).

Different retrospective time frames were used for each group of participants. Group Walkers' retrospective time frame was *"before you started WfH"*. The retrospective time frame will vary for each Group Walker as some Group Walkers will have been involved in WfH for years and others a few weeks. Non-Group Walkers' retrospective time frame was *"one year ago"*.

Two items were used to assess retrospective change over time: the first measured retrospective well-being ('then') and the second measured well-being at Time 1 ('now'). Both groups of participants had the same time frame for 'now', which was at Time 1. All participants were first asked how they felt 'then' (e.g. *"Before you started WfH, how was your mood?"; "One year ago, how was your mood?"*), followed by an assessment of how they felt 'now' at T1 (i.e. *"How is your mood now?"*). This administration is identical to that used in previous research (Peacock et al., 2007; Ritenbaugh et al., 2011; Thompson et al., 2011).

3.3.2 Independent variables

<u>Adversity</u>

Two measures of adversity were included in the study: *social deprivation* and the *number of stressful life events* experienced. Social deprivation is a measure of the social inequalities in health. Residents of the most deprived communities in Britain have the poorest physical health and well-being (HM Government, 2011; McManus, Meltzer, Brugha, Bebbington, & Jenkins, 2009). Living in a deprived neighbourhood is associated with an increased risk of premature mortality, over and above the effects of socio-economic status (van Lenthe, 2006). Individuals living in the most deprived areas of western Scotland were found to have ill health 16 years earlier in life than those living in the least deprived areas (Ellaway, Benzeval, Green, Leyland, & Macintyre, 2012).

The English Indices of Deprivation (Department for Communities and Local Government, 2011) identifies multiple aspects of deprivation in small geographical areas in England (Department for Communities and Local Government, 2011). The social deprivation measure used in this study was the overall Index of Multiple Deprivation, which is a combination of seven domains of deprivation: Income Deprivation, Employment Deprivation, Health Deprivation and Disability, Education Skills and Training Deprivation, Barriers to Housing and Services, Living Environment Deprivation, and Crime. The overall Index of Multiple Deprivation ranks the overall deprivation of all 32,482 small geographical areas in England according to the deprivation of people living there (range from 1 = most deprived to 31,482 = least deprived) (Department for Communities and Local Government, 2011). For the analysis in this thesis, the overall deprivation rank scores were reduced to tertiles (1 = most deprived, 3 = least deprived). The IMD tertile variable was treated as continuous as the underlying scale is continuous (Tabachnick & Fidell, 2013, p. 7). Participants' residential postcode was used to identify the overall Index of Deprivation for the participants' neighbourhood.

An accumulation of stressful life events has been associated with greater perceived stress (Cohen, 2000), increased risk of mental illness (Jordanova et al., 2007; Kessler, 1997; Shevlin, Houston, Dorahy, & Adamson, 2007), higher psychological distress (Seery et al., 2010) and lower life satisfaction (Seery et al., 2010). *Stressful life events* were assessed with the List of Threatening Experiences (LTE-Q) (Brugha, Bebbington, Tennant, & Hurry, 1985; Brugha & Cragg, 1990), a self-report checklist that examines the incidence of 11 stressful life events of moderate to long-term threat[11] (Brugha & Cragg, 1990; Office for National Statistics, 2002):

- Serious illness or injury to self or a close relative;
- Death of a family member or close friend;
- Marital separation or relationship break-up;
- Interpersonal problems;
- Unemployment;
- Financial crisis;
- Legal problems or;
- Property loss.

Participants respond to whether they have not (0) or have (1) experienced each event in a specific timeframe. The sum of 11 stressful life events was calculated, resulting in a range 0 to 11 stressful life events experienced in the past year. The T1 questionnaire assessed the number of stressful life events experienced. This time frame has been used

[11] The 11-item version used in this study was taken from the British Psychiatric Morbidity Survey (Office for National Statistics, 2002).

previously (Brugha et al., 1985). The T2 questionnaire assessed the number of stressful life events experienced in the previous 13-weeks. This time frame has been used in previous studies (van den Berg et al., 2010; Wells & Evans, 2003). The LTE-Q was originally developed and tested on the UK general population (Brugha et al., 1985) and has been used extensively in large population surveys in the UK (Jordanova et al., 2007; Kinderman, Schwannauer, Pontin, & Tai, 2011; Office for National Statistics, 2002; Shevlin et al., 2007). The scale has been used in previous nature and health research (van den Berg et al., 2010).

<u>Group walk behaviour</u>

Four measures of group walk behaviour were included in the study: *length of involvement in WfH*, *frequency of group walk, frequency* and *duration of group walks and type of environment for a group walk*[12]. *Length of involvement in WfH group walks* at T1 assessed as the number of months a participant had attended his or her walking group. *Frequency of WfH group walks* was measured at both T1 and T2; at T1 the response options were collected on a 9-point scale (1 = *never*; 9 = *daily*), and at T2 the response options were collected on a 7-point scale[13] (1 = *never*; 7 = *daily*) as the participant assessed their average frequency of attending a WfH group in the previous 13-weeks.

Duration of group walks and type of environment for a group walk were assessed at T2 only. *Duration of group walks* measured the average duration of WfH group walks in the 13-week study period; responses were collected in 15-minute increments, ranging from 0 to 195 minutes. *Type of environment for a group walk* was assessed with the following question, *"What is the main type of environment you walk in with this [walking] group?"* in the past 13-weeks. All Group Walkers selected one response from a list of 10 categories, which were based on the WfH Walk Route Assessment questionnaire (Walking for Health, 2011) and English Planning Policy Guidance (Department for Communities and Local Government, 2002).

[12] Data on group walk behaviour were also collected from Non-Group Walkers as part of an eligibility check (see Section 3.2.1).
[13] The omitted response options in the T2 questionnaire were: 'several times a year' and 'once a year or less'.

The walk environment type categories were:

- Natural and Semi-natural places (e.g. Country Park, Nature Reserve)
- Parks and Gardens (e.g. public gardens, formal parks)
- Green corridor (e.g. river path, cycleways, bridleways)
- Urban public space (e.g. streets, shopping centre, plaza)
- Outdoor sports facilities (e.g. school playing field, football pitch)
- Amenity green space (e.g. informal recreation ground, village greens)
- Allotments, Community gardens, Urban farms
- Farmland
- Coastal (e.g. seaside, estuary)
- Other.

3.3.3 Covariates

Four additional non-demographic constructs that might affect mental and emotional well-being were measured in both online questionnaires: *social well-being, perceived stress, resiliency* and *connectedness to nature*. Social well-being is conceptualized as a covariate in this study, rather than an outcome, because it has been identified as a mechanism that explains the relationship between nature and well-being (Health Council of the Netherlands and Dutch Advisory Council for Research on Spatial Planning, Nature and the Environment, 2004) and has been shown to be related to all four outcome variables (Cohen, Mermelstein, Kamarck, & Hoberman, 1985; Hawkins, 2012; Watson, 1988). Perceived stress, resiliency and connectedness to nature have been shown to have a relationship with the four outcome variables. Perceived stress is negatively correlated with mental well-being (Hawkins, 2012; Ward Thompson et al., 2012) and positive affect (Watson, 1988), and positively correlated with negative affect (Watson, 1988) and depression (Cohen, Kamarck, & Mermelstein, 1983; Olsen et al., 2004). Resiliency is positively associated with positive affect (Burns & Anstey, 2010; Fredrickson et al., 2003; Tugade & Fredrickson, 2004) and mental well-being (Smith, Tooley, Christopher, & Kay, 2010) and negatively associated with depression (Fredrickson et al., 2003; Smith et al., 2008; Tugade & Fredrickson, 2004; Wingo et al., 2010). Connectedness to nature has been identified as a mediator of the nature-health relationship (Mayer et al, 2009); it is positively associated with positive affect (Mayer et al, 2009) and may be important for group walkers' mental and emotional well-being (Wensley & Slade, 2012).

Social well-being was assessed with the 10-item Appraisal subscale of the Interpersonal Support Evaluation List (ISEL) (Cohen et al., 1985)[14], which measures perceived availability of emotional social support. Two items[15] were slightly modified in order to better fit the sample. Participants were asked to rate how true each statement was on a 4-point scale (0 = *definitely false*; 3 = *definitely true*). No time frame is used. Five items were recoded (items 2, 3, 4, 8 & 9). Total scores ranged from 0 to 30; higher scores indicate greater emotional social support. The ISEL has been used in the UK general population (Rees, Ingledew, & Hardy, 1999; Steptoe, 2000; Wood, Maltby, Gillett, Linley, & Joseph, 2008); this is the first time it has been used in nature and health research.

Perceived stress was measured with the 10-item Perceived Stress Scale (PSS) (Cohen & Williamson, 1988; Cohen et al., 1983). Participants were asked to rate the frequency of experiencing certain thoughts and feelings in the past two weeks on a 5-point Likert scale (0 = *never*; 4 = *very often*). Four items were recoded (items 4, 5, 7, & 8). Total scores ranged from 0 to 40; higher scores indicate greater psychological stress. This measure has been used in the general population in the US (Cohen & Janicki-Deverts, 2012), and in previous nature and health studies in both the UK (Hawkins, 2012; Ward Thompson et al., 2012) and Sweden (Stigsdotter et al., 2010).

Resiliency was assessed with the 10-item Connor-Davidson Resilience Scale (CD-RISC) (Campbell-Sills & Stein, 2007; Connor & Davidson, 2003), which measures personality characteristics that protect against the development of mental illness following adversity (Stein, Campbell−Sills, & Gelernter, 2009). Participants were asked to rate how much they agreed with each statement on a 5-point Likert scale (0 = *not true at all*; 4 = *true nearly all of the time*). Total scores range from 0 to 40; higher scores

[14] Items on the ISEL have been updated. For the updated version see the ISEL scale for the general population on Professor Sheldon Cohen's website (http://www.psy.cmu.edu/~scohen/).

[15] The item *"There is someone I could turn to for advice about making career plans or changing my job"* was inappropriate for a sample that could contain retired individuals. It was changed to *"There is someone I could turn to for advice about changing my job or volunteer focus"* (León, Nouwen, Sheffield, Jaumdally, & Lip, 2010, León, 23 July 2011). The item, *"There really is no one who can give me an objective view of how I'm handling my problems",* was modified by changing the word 'objective' to 'honest' (León et al., 2010).

indicate greater psychological resilience. No time frame was used as the scale assesses a stable personality trait with a possible hereditary basis (Stein et al., 2009). The scale has good internal consistency and test-retest reliability. The scale has been used in the UK (Lit, Garner, Carr, & Baldwin, 2008; Swan, 2011); this is the first time it has been used in nature and health research.

The 14-item *Connectedness to Nature* scale assessed participants' emotional, experiential connection to the natural world (Mayer & Frantz, 2004). Participants are asked to rate how much they agree with each statement on a 5-point Likert scale (1 = *strongly disagree*; 5 = *strongly agree*). No time frame is used for this scale, as connectedness to nature is conceived as a trait (Mayer et al., 2009). Three items were recoded (items 4, 12 & 14). Total scale scores range from 14 to 70, with higher scores reflecting greater feelings about one's connection to nature. A short version of this scale has been used in previous nature and health studies in the UK (Hine et al., 2011; Peacock, Hine, & Pretty, 2008).

<u>Non-group walk behaviour & physical activity</u>

Non-group walking in green space, in particular (Hartig et al., 2003; Mitchell, 2013; Thompson Coon et al., 2011) and physical activity, in general (Biddle & Mutrie, 2008; Blumenthal et al., 1999; Department of Health, 2011; Dunn et al., 2005; Hendrickx & van der Ouderaa, 2008; Mata et al., 2012) have been shown to have a relationship with the four outcome variables. As such both variables were considered as covariates in this study.

Previous WfH evaluations found the most common form of physical activity among inactive WfH walkers was informal walking with friends or family (43%) (Phillips et al., 2011). *Frequency of non-group walks in green space* was assessed at both T1 and T2 by asking participants, *"On average, how frequently do you walk or hike in green space (such as a local park, natural area, national park, countryside)?"* Group Walkers were instructed to exclude their WfH walks. The time frame for T1 was in the past year and in the previous 13-weeks for T2. Response options at T1 were collected on a 9-point scale (1 = *never*; 9 = *daily*) and at T2 questionnaire were collected on a 7-point scale (1 = *never*; 7 = *daily*).

Data on the *duration of non-group walks in green space* were collected at T2 only. *Duration of non-group walks in green space* measured the average duration of a non-group walk in green space in the 13-week study period. Responses were collected in 15-minute increments (range 0 - 195 minutes).

Physical activity was assessed at T2 only due to researcher error. Physical activity was measured by asking participants*, "In the last seven days on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate?*" (Milton, Bull, & Bauman, 2011; Walking for Health, 2013c). Participants could include their group walks, as well as any other walking, cycling, sports or exercise. Responses were recorded on an 8-point scale (0 = *0 days*; 7 = *7 days*).

Demographics

Data were collected on the following demographic variables: *sex, age, highest level of education* and *marital status*. *Age* was assessed in eight 10-year age categories (1 = *18-24*; 8 = *85 and over*) (Ipsos MORI, 2007; Walking for Health, 2013c). For the analysis, this variable was dichotomized (0 = *18-54*, 1 = *55+*) based on previous WfH studies (Coleman et al., 2011; Fitches, 2011). Participants' *highest level of education* had five response categories based on the 2001 and 2011 English Census (Office for National Statistics, 2010), that were reduced to tertiles in the analysis (1= *No education*, 2 = *Secondary education*, 3 = *Tertiary education*) based on previous research (OECD, 2011; Steptoe, Wright, Kunz-Ebrecht, & Iliffe, 2006). Seven response categories were used to determine *marital status* (Office for National Statistics, 2011; University of London, Institute of Education, Centre for Longitudinal Studies, 2008; University of London, Institute of Education, Centre for Longitudinal Studies, 2012). For the analyses, this variable was dichotomized (0 = *single, widowed, divorced;* 1 = *married, civil partnered, cohabitating*) based on previous research (Office for National Statistics, 2012).

3.3.4 Questionnaire piloting

Draft versions of the Time 1 and Time 2 online questionnaires were piloted prior to data collection. Pre-testing online questionnaires is especially important to gauge questionnaire length and participant burden (Hugick & Best, 2008). The Time 1 questionnaire was tested on three different groups of individuals. It was first piloted in a focus group of convenience sampled PhD students and staff from De Montfort University (*n* = 8). Prior to the focus group, all participants completed a draft version of the online questionnaire, which contained 176 items. The focus group identified that participant burden was high; the draft T1 questionnaire took participants on average 42 minutes to complete. Hugick and Best (2008) state that online questionnaires should take about 20 minutes to complete in order to avoid participant attrition. Thus, the questionnaire was revised to remove 54 items, improve formatting and grammar. A second pilot was conducted with a convenience sample of friends, library patrons and non-WfH group walkers (*n* = 15). The average time to complete the 123-item questionnaire was 23 minutes. The questionnaire length was deemed acceptable to not adversely effect response rates (Hugick & Best, 2008). The final version of the 123-item questionnaire was piloted with WfH staff (*n* = 3) to assess its appropriateness to the WfH population. Minor revisions were made based on feedback. This became the final version used for data collection; see Appendix C for the final version of the Time 1 questionnaire.

New items for the Time 2 questionnaire were piloted with a convenience sample of Non-Group Walkers who were unable to take part in the study due to ineligibility (*n* = 21). Although, the Time 2 questionnaire was almost identical to the Time 1 questionnaire, it contained new phrasing to describe WfH group walks[16] and new questions about the walking group, frequency and duration of walking, and type of environment for a group walk (see Section 3.3.2). These participants completed an online questionnaire containing the 10 new questions. Piloting identified response options for frequency items needed to be in a different order and three items to be

[16] Group Walkers' provided feedback that the language used to describe their WfH health walk in the Time 1 questionnaire ('Natural England's Walking for Health walk scheme') was not colloquial. Following feedback from Group Walkers, Walking for Health walks were referred to as a '*Walking for Health* health walk' in the Time 2 questionnaire.

omitted due to repetition. These new items were included into the T2 questionnaire. Appendix D contains the final Time 2 questionnaire used for data collection.

3.3.5 Reliability of measures

Internal consistencies of the above measures were tested with the Time 1 *as treated* sample by calculating Cronbach's alpha for each of the scales. The results are presented in Table 3.4. Cronbach's alpha for this study were equal to or above to those previously reported in the literature, except for the ISEL. Variables in nonexperimental research should have Cronbach's alpha greater than .80 (Tabachnick & Fidell, 2013, p. 205); all scales used in this study meet and exceed that criterion.

Table 3.4. Cronbach's alpha for all psychometric scales from *as treated* GRIN sample (left) and from previous research (right).

Scale Name	Number of items	*n*	α	Previous research α	
Appraisal Subscale of the (ISEL)	10	3007	0.90	0.95	(León, Nouwen, Sheffield, Jaumdally, & Lip, 2010)
Connectedness to Nature	14	3008	0.86	0.84	(Mayer & Frantz, 2004)
Connor-Davidson Resilience Scale (CD-RISC)	10	3008	0.88	0.85	(Campbell-Sills & Stein, 2007)
Major Depression Inventory (MDI)	12	2999	0.90	0.90	(Forsell, 2005)
Negative Affect	10	2998	0.88	0.85	(Crawford & Henry, 2004)
Perceived Stress Scale (PSS)	10	3000	0.87	0.78	(Starkweather, 2007)
Positive Affect	10	2998	0.92	0.89	(Crawford & Henry, 2004)
Warwick-Edinburgh Mental Well-being Scale (WEMWBS)	14	2999	0.94	0.91	(Tennant et al., 2007)

3.4 Procedure

3.4.1 Data collection

Table 3.5 details the data collection timeframes for Group Walkers and Non-Group Walkers. Data were collected from participants at different times, based on the recruitment method. Group Walkers and snowball sampled Non-Group Walkers were invited to take part in the T1 questionnaire from 1 August 2011. 'Inactive' Non-Group Walkers were invited to take part in the T1 questionnaire on 26 September 2011[17]. Both the Group Walkers and 'inactive' Non-Group Walkers had two weeks to complete the T1 online questionnaire. Snowball sampled Non-Group Walkers had one month to complete the T1 online questionnaire to allow a snowball participant sufficient time to receive and complete the questionnaire.

Group Walkers and snowball sampled Non-Group Walkers were invited to take part in the T2 online questionnaire from 14 November 2011. Snowball sampled Non-Group Walkers were separated into two cohorts for the T2 questionnaire based on their completion date of the T1 questionnaire (see Table 3.5). 'Inactive' Non-Group Walkers were invited to take part in the T2 online questionnaire from 9 January 2012. All participants had 2 weeks and 3 days to complete the T2 questionnaire. The reason for extending the follow-up survey by three days was to obtain as many respondents to the follow-up survey as possible.

[17] 'Inactive' Non-Group Walkers were recruited as an auxiliary recruitment option after it was clear on 31 August 2011 that the snowball sampling recruitment of Non-Group Walkers was unsuccessful. Consequently, there was a delay of 26 days between the end of recruitment for snowball sampled Non-Group Walkers and recruitment for 'inactive' Non-Group Walkers from the WfH sampling frame.

Table 3.5. Data collection timeframes for Time 1 and Time 2 questionnaire by sample group.

Group of participants	Time 1 Questionnaire		Time 2 Questionnaire	
	Start	End	Start	End
Group Walkers	1 August 2011	15 August 2011	14 November 2011	1 December 2011
Snowball sampled Non-Group Walkers^	1 August 2011	31 August 2011	Cohort 1: 14 November 2011	1 December 2011
			Cohort 2: 28 November 2011	15 December 2011
'Inactive' Non-Group Walkers	26 September 2011	10 October 2011	9 January 2012	26 January 2012

^ = Due to the longer timeframe to complete the Time 1 questionnaire, the snowball sample was separated into two cohorts for the Time 2 questionnaire. Cohort 1 consisted of snowball participants who completed Time 1 between 1-15 August; and Cohort 2 consisted of snowball participants who completed the Time 1 between 16-31 August.

3.4.2 Administering the questionnaires

Time 1 questionnaire

All participants were invited to take part in the T1 questionnaire via an invitation e-mail. The invitation e-mail detailed the reason the individual was being contacted, the aim of the study, what the study involved, ethical issues and a prize draw (Appendix E). As an incentive for participation, participants who completed both online questionnaires would be entered into a prize draw for £150 worth of shopping vouchers. There was a separate prize draw for Group Walkers and Non-Group Walkers.

Participants accessed the T1 online questionnaire by clicking on the web link in the invitation e-mail. For Group Walkers and 'inactive' Non-Group Walkers, the web link in the invitation e-mail was unique to that participant. For snowball sampled Non-Group Walkers, the web link to the T1 online questionnaire was anonymous. Snowball sampled Non-Group Walkers were asked to enter their name and e-mail address at the end of their T1 questionnaire in order to receive the T2 questionnaire and be eligible for the prize draw. All Group Walkers and 'inactive' Non-Group Walkers who had not completed the T1 questionnaire received a reminder e-mail (Appendix F) 5 and 10 days after the T1 invitation e-mail. Reminder e-mails were unable to be sent to snowball sampled Non-Group Walkers. Due to the high volume of queries about the project from Group Walkers, a Frequency Asked Questions (FAQs) (see Appendix G) was created and posted onto the WfH website. The web link to the FAQs was included in all T1 reminder e-mails (as well as the invitation e-mail for 'inactive' Non-Group Walkers). All participants received a 'thank you' e-mail after completing the T1 questionnaire (Appendix H).

Administering the Time 2 questionnaire

All participants received an advance notice e-mail ten weeks after the end of the T1 questionnaire (i.e. two weeks prior to the start of the Time 2 questionnaire) (see Appendix I). The aim of the advance notice e-mail was to increase participants' awareness of the upcoming T2 questionnaire and emphasise the importance of the individual to the research study (Dillman, 1978; Dillman, Smyth, & Christian, 2009). Two weeks after the advance notice e-mail, all participants who completed the T1 questionnaire received an invitation e-mail with weblink to the T2 questionnaire (see Appendix J). Reminder e-mails were sent 5 and 12 days after the T2 invitation e-mail to all participants who had not completed the T2 questionnaire (see Appendix K). All participants received a 'thank you' e-mail, with details about the prize draw, following completion of the T2 questionnaire (see Appendix L).

Participants who were unable to access the online questionnaire

Approximately 33 participants were unable to access the T1 online questionnaire and 12 participants were unable to access the T2 questionnaire. It is possible more participants were unable to access the online questionnaires, but did not inform the researcher. Individuals who were unable to access the T1 online questionnaire were unable to participate in the study. No alternative method for completing the questionnaire was provided because the retrospective pre-test (RPT) measures could not be completed off-line. Individuals who were unable to access the T2 online questionnaire were provided with a Microsoft Word version of the questionnaire via e-mail. Using the participant's unique web link to their questionnaire, participants' data were then entered in their T2 online questionnaire. The Word version of the questionnaire was deleted immediately following data entry into the online questionnaire to ensure confidentiality.

3.4.3 Ethics

Ethical approval was obtained from De Montfort University's Human Research Ethics committee. Participants gave informed consent prior to starting the Time 1 online questionnaire. All information was anonymised and stored in compliance with the Data Protection Act 1998 (Great Britain, 1998).

3.5 Data screening

Data were heavily managed prior to analysis. Three different datasets from Qualtrics were joined together to create a Time 1 SPSS dataset[18] using unique participant ID codes. Four different datasets from Qualtrics were joined together to create a Time 2 SPSS dataset. Finally, all datasets were joined together into one complete dataset containing all Time 1 and Time 2 data from all respondents. Secondary data variables from the national WfH database (i.e. ethnicity, health and medical conditions) were then added into this dataset.

Prior to analyses, data were screened for accuracy, missing data, outliers, normality, and homoscedasticity. Accuracy of data was checked to ensure all responses were within the correct range. Negatively framed items on perceived stress, social support and connectedness to nature measures were reverse coded and total scale scores computed. Several variables had more than 5% missing data[19], which is a problem of concern (Tabachnick & Fidell, 2013, p. 63); the data were missing at random. Hot Deck imputation (Myers, 2011) was used to replace missing items. It is an appropriate procedure to use when 5% of data is missing at random (Myers, 2011). Hot Deck imputation replaces a missing value from a participant with a value from another participant that is similar in character[20] (Myers, 2011). Individual items on the

[18] There were three different datasets at Time 1 – questionnaire responses from Group Walkers, snowball sampled Non-Group Walkers, and 'inactive' Non-Group Walkers – which were combined into one dataset. At Time 2 there were for different datasets, which were combined into one SPSS dataset: questionnaire responses from Group Walkers, Cohort 1 snowball sampled Non-Group Walkers, Cohort 2 snowball sampled Non-Group Walkers, and 'inactive' Non-Group Walkers.

[19] T1 had 5% missing data on total scale scores for social support (5.5%), positive affect (5%) and connectedness to nature (5.9%) and close to 5% missing data for IMD (4.9%) and negative affect (4.7%). T2 had 5% missing data on the total scale of WEMWBS (5.4%) and IMD (5.2%).

[20] Cases that are similar in character were defined with the following 'deck variables': group (Group Walker or Non-Group Walker), sex and age. The Hot Deck imputation procedure randomly sorted participants in the dataset by the 'deck variables', so that participants who are similar to one another are

following measures were replaced with Hot Deck imputation (Myers, 2011): retrospective pre-test variables, mental well-being, depression, positive and negative affect, perceived stress, social support, resiliency, connectedness to nature and stressful life events. Imputation of missing values did not occur for demographics, IMD or walk behaviour variables, because of the threats to validity caused by imputing personal data. Hot Deck imputation reduced the percentage of missing data to 1% or less, but did not eliminate it entirely[21]. The Hot Deck imputation variables were used in all statistical analyses.

Data were then assessed for outliers, normality and homoscedasticity. Univariate outliers within each group and for the entire sample were identified through standardised *z*-scores greater than 3.29 (Tabachnick & Fidell, 2013, p. 73). Three cases had maximum scores for mental well-being, depression, positive affect and negative affect, which is self-contradictory and suggests acquiescence response bias (Baumgartner & Steenkamp, 2006). These cases were removed from the study because responses indicate the case was not a member of the intended population (Tabachnick & Fidell, 2013, p. 73) (see 'outliers' in Figure 3.2). All other outliers remained because a few outliers are expected in a large sample (Tabachnick & Fidell, 2013). Normal distributions were assessed prior to analysis and will be reported in each chapter.

3.6 Summary

This chapter described the Walking for Health programme and presented the research design for this study. Participant recruitment, content of the online questionnaires, the timeline and administration of the questionnaires were discussed. The study presented here was a nonexperimental, longitudinal panel study of the well-being of individuals who did and did not take part in outdoor walking groups.

3.6.1 Limitations of the research design – threats to internal and external validity

The nonexperimental, longitudinal panel research design presents several threats to internal and external validity. Internal validity is the extent to which a causal relationship between variables can be determined. External validity is the extent to

in adjacent rows. Then, it replaces a missing item with a value from a participant that is in an adjacent row.

[21] At Time 1 less than 20 cases still had missing data following Hot Deck imputation. At Time 2, one case had missing data after Hot Deck imputation.

which the findings are generalisable to other groups (Howitt & Cramer, 2008). The following will discuss the threats to internal validity from the research design before addressing the threats to external validity.

Internal validity

The research design has five threats to internal validity, the first of which is the lack of treatment manipulation. At the start of the study, participants were either participating or not participating in WfH walks. The study is thus unable to determine the 'true' effect group walk participation has on well-being. The longitudinal design helps to mitigate this threat by demonstrating the change in well-being that occurs if one continues to walk, or not walk, in a group during the 13-week study period.

The second threat to internal validity concerns the non-allocation of participants to conditions (Stangor, 2007). The lack of random allocation to conditions (i.e. group walk, no group walk) means the two groups may differ on various demographic variables, which can confound any statistically significant group differences. Statistical matching of participants was conducted to address this limitation (see Chapter 5).

The third threat to internal validity has to do with 'history' or unmeasured events that occurred in the 13-week period between the two online questionnaires and have nothing to do with the 'treatment' variable. History events can affect the dependent variable and undermine causal conclusions (Howitt & Cramer, 2008). For example, seasonal factors and the economic climate at the time are unmeasured variables that could have affected the outcome variables. The change in seasons could have accounted for differences in mental and emotional well-being of each group at Time 2 (Rosenthal et al., 1984). However, both groups are likely to be as equally affected by the change in seasons as both groups were assessed within 6 weeks of one another and Seasonal Affective Disorder follows an autumn-winter pattern (Rosenthal et al., 1984; Westrin & Lam, 2007). The economic climate at the time of data collection was one of record high unemployment and uncertainty about job losses (Allen, 2011; The Guardian, 2011), which can affect physical and mental health (Dorling, 2009; Royal College of Psychiatrists, 2009). There were no strategies to mitigate this threat.

Expectancy effects are the fourth threat to internal validity. Expectancy effects are when the researcher subtly communicates to participants the kind of results he or she expects to find from the study, thereby influencing participants' behaviour toward the researcher's expected result (American Psychological Association, 2002). In order to prevent expectancy effects, all participants were informed the study was investigating "the personal well-being of people who do and do not take part in WfH" in all study materials (i.e. invitation, reminder and advance notice e-mails, consent form, FAQs).

Attrition or the loss of participants over time is the fifth threat to internal validity (Howitt & Cramer, 2008). Changes in the sample over time may not be a result of the 'treatment' variable but the loss of a group of participants (Howitt & Cramer, 2008, p. 216). This could result in a particular set of results that are an artefact of the sample only. Thirty five percent of as treated Group Walkers and 33% of as treated Non-Group Walkers did not continue to take part in the study at Time 2. These individuals may be markedly different from those participants who continued to take part. Strategies were put in place to prevent the loss of participants, such as the financial incentive for completing both questionnaires, piloting of the questionnaires, use of reminder and advance notice e-mails, and use of language in all e-mails emphasizing the importance of the participant to the study. No strategies were applied to prevent withdrawal.

External validity

The main threats to external validity are selection bias and attrition of participants (Howitt & Cramer, 2008). The kind of person who volunteered to take part in this research study may not be representative of the larger WfH population. Furthermore, collecting data via online questionnaires will limit the generalisibility of findings, as study participants are individuals who had access to a computer connected to the Internet, an e-mail address and checked their e-mail regularly. For these reasons, care may need to be taken to avoid generalising from the sample to the WfH population. The attrition of participants is a problem for external validity, as well as internal validity, because the sample may be less representative of the WfH population.

The next chapter describes the demographics of the *as treated* sample, differences between the study sample, and the WfH population and sampling frame. In addition, between group differences at the start of the study on demographics, adversity, walk behaviour, well-being variables and covariates are examined.

Chapter 4 Group Walkers and Non-Group Walkers at the start of the study

This chapter presents Time 1 data of participants' well-being and experiences at the start of the study. There are six sections to this chapter. The first section details the statistical analyses conducted in this chapter. The second section tests the generalisibility or external validity of the study by assessing whether the *as treated* sample is representative of the WfH population and sampling frame. Section two assesses internal validity by examining the group differences between Group Walkers and Non-Group Walkers on demographic variables at the start of the study. Sections three and four assess the internal validity of the study by examining the differences between Group Walkers and Non-Group Walkers on adversity and covariates. The fifth section investigates the retrospective change in well-being within each *as treated* group before examining the between group differences on the main outcome variables: mental well-being, depression, positive and negative affect. The chapter concludes with a summary of the relationships found in relation to external and internal validity.

4.1 Statistical analyses

Due to the nonexperimental research design, two *as treated* groups (Group Walkers and Non-Group Walkers) were created for this study based on whether an individual met the eligibility criteria detailed in Section 3.2.1. *As treated* Group Walkers are individuals who attended at least one WfH walk 6 months prior to the Time 1 questionnaire and continued to attend at least one WfH walk in the 13-week 'intervention' period between the Time 1 and Time 2 questionnaire. *As treated* Non-Group Walkers are individuals who did not attend any outdoor walking group (WfH or otherwise) 6 months prior to the Time 1 questionnaire, nor attended a group walk in the 13-week 'intervention' period.

Table 4.1 lists the statistical analysis conducted in this chapter. Assumptions for the chi-square test (Field, 2009) were met prior to analysis. Effect sizes for chi-square analyses were assessed with Cramer's V. For the independent samples t-tests analyses, all ten dependent variables listed in Table 4.1 were assessed for normal distribution prior to analysis. Normal distributions were assessed by the Kolmogorov-Smirnov (K-S) test, skewness and kurtosis values (less than ± 1 was assessed as normal in large sample)

(Fife-Schaw, 2003), and histograms. The K-S test was significant for all variables ($p < .001$) indicating significant non-normality. As the K-S test is sensitive to small deviations from normality in a large sample (Field, 2009), this output will be of secondary importance. T1 stressful life events, negative affect and depression for both *as treated* groups were severely skewed. A logarithmic transformation was applied to these three variables; transformations were successful at achieving normal distribution.

All independent samples *t*-tests had a Bonferroni correction applied to the alpha level in order to control for familywise Type 1 error rate from multiple comparisons (Field, 2009). The Bonferroni corrected alpha of 0.005[22] ensures that the cumulative significance level for the 10 comparisons did not exceed the critical value of 0.05 (Field, 2009). The null hypothesis was rejected if *p*-values were less than 0.005. Pairwise deletion was applied in each set of analyses. Effect sizes were assessed with *r* (Cohen, 1988; Cohen, 1992; cited in Field, 2009, p. 57).

For the dependent samples *t*-tests, the distribution of the change scores ('then' minus 'now') (Field, 2009, p. 329) for the retrospective pre-test (RPT) measures of mental well-being, emotional well-being and depression were analysed for normality prior to analysis. Change scores on all four variables within each group were not normally distributed. Consequently, the Wilcoxon Signed Ranks test, the non-parametric equivalent for the dependent samples *t*-test, was used to analyse retrospective change in mental well-being, emotional well-being and depression. Alpha levels for these analyses were set at .05. Effect sizes were assessed with *r* (Cohen, 1988; Cohen, 1992; cited in Field, 2009, p. 57).

[22] Bonferroni correction for independent samples *t*-tests was $0.05/10 = 0.005$.

Table 4.1. List of statistical analyses conducted in this chapter, their purpose and the independent and dependent variables.

Construct	Analysis	Purpose	Independent Variable	Dependent Variable
Demographics	Pearson chi-square	To assess external validity of the *as treated* sample. Is the sample representative of the WfH population? Can outcomes be generalised to the WfH population?	*As treated* sample WfH population	Sex, Age, Ethnicity
		To assess external validity of the *as treated* sample. Is the sample representative of the sampling frame^?	*As treated* sample WfH sampling frame^	Sex, Age, Ethnicity, Disability, GP referral to WfH, Health condition, Medical condition
		Test internal validity / equivalence between the two *as treated* groups	Group Walkers Non-Group Walkers	Sex, Age, Marital status, Education, Ethnicity, Disability, General Practitioner (GP) referral to WfH, Health condition, Medical condition
Adversity	Independent samples *t*-tests	Differences between *as treated* groups on adversity variables at Time 1	Group Walkers Non-Group Walkers	Stressful life events
	Pearson chi-square	As above	Group Walkers Non-Group Walkers	Tertile of IMD
Covariates	Independent samples *t*-tests	Discern differences between *as treated* Group Walkers and Non-Group Walkers on walk behaviour outside WfH walks	Group Walkers Non-Group Walkers	Non-group walks in green space
		Discern differences between *as treated* Group Walkers and Non-Group Walkers on covariates	Group Walkers Non-Group Walkers	Social support, Perceived stress, Resiliency, Connectedness to nature
Well-being	Wilcoxon Signed Ranks	Within groups analysis of retrospective change in mental well-being, affect and depression	Time	Retrospective Pre-test variables: Mental well-being, Emotional well-being, and Depression
	Independent samples *t*-tests	Discern differences between *as treated* Group Walkers and Non-Group Walkers on measures of well-being	Group Walkers Non-Group Walkers	Mental well-being, Positive affect, Negative affect, Depression

^ = List of individuals involved in the WfH programme that was used for participant recruitment. IMD = Index of Multiple Deprivation

4.2 Demographics

At the start of the study, 3,015 *as treated* participants took part in the Time 1 questionnaire (1,923 Group Walkers; 1,092 Non-Group Walkers). This section first assesses the external validity of the study by examining how well the *as treated* sample represents the WfH population and WfH sampling frame. The equivalence between the two *as treated* groups on demographics and pre-existing health conditions is analysed second.

4.2.1 Representativeness of the sample

Table 4.2 shows the results from the chi-square tests comparing the *as treated* sample to the WfH population on sex, age and ethnicity[23]. Data about the WfH population, defined as all individuals who had attended at least one WfH walk from 1 January 2001 to 1 January 2013, were obtained from the national WfH database (accessed on 12 January 2013). There was a significant difference between the *as treated* study sample and the WfH population on sex and age. The *as treated* sample was comprised of more men, and individuals aged 55 years or over than the WfH population. There was no significant difference between the *as treated* sample and the WfH population on ethnicity.

Table 4.2. Comparison of the *as treated* sample (*n* = 3,015) to the WfH population (N = 122,840) on demographic variables.

Variable	***As treated* sample** % (*n*)	**WfH population** [a] *% (n)*	$\chi^{2\,b}$	*df*	***p*-value**	**Effect size Cramer's V**
Sex[1]	3,009	122,840	8.395	1	.004	.01
Female	69.4 (2088)	71.8 (88198)				
Male	30.6 (921)	28.2 (34642)				
Age[1]	2,997	118,020	7.656	1	.006	.01
18-54	27.3 (818)	29.6 (34969)				
55+	73.7 (2179)	70.4 (83051)				
Ethnicity[1]	2,892	117,192	3.412	1	.07	.01
White	95.1 (2749)	94.2 (110450)				
Non-white ethnicity	4.9 (143)	5.8 (6742)				

[a] All individuals recorded on the national WfH database from 1 January 2001 to 1 January 2013. [b] Pearson Chi-square. [1] Pairwise deletion.

[23] Analyses were unable to be conducted on education, marital status, disability, GP referral, health screening and medical conditions because these data were not provided in the national WfH database.

Table 4.3 shows the chi-square results comparing the *as treated* sample to the WfH sampling frame on demographics and pre-existing health data. The *as treated* sample significantly differed from the WfH sampling frame on sex, age, ethnicity, disability and medical conditions. More individuals in the *as treated* sample were male, aged 55 and over, white ethnicity, disabled, and with a medical condition than individuals in the WfH sampling frame.

Table 4.3. Comparison of the *as treated* sample (*n* = 3,015) to the WfH sampling frame (N = 32,579) on demographic and pre-existing health variables.

Variable	***As treated* sample** *% (n)*	**Sampling frame** *% (n)*	$\chi^{2\,a}$	*df*	***p*-value**	**Effect size Cramer's V**
Sex[1]	3,009	32,579	10.12	1	.002	.02
Female	69.4 (2,088)	72.1 (23,495)				
Male	30.6 (921)	27.9 (9,084)				
Age[1]	2,997	32,057	157.31	1	< .001	.07
18-54	27.3 (818)	38.9 (12,476)				
55+	72.7 (2,179)	61.1 (19,581)				
Ethnicity[1]	2,892	32,578	29.07	1	< .001	.03
White	95.1 (2,749)	92.3 (30,071)				
Non-white ethnicity	4.9 (143)	7.7 (2,507)				
Disability[1]	2,895	32,579	4.62	1	.03	.01
Disabled	10.4 (302)	9.2 (3,004)				
Not disabled	89.6 (2,593)	90.8 (29,575)				
GP referral to WfH? [1]	2,895	32,578	0.97	1	.32	.01
Yes	6.7 (194)	6.2 (2,032)				
No	93.3 (2,701)	93.8 (30,546)				
Health screening[1]	2,895	32,577	3.68	1	.06	.01
One or more Health screening conditions	15.2 (439)	13.9 (4,520)				
No Health screening conditions	84.8 (2,456)	86.1 (28,057)				
Medical Conditions[1]	2,895	32,579	10.61	1	.001	.02
One or more Medical Conditions	32.5 (941)	29.6 (9,648)				
No Medical Conditions	67.5 (1,954)	70.4 (22,931)				

[a] Pearson Chi-square. [1] Pairwise deletion.

4.2.2 *Demographics of as treated sample*

Table 4.4 presents a summary of the demographic and pre-existing health data for the *as treated* sample. As a whole, the *as treated* sample were predominately white ethnicity (95.1%), not referred to WfH by their GP (93.3%), not disabled (89.6%) and did not have a health screening condition (84.8%). Greater than two-thirds of *as treated* participants were female (69.4%), aged 55 or over (73.0%), married, civil partnered or cohabiting (71%) and did not have a medical condition (67.5%). Just over half of all *as treated* participants were educated to university (tertiary) level (55%).

Table 4.4. ***As treated*** **participant demographics and pre-existing health (*n* = 3,015).**

Variable	% (*n*)
Sex (*n* = 3009)[1]	
Female	69.4 (2088)
Male	30.6 (921)
Age (*n* = 2997)[1]	
18-54	27.3 (818)
55+	72.7 (2179)
Marital Status (*n* = 2979)[1]	
Married/civil partnered/cohabiting	71.0 (2116)
Single/divorced/separated/widowed	29.0 (863)
Education (*n* = 2983)[1]	
No qualifications	5.5 (165)
Secondary education	39.5 (1177)
Tertiary education	55.0 (1641)
Ethnicity[1] (*n* = 2892)[1]	
White	95.1 (2749)
Non-white ethnicity	4.9 (143)
Disability[1] (*n* = 2895)[1]	
Disabled	10.4 (302)
Not disabled	89.6 (2593)
GP referral to WfH?[1] (*n* = 2895)[1]	
Yes	6.7 (194)
No	93.3 (2701)
Health Screening (*n* = 2895)[12]	
One or more health screening conditions	15.2 (439)
No health screening conditions	84.8 (2456)
Medical Conditions[1] (*n* = 2895)[1]	
One or more medical conditions	32.5 (941)
No medical conditions	67.5 (1954)

[1] Pairwise deletion. [2] Data came from Outdoor Health Questionnaire (OHQ) individuals completed at their first WfH walk.

4.2.3 Differences of as treated samples on demographics and pre-existing health

At the start of the study, *as treated* Group Walkers and Non-Group Walkers significantly differed on sex, age, education, ethnicity, disability and medical conditions (see Table 4.5). More Non-Group Walkers were female, aged 18-54 years old, university (tertiary) educated, non-white ethnicity, disabled and without a medical condition than Group Walkers. These results demonstrate that the two *as treated* groups are not independent of sex, age, education, ethnicity, disability and medical conditions. Any differences between the two *as treated* groups are confounded with the effect of these demographic and pre-existing health variables.

Table 4.5. Comparison of *as treated* Group Walkers and Non-Group Walkers on demographic and pre-existing health (n = 3,015).

Variable	Group Walkers % (n)	Non-Group Walkers %(n)	$\chi^{2\,a}$	*df*	*p*-value	Effect size Cramer's V
Sex[1]	1922	1087	21.81	1	< .001	0.09
Female	66.4 (1277)	74.6 (811)				
Male	33.6 (645)	25.4 (276)				
Age[1]	1905	1092	174.31	1	< .001	.24
18-54	19.2 (365)	41.5 (453)				
55+	80.8 (1540)	58.5 (639)				
Marital Status[1]	1897	1082	0.516	1	.47	.01
Single/divorced/separated/ widowed	28.5 (541)	29.8 (322)				
Married/Civil partnered/cohabiting	71.5 (1356)	70.2 (760)				
Education[1]	1893	1090	7.97	2	.02	.05
No qualifications	5.9 (112)	4.9 (53)				
Secondary education	41.0 (776)	36.8 (401)				
Tertiary education	53.1 (1005)	58.3 (636)				
Ethnicity[12]	1906	986	19.25	1	< .001	.08
White	96.3 (1836)	92.6 (913)				
Non-white ethnicity	3.7 (70)	7.4 (73)				
Disability[12]	1908	987	5.35	1	.02	.04
Disabled	9.5 (181)	12.3 (121)				
Not disabled	90.5 (1727)	87.7 (866)				
GP referral to WfH?[12]	1908	987	1.52	1	.22	.02
Yes	6.3 (120)	7.5 (74)				
No	93.7 (1788)	92.5 (913)				
Health Screening[12]	1908	987	0.07	1	.80	.01
One or more health screening conditions	15.0 (287)	15.4 (152)				
No health conditions	85.0 (1621)	84.6 (835)				
Medical Conditions[12]	1908	987	5.04	1	.03	.04
One or more medical conditions	33.9 (647)	29.8 (294)				
No medical conditions	66.1 (1261)	70.2 (693)				

[a] Pearson Chi-square. [1] Pairwise deletion. [2] Data came from OHQ individuals completed at their first WfH walk.

4.3 Adversity

Objective 3 of this study will investigate whether outdoor group walks facilitate resilience by moderating the effects of adversity on mental and emotional well-being. Adversity was measured with two variables: number of stressful life events experienced and social deprivation (see Section 3.3.2). The following examines whether there was equivalence between the two *as treated* groups on these adversity variables at the start of the study.

4.3.1 Stressful life events

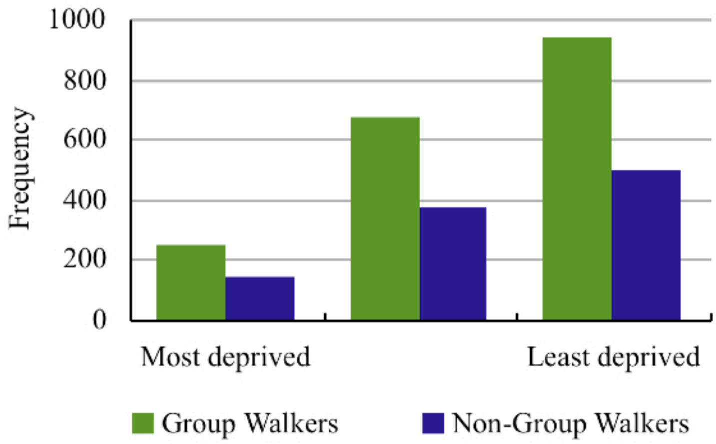
Over two-thirds of *as treated* Group Walkers (66.4%) and Non-Group Walkers (71.1%) experienced one or more stressful life events in the year prior to the start of the study. An independent samples *t*-test was conducted to determine if there was a significant difference between the two *as treated* groups on the cumulative number of stressful life events experienced in the year prior to the start of the study. At Time 1, Group Walkers experienced fewer stressful life events in the past year on average ($M = 1.35$, $SE = .03$) than Non-Group Walkers ($M = 1.45$, $SE = .04$)[24]. There was no significant difference between the two groups on the number of stressful life events in the past year, $t(3008) = 2.520$, $p = .01$ with the Bonferroni alpha correction of .005.

4.3.2 Social deprivation

Social deprivation was measured as tertile ranks of the overall English Indices of Multiple Deprivation 2010 (IMD) (Department for Communities and Local Government, 2011). Figure 4.1 shows the frequency of Group Walkers and Non-Group Walkers by IMD tertile. At the start of the study, approximately half of Group Walkers (50.6%) and Non-Group Walkers (49.2%) lived in the least deprived areas in England, whilst a minority of Group Walkers (13.3%) and Non-Group Walkers (13.8%) lived in the most deprived areas of England. There was no significant difference between the two *as treated* groups by IMD tertile at the start of the study ($X^2 = .542$, $p = .76$).

[24] Untransformed means are shown here. Independent samples *t*-tests were conducted with log-transformed variable.

Figure 4.1. Frequency of Group Walkers (n = 1,857) and Non-Group Walkers (n = 1,010) by IMD tertile at the start of the study.



4.4 Covariates

4.4.1 Non-group walks in green space

Table 4.6 shows the frequency of non-group walks in green space for the two *as treated* groups at the start of the study. At the start of the study, 65% of Group Walkers and 58% of Non-Group Walkers took part in non-group walks in green space once a week or more. On average, Group Walkers took part in significantly more non-group walks in green space (M = 6.01, SE = .04) than Non-Group Walkers (M = 5.73, SE = .06) at Time 1, $t(1999.75) = -3.70$, $p < .001$ with a small effect size (r = .08).

Table 4.6. Frequency of non-group walks in green space for *as treated* Group Walkers (*n* = 1,918) and Non-Group Walkers (*n* = 1,091) at the start of the study.

Frequency of non-group walks in green space	Group Walkers % (*n*)	Non-Group Walkers % (*n*)
Never	0.9 (17)	2.6 (28)
Once a year	1.4 (26)	4.2 (46)
Several times a year	10.3 (198)	12.6 (138)
Once a month	8.0 (154)	9.1 (99)
2-3 times per month	14.3 (275)	13.3 (145)
Once a week	21.3 (408)	19.0 (207)
2-3 times a week	25.5 (490)	18.8 (205)
4-6 times per week	8.3 (159)	8.5 (93)
Daily	10.0 (191)	11.9 (130)

Note. Responses measured on a 9-point scale, from 1 (never) to 9 (daily), based on the question *"On average, how frequently do you walk or hike in green space (such as a local park, natural area, national park or countryside)?"*.

4.4.2 Social support, perceived stress, resiliency and connectedness to nature

The following section tests whether *as treated* Group Walkers and Non-Group Walkers differed on social support, perceived stress, resiliency, and connectedness to nature at the start of the study (see Table 4.7). There was no significant difference between the two *as treated* groups on Time 1 social support, $t(3005) = 0.843$, $p = .40$. On average, Group Walkers expressed similar levels of social support as Non-Group Walkers at the start of the study. There was a significant difference between the two *as treated* groups on Time 1 perceived stress, $t(2165.59) = 8.84$, $p < .001$ with a small effect size ($r = .19$). On average, Group Walkers expressed less perceived stress than Non-Group Walkers at the start of the study. At Time 1, there was no significant difference between Group Walkers and Non-Group Walkers on resiliency, $t(3006) = -0.750$, $p = .45$, and connectedness to nature, $t(2111.77) = -.009$, $p = .99$. Mean scores for resiliency and connectedness to nature were similar between the two *as treated* groups at the start of the study.

Table 4.7. Independent *t*-tests between *as treated* Group Walkers (n = 1,916) and Non-Group Walkers (n = 1,092) on Time 1 social support, perceived stress, resiliency, and connection to nature.

Construct	Group Walkers		Non-Group Walkers	
	M	***SE***	***M***	***SE***
Social Support[3]	22.77	.14	22.97	.19
Perceived Stress[12] ***	13.78	.14	15.93	.20
Resiliency	27.35	.15	27.16	.20
Connectedness to Nature[1]	50.94	.16	50.94	.24

Note: Higher scores indicate greater: social support (range 0 – 30); perceived stress (range 0-40); resiliency (range 0-40; and connection to nature (14 -70). [1] Equal variances not assumed. [2] Group Walkers n = 1,908. [3] Non-Group Walkers n = 1,091. *** = Significant at Bonferroni corrected alpha level, p < .005.

4.5 Participants' well-being

4.5.1 Retrospective pre-test (RPT)

Retrospective pre-test (RPT) measures were used to assess change in participants' mental well-being, emotional well-being and depression from before joining WfH (Group Walkers) or one year before the T1 questionnaire (Non-Group Walkers). Due to the difference in retrospective time frames, within groups analyses were conducted to determine change over time. Table 4.8 shows the median scores for both *as treated* groups on all four RPT items. Both *as treated* groups showed an improvement from RPT ('then') to Time 1 ('now') on all four RPT items. Both groups demonstrated significant positive changes in relaxation, thinking clearly, mood and depression over time (see Table 4.8). These results indicate a general trend toward greater mental and emotional well-being over time – irrespective of whether one participates in a walking group.

Table 4.8. Median scores of *as treated* Group Walkers and Non-Group Walkers retrospective pre-test median scores for relaxation, thinking clearly, mood and depression, and results from the Wilcoxon signed ranks test.

Variable	RPT 'Then' *Mdn*	Time 1 'Now' *Mdn*	*z*	*p*-value	Effect size *r*
Group Walkers (n = 1,923)					
Relaxation	63	85	-29.95	< .001	-0.68
Thinking clearly	81	87	-24.63	< .001	-0.56
Mood	67	84	-29.54	< .001	-0.67
Depression	7	4	-15.29	< .001	-0.35
Non-Group Walkers (n = 1,092)					
Relaxation	51	62	-9.01	< .001	-0.27
Thinking clearly	75	79	-10.98	< .001	-0.33
Mood	61	71	-9.62	< .001	-0.29
Depression	11	10	-4.737	< .001	-0.14

Note. Mental well-being assessed by 'relaxed' and 'thinking clearly'. Emotional well-being assessed by 'mood'. Higher scores indicate greater: relaxation, thinking clearly, positive mood and depression. Anxious (0) - Relaxed (100); Not thinking clearly (0) - Thinking clearly (100); Negative mood (0) - Positive Mood (100); No depression (0) - Severely Depressed (100).

4.5.2 Mental well-being, depression and positive and negative affect

Table 4.9 details the mean and standard error of *as treated* Group Walkers and Non-Group Walkers' mental well-being, positive affect, negative affect and depression at the start of the study. At Time 1, Group Walkers experienced significantly greater mental well-being, on average, than Non-Group Walkers, $t(2139.96) = -5.66$, $p < .001$ with a small effect size $r = .12$. Group Walkers experienced significantly greater positive affect, on average, than Non-Group Walkers at Time 1, $t(2125.09) = -2.994$, $p = .003$ with a very small effect size $r = .06$. On average, Group Walkers experienced significantly less negative affect, than Non-Group Walkers at the start of the study, $t(2042.45) = 9.71$, $p < .001$ with a small effect size $r = .21$. At the start of the study, Group Walkers experienced significantly less depression, on average, than Non-Group Walkers, $t(2166.46) = 7.44$, $p < .001$ with a small effect size $r = .16$.

Table 4.9. Mean and standard error of *as treated* Group Walkers (*n* = 1,907) and Non-Group Walkers (*n* = 1,092) on Time 1 mental well-being, positive affect, negative affect and depression.

Construct	Group Walkers		Non-Group Walkers	
	M	***SE***	***M***	***SE***
Mental well-being[1] ***	52.68	.19	50.77	.28
Positive Affect[2] ***	34.28	.17	33.40	.24
Negative Affect[123] ***	15.32	.12	17.54	.21
Depression[13] ***	7.51	.15	9.99	.26

Note: Higher scores indicate greater: mental well-being (range 14-70); positive affect (range 10-50); negative affect (range 10-50); depression (range 0-50).[1] Equal variances not assumed. [2] Group Walkers *n* = 1,906. [3] = log10 transformation; untransformed mean scores shown. *** = Significant at Bonferroni corrected alpha level, $p < .005$.

4.6 Summary and discussion

The purpose of this chapter was to determine the similarity between the two *as treated* groups at the start of the study. The generalisibility of the study sample, or external validity, was examined by comparing the *as treated* sample to the WfH population and sampling frame. The claim for causal assumptions of the effect of outdoor group walk participation on well-being, or internal validity, was appraised by testing the differences between *as treated* Group Walkers and Non-Group Walkers at the start of the study on demographics, adversity, covariate and well-being variables.

4.6.1 External validity

Participant characteristics were compared to the WfH population and sampling frame in order to assess whether the *as treated* sample represented individuals who take part in WfH. Participant demographics mirrored the national WfH population on ethnicity, but not for age and sex. The *as treated* sample was comparatively older and included more male than the WfH population. The *as treated* sample significantly differed from the sampling frame on a number of demographic and health variables. The *as treated* sample was comprised of more men, older people aged 55 years or more, and individuals of white ethnicity, with a disability, and a medical condition than the WfH sampling frame. These significant differences between the *as treated* sample and the WfH population and sampling frame limit the generalisibility of the study's findings.

As such, conclusions from the study cannot be said to represent WfH population as a whole.

4.6.2 Internal validity

Between group analyses examined the differences between *as treated* Group Walkers and Non-Group Walkers at the start of the study on demographic and pre-existing health characteristics. These analyses are important because the study design did not randomly allocate participants to groups, which means the two groups could differ on these background variables. If, at the start of the study, the two groups had no differences on any of these variables, then causal assumptions about the effect of participating in WfH group walks could be made. Unfortunately, outdoor group walk participation was not independent of certain demographic and pre-existing health variables. At the start of the study, *as treated* Group Walkers and Non-Group Walkers significantly differed on sex, age, education, ethnicity, disability and medical conditions. Group Walkers were comprised of comparatively more males, older people, and individuals of white ethnicity, with non-university education, without a disability, and with more medical conditions than Non-Group Walkers. The causal relationship between group walk participation and measures of well-being are confounded by these demographic and pre-existing health differences. Confounding variables are 'third' variables that explain the relationship between an independent and a dependent variable (MacKinnon, Krull, & Lockwood, 2000, p. 2). For example, disability may confound the relationship between group walk participation and well-being. People who have a disability may be less likely to take part in an outdoor walking group, and people with a disability may have lower scores of well-being than individuals without a disability.

Also investigated were the differences between *as treated* Group Walkers and Non-Group Walkers at the start of the study on adversity, frequency of non-group walks, social support, perceived stress, resiliency and connectedness to nature. There was no difference between the two groups on either adversity variable at the start of the study. There was a significant difference between the *as treated* two groups on frequency of non-group walks and perceived stress, with Group Walkers engaging in more non-group walks in green space, and expressing less perceived stress than Non-Group Walkers. The two groups were equivalent with regard to mean scores of social support, resiliency and connectedness to nature at the start of the study.

Finally, baseline measures of mental and emotional well-being were assessed. Both *as treated* groups showed significant improvements from retrospective pre-test to baseline, suggesting a general trend for improvement in well-being over time that has nothing to do with group walk participation. At the start of the study, there were significant group differences on mental well-being, positive affect, negative affect and depression. Group Walkers expressed more mental well-being and positive affect, and less negative affect and depression than Non-Group Walkers. However, due to the differences in demographics, pre-existing health, walk behaviour, and perceived stress it is not possible to conclude that the positive well-being of Group Walkers was due to outdoor group walk participation. For example, conclusions on the effect of group walk participation on depression may be an effect of the differences in age between the two groups; perhaps older people are more likely to participate in WfH, and older people are less depressed than the younger people.

The aim of the study and its objectives are under threat by the non-equivalence between *as treated* Group Walkers and Non-Group Walkers on demographic and pre-existing health variables. To improve internal validity and establish independence between outdoor walking group participation and these variables, a statistical matching procedure was carried out on the *as treated* sample. Chapter 5 will discuss the theory and procedure of statistical matching, and describe how the *as treated* groups were statistically matched in order to improve internal validity.

Chapter 5 Improving causal associations with statistical matching

As reported in the previous chapter, Group Walkers and Non-Group Walkers significantly differed on sex, age, education, ethnicity, disability and medical conditions. These significant differences between the two *as treated* groups confound any causal assumptions of the effect of outdoor group walk participation on well-being. In other words, any differences on well-being between Group Walkers and Non-Group Walkers could be attributed to the differences on these variables, as well as participation in a group walking programme. To mitigate this, the two groups were statistically matched on pre-existing variables using propensity score matching. A statistically matched sample would improve the causal hypotheses from Objectives 1, 2 and 3 by eliminating differences on confounding variables between the two groups.

The chapter starts with the literature and procedure of propensity score matching. The second section presents the results of the propensity score matched *as treated* Group Walkers and Non-Group Walkers. The third section shows the results of the differences between the matched *as treated* sample on demographic, pre-existing health, and adversity variables. The chapter concludes with a summary.

5.1 Estimating causal effects in nonexperimental research design

Estimating causal effects between groups of participants requires the participants in each group be as similar as possible, so that the only difference between the two groups is the ‘treatment’ condition (Stuart & Rubin, 2007). This is called the assumption of “ignorability” (Stuart, 2010, p. 3). Experimental studies achieve ignorability through random assignment of participants to treatment groups. The consequence of which is that confounding covariates[25] are randomly distributed between the treatment and the control groups – ensuring the only difference between the two experimental groups is the treatment condition.

Nonexperimental studies violate the assumption of ‘ignorability’ because they do not randomly assign participants to conditions. Consequently, there may be many differences between the treatment and control groups. Nonexperimental studies need to

[25] A covariate is a variable that is related to the dependent variable (Field, 2009). It can be thought of as an alternative predictor variable.

control for many potential confounding covariates in order to improve internal validity and causal claims (Stuart & Rubin, 2007).

How to control for confounding covariates between groups in a nonexperimental study? Nonexperimental studies often use hierarchical regression or structural equation modelling to control for potentially confounding covariates (Harder, Stuart, & Anthony, 2010; Stuart, 2010). However, the statistical literature highlights two problems with using regression methods to adjust for confounding covariates. First, regression analyses can produce misleading results when there are large differences in the covariate distributions between the two groups (Cochran & Rubin, 1973; Rubin, 1973; cited in Stuart & Rubin, 2007). This is because large differences in the covariate distributions require heavy extrapolation in regression models beyond the limits of the observed data (Stuart & Rubin, 2007; Stuart, 2010), thus increasing the risk of Type 1 error[26]. Secondly, regression models control for confounding covariates on the outcome variable. This could lead to bias, in which a researcher selects a regression model that gives the desired result (Ho, Imai, King, & Stuart, 2007; Stuart & Rubin, 2007).

Statistical matching methods "replicate a randomized experiment" (Stuart & Rubin, 2007, p. 3) in a nonexperimental study by balancing the distribution of confounding covariates so that they are the same in both the treatment and control groups (Harder et al., 2010; E. A. Stuart & Rubin, 2007; Stuart, 2010). The outcome of statistical matching is 'ignorability' in that the only difference between the 'treatment' and 'control' groups is the treatment assignment (Ho et al., 2007). In contrast to regression models, statistical matching methods ensure similar covariate distributions between the 'treatment' and 'control' groups (Harder et al., 2010; Rosenbaum & Rubin, 1983; Stuart & Rubin, 2007; Stuart, 2010) and it does this without "consulting" the outcome variable (Ho et al., 2007, p. 220). After matching, if there are no differences between the groups on measured covariates, then treatment assignment is 'ignorable' – given these measured covariates (Stuart & Rubin, 2007). It is also assumed there are no group differences on unmeasured confounding variables; however, this may be harder to prove (Harder et al., 2010).

[26] Type 1 error is rejecting a true null hypothesis or finding an effect that, in reality, does not exist (Field, 2009).

5.2 Propensity score matching (PSM)

The propensity score is the probability of a participant receiving the treatment given the observed covariates (Rosenbaum & Rubin, 1983; cited in Ho et al., 2007). The propensity score is a combination of all observed covariates. Statistical matching of 'treatment' and 'control' participants is done on the propensity score instead of with each individual covariate.

Propensity score matching assembles a sample of participants that are similar on observed covariates (Stuart, 2010). A subsample of participants is selected from the original sample in which the 'treatment' and 'control' groups have similar distributions on the propensity score (Ho et al., 2007; Stuart & Rubin, 2007; Stuart, 2010). Matching participants will result in a loss of participants. It is be better to think of PSM as 'pruning' rather than 'matching' because of the loss of participants, and that actual matched pairs are not required[27] (Ho et al., 2007, p. 212). The loss of participants does not affect power. According to the statistical literature, matching increases power due to reduced extrapolation, compared to unmatched groups (Ho et al., 2007; Stuart, 2010).

Propensity score matching has not been used widely in psychological research (Harder et al., 2010). This could be a practical limitation, as the majority of PSM programmes are in R, STATA or SAS (Harder et al., 2010; Ho et al., 2007; Stuart, 2012; Thoemmes, 2012), instead of SPSS, the statistical software package of choice for many social scientists (Thoemmes, 2012). To date, only one PSM programme for SPSS exists (Stuart, 2012; Thoemmes, 2012).

[27] It is only the covariate distributions that need to be equivalent in propensity score matching (Ho, Imai, King, & Stuart, 2007, p. 212).

5.2.1 Procedure

The PSM procedure consists of five steps (Thoemmes, 2012):

1. Selection of covariates for matching;
2. Estimating the propensity score;
3. Matching participants;
4. Assess balance on covariates after matching;
5. Outcome analysis.

The first step involves the selection of observed covariates. Credibility of the propensity score analysis is determined by the selection of the observed covariates (Thoemmes, 2012). The PSM literature recommends including as many observed covariates *as possible* in order to obtain 'ignorability' (Stuart, 2010; Thoemmes, 2012). Thus, matching participants on fixed covariates (e.g. sex, age, ethnicity) is insufficient for 'ignorability' (Harder et al., 2010; Thoemmes, 2012). Selected covariates should be known to effect both the treatment assignment and the outcome variable (Ho et al., 2007; E. A. Stuart & Rubin, 2007; Stuart, 2010). Excluded are all outcome variables and any covariates that are affected by the treatment (Ho et al., 2007; Stuart, 2010).

The second step of propensity score analysis involves estimating the propensity score. Estimating the propensity score is most commonly achieved through logistic regression (Stuart, 2010; Thoemmes, 2012). The treatment condition as the dependent variable and observed covariates are the independent variables in the logistic regression.

The third step involves matching participants, which can occur using different techniques (see Stuart, 2010). The most common technique, 1:1 nearest neighbour matching (Thoemmes, 2012), involves matching a single 'control' participant to a single 'treated' participant with the most similar propensity score (Stuart & Rubin, 2007; Stuart, 2010; Thoemmes, 2012). Nearest neighbour matching can occur with or without replacement. 1:1 matching without replacement results in equal sample sizes for both matched groups (see Beard, Aveyard, Brown, & West, 2012). 1:1 matching with replacement means that the same 'control' participant can be re-used and matched to more than one 'treatment' participant (Stuart, 2010); re-used 'control' participants “receive a frequency weight that reflects the number of times they were selected as a match” (Stuart, 2010, p. 13). To ensure ‘good matches’ a calliper is applied to restrict the propensity score distributions between two participants (Stuart, 2010; Thoemmes, 2012). ‘Control’ participants who are not identified as a ‘good match’ for a ‘treated’ participant are ‘pruned’ from the sample (Stuart, 2010).

The fourth step involves assessing balance after matching (Thoemmes, 2012). Balance is assessed numerically and graphically (Stuart, 2010). Numerically, balance is determined by comparing the standardised mean difference of each covariate before and after matching. After matching, standardised mean differences should ideally be close to zero (Thoemmes, 2012) and always less than .25 standard deviations (Cochran, 1968; cited in Ho et al., 2007), as this is the point where regression adjustments are considered to be “trustworthy” (Rubin, 2001; cited in Stuart, 2010, p. 11). Graphs of the distribution of propensity scores before and after matching are another way of assessing balance. In each graph, the researcher is to “look for good overlap of the propensity scores between the two groups in the matched sample” (Stuart, 2010, p. 12). Matching is an iterative process. It continues until the best covariate balance is found (Ho et al., 2007). “One should try as many matching solutions as possible and choose the one with the best balance as the final pre-processed data set .... Matching solutions with suboptimal balance are…irrelevant” (Ho et al., 2007, p. 216).

The final step is the outcome analysis (Thoemmes, 2012). Matched samples can be analysed with exactly the same analysis techniques used on the unmatched sample (Ho et al., 2007; Stuart, 2010). The analyses compare groups, not pairs of individuals (Stuart, 2010). Statistical matching and regression have been shown to work best in combination (Cochran & Rubin, 1973; Rubin, 1973; Rubin, 1979; Rubin & Thomas, 2000; cited in Stuart & Rubin, 2007), as regression analyses can control for any remaining variance in the matched sample. Outcome analyses with a sample that was matched using 1:1 matching with replacement (see Step 3) need to be weighted by the frequency weights, which indicate how many times a ‘control’ participant was matched to a ‘treatment’ participant (Thoemmes, 2012).

5.3 Propensity score matching for study sample

Propensity score matching was used to match *as treated* Group Walkers and Non-Group Walkers on confounding covariates in order to improve estimates of causation, which are necessary to address the aim and objectives of this thesis.

5.3.1 Participants

1,991 *as treated* participants (1,258 Group Walkers and 733 Non-Group Walkers) completed both online questionnaires. PSM cannot occur on cases with missing data on the covariates (Thoemmes, 2012). Consequently, this meant a loss of 184 participants (58 Group Walkers and 126 Non-Group Walkers) who had missing data. Covariates with missing data were mostly IMD tertile (96 cases missing) or pre-existing health screening (77 cases missing). The majority of snowball sampled Non-Group Walkers would have missing data on the health condition variable[28] and were dropped from the sample. The propensity score matching procedure was conducted on a subsample of 1,807 *as treated* participants (1,200 Group Walkers and 607 Non-group Walkers) who had completed both online questionnaires and had no missing data on any of the measured covariates.

5.3.2 Procedure

The SPSS PSM programme 'psmatching' (version 2)[29] (Thoemmes, 2012) was used to match the subsample of 1,807 *as treated* participants. The 'psmatching' programme performs all analyses in R (version 2.12) using the R plug-in for SPSS (SPSS R Essentials). The propensity score matching procedure was performed many times in order to find the solution with the best covariate balance (Ho et al., 2007). The final matched sample was selected based on recommendations by Ho et al. (2007). The five steps of the final propensity score matching procedure are described below.

The first step in the propensity score matching involved selection of the covariates. Eleven covariates were included in the matching procedure (see Table 5.1). Selected

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[28] Data on health screening conditions were obtained from the national WfH database, which stores Outdoor Health Questionnaire (OHQ) data. Group Walkers and 'inactive' Non-Group Walkers would have completed an OHQ at their first WfH walk. Snowball sampled Non-Group Walkers on the whole may not have an OHQ, resulting in missing data and in their exclusion from the propensity score matched sample.

[29] Available from http://sourceforge.net/projects/psmspss/

covariates should be known to effect both the treatment assignment and the outcome variables (Ho et al., 2007; Stuart & Rubin, 2007; Stuart, 2010). Sex, age, disability, health and medical conditions can all affect WfH attendance (Coleman et al., 2011; Phillips et al., 2011), as well as well-being (Deacon et al., 2010; Office for National Statistics, 2012; Olsen et al., 2004; Tennant et al., 2007; Watson, 1988). Marital status is a predictor of walking behaviour (Bergland, Thorsen, & Loland, 2010) and is associated with well-being (Office for National Statistics, 2012). Highest level of education can affect involvement in physical activity (Trost, Owen, Bauman, Sallis, & Brown, 2002) and well-being (Deacon et al., 2010; Huppert et al., 2009; Tennant et al., 2007). Ethnicity (Department of Health, 2011; Trost et al., 2002), social deprivation (Collins, 2004; cited in Biddle & Mutrie, 2008), and stressful life events in the past year (Oman & King, 2000) can all affect physical activity involvement, as well as well-being (Office for National Statistics, 2012; HM Government, 2011; McManus et al., 2009; Cohen, 2000; Radloff, 1977).

Table 5.1. Covariates used in the propensity score matching, their level of measurement and score range.

Covariate	Level of measurement	Score Range
Sex	Dichotomous	Woman = 0, Men = 1
Age	Dichotomous	18-54 = 0, 55+ = 1
Marital Status	Dichotomous	Single, divorced, widowed = 0, married/civil partnered/cohabiting = 1
Qualification	Ordinal	No qualifications (0), Secondary education (1), Tertiary education (2)
IMD	Ordinal	Most (1) to least (3) deprived
Stressful life events in past year	Ordinal	0 stressful events (0); 1-2 stressful events (1); 3+ stressful events (2)
Ethnicity	Dichotomous	White ethnicity = 0, Non-white ethnicity = 1
Health screening	Dichotomous	No health condition = 0, 1 or more health conditions = 1
Medical condition	Dichotomous	No medical condition = 0, 1 or more medical conditions = 1
Disability	Dichotomous	No = 0, Yes = 1
GP recommendation to WfH	Dichotomous	No = 0, Yes = 1

The selected covariates were *not* causal consequences of the treatment condition (Ho et al., 2007; Stuart, 2010): five covariates (age, sex, ethnicity, marital status, highest qualification) are fixed covariates; four covariates (GP referral, health and medical condition, disability) were measured before the treatment[30]. Social deprivation and stressful life events in the year prior to T1 were not caused by one's participation in WfH in 2011. Excluded from the matching were all outcome variables and covariates that could have been affected by participation in WfH (Ho et al., 2007; Stuart, 2010), such as: mental well-being, positive affect, negative affect, depression, social support, perceived stress, resiliency, connection to nature, non-group walk behaviour, physical activity.

Steps 2 and 3 involved estimating the propensity score and matching participants. Propensity scores were estimated with logistic regression, with the treatment assignment (0 = Non-Group Walking, 1 = Group Walking) as the outcome variable and the covariates listed in Table 5.1 as predictors. Participants were matched using 1:1 nearest neighbour matching with replacement (Dehejia & Wahba, 1999; Ho et al., 2007; Stuart, 2010). Matching with replacement is recommended when there are fewer 'control' participants than 'treated' participants (Dehejia & Wahba, 1999; cited in Ho et al., 2007; Stuart, 2010), as was the case with the *as treated* subsample. Matching with replacement can often yield better matches and reduce bias than matching without replacement (Stuart & Rubin, 2007; Thoemmes, 2012), as was the case with the *as treated* subsample. To ensure 'good matches', a calliper of .25 of the standard deviation was set based on recommendations in the literature (Ho et al., 2007; Rosenbaum & Rubin, 1985; Stuart, 2010). The fourth and fifth steps will be discussed in the sections 5.3.4 and 5.4, respectively.

5.3.3 Matched participants

The matched *as treated* sample comprised 1,650 participants (1,200 Group Walkers and 450 Non-Group Walkers). The matching procedure resulted in a loss of data: 157 Non-Group Walkers were unmatched. No Group Walkers were unmatched. Matching with

[30] Data on ethnicity, GP referral, health condition, mediation condition and disability came from the national WfH database, which stores Outdoor Health Questionnaire (OHQ) data.

replacement resulted in each of the 450 Non-Group Walkers having a propensity score weight to reflect the number of times the participant was matched to a Group Walker.

5.3.4 Assessing balance of the matched sample

The matched *as treated* sample was assessed for balance on all covariate distributions. Balance was assessed in three ways: i) balance statistic; ii) standardised difference in means; iii) graphical propensity score distributions between the two groups. Balance statistics demonstrated an improvement of the sample after matching. The Relative Multivariate Imbalance *L* statistic (Iacus, King, & Porro, 2012) was larger in the unmatched sample (.547) than the matched sample (.468) indicating that matching improved covariate balance (Thoemmes, 2012). Table 5.2 shows the standardised mean difference before and after matching. The standardised mean differences show an improvement after matching; each covariate after matching had a standardised mean difference close to zero and less than .25 standard deviations. Results from the two numerical analyses demonstrate that the matched *as treated* sample achieved balance on the covariate distributions.

Table 5.2. Standardised mean difference between Group Walkers and Non-Group Walkers on selected covariates before and after propensity score matching.

	Standardised Mean Difference	
Covariate	**Before matching**	**After matching**
Propensity Score	0.87	0.01
Sex	0.17	0.06
Age	0.83	0.00
Marital Status	0.02	0.02
Qualification	-0.18	0.01
Ethnicity	-0.19	0.01
IMD	0.09	-0.03
Health screening	0.00	-0.05
Medical condition	0.10	-0.02
Disability	-0.15	-0.01
GP recommendation to WfH	-0.02	-0.02
Stressful life events in past year	-0.11	-0.06

Note. Sex, age, marital status, ethnicity, health condition, medical condition, disability, GP recommendation to WfH are dichotomous variables. Qualification, IMD, stressful life events in the past year are tertiles.

Balance was also assessed graphically (Stuart, 2010). Figure 5.1 shows the distribution of the propensity scores was not similar before matching, but improved after matching. Figure 5.2 is a dot plot of the individual propensity scores for the matched and unmatched Group Walkers (treated) and Non-Group Walkers (control). The figure shows good overlap of the propensity scores between the two groups in the matched sample and there is a match for each 'treated' participant. Re-used 'control' participants have dots of a size proportional to how many times they were matched to a 'treatment' participant (Stuart, 2010; Thoemmes, 2012). Figure 5.3 shows the magnitude of the standardised mean differences before and after matching. After matching, standardised differences are centred on zero (Thoemmes, 2012). Figure 5.4 is a graphical representation of Table 5.2; it shows that for each covariate (except health screening), standardised mean differences improved after matching by being centred on zero. Figure 5.5 shows a plot of the standardised mean differences before and after matching to discern whether balance improved for individual covariates. Grey lines show the standardised difference in means that decreased after matching. Lines in bold are standardised mean differences that increase after matching. A few covariates show an increase in standardised means difference after matching; however, this increase is not above the .25 standard mean difference cut-off (see Table 5.2).

In sum, output from balance statistics, standardised mean difference and graphs demonstrated covariate balance of Group Walkers and Non-Group Walkers after matching, suggesting that balance in the matched *as treated* sample had been achieved.

Figure 5.1. Distribution of propensity scores of Group Walkers (treated) and Non-Group Walkers (control) before and after matching, overlaid with kernel density estimate.

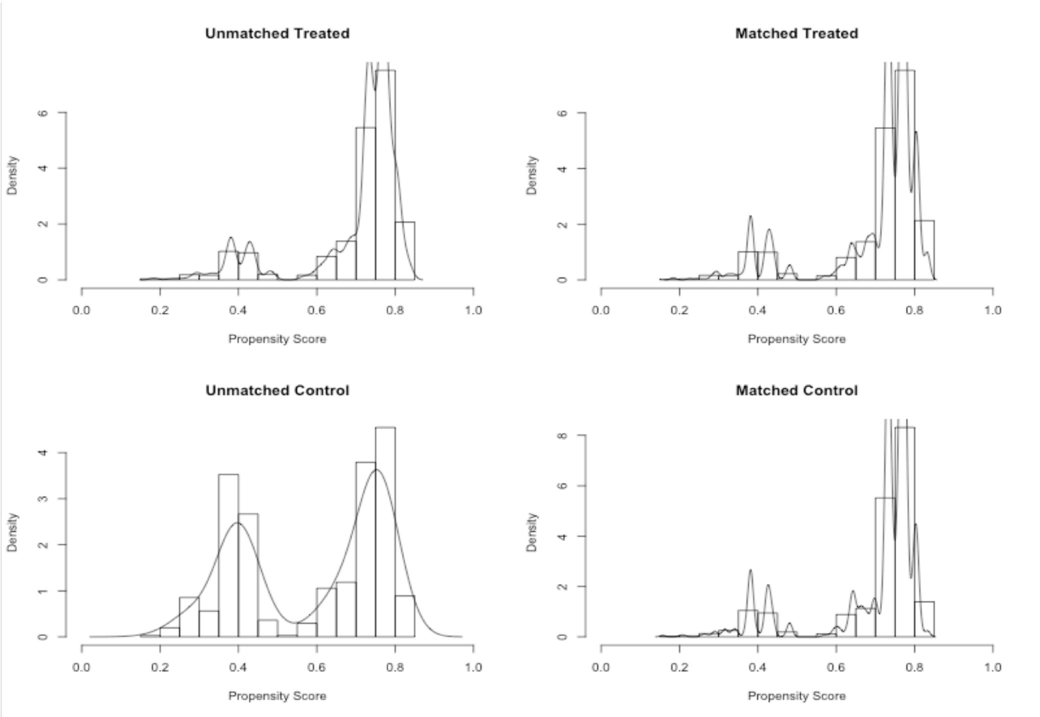


Figure 5.2. Dot plot of individual Group Walkers (treatment) and Non-Group Walkers (control) who were either matched or unmatched.

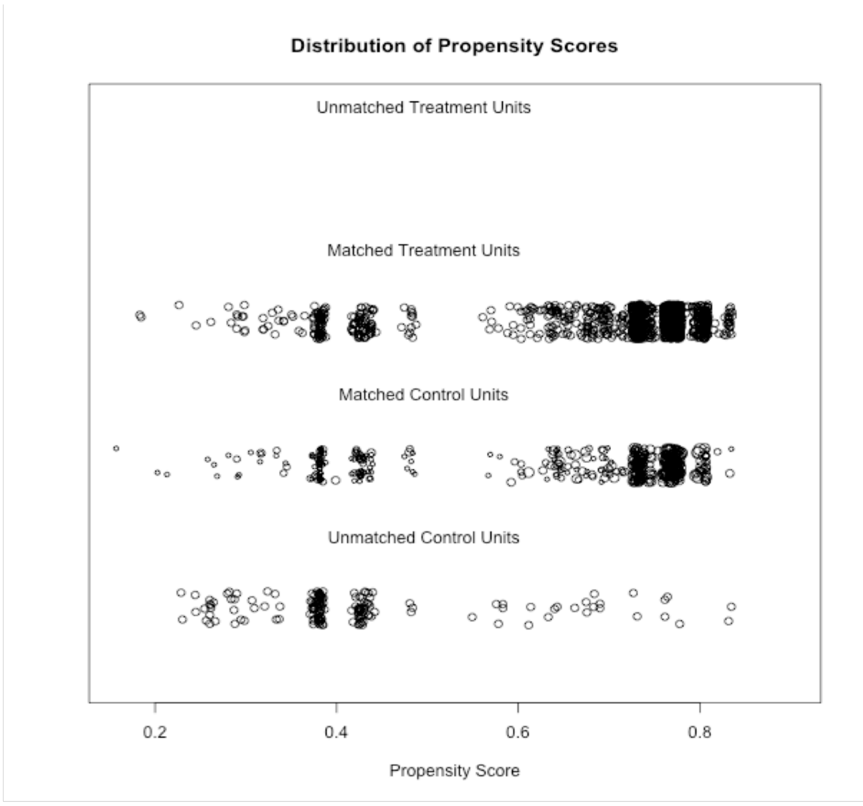


Figure 5.3. Histograms overlaid with kernel density estimates of standardised mean differences before and after matching.

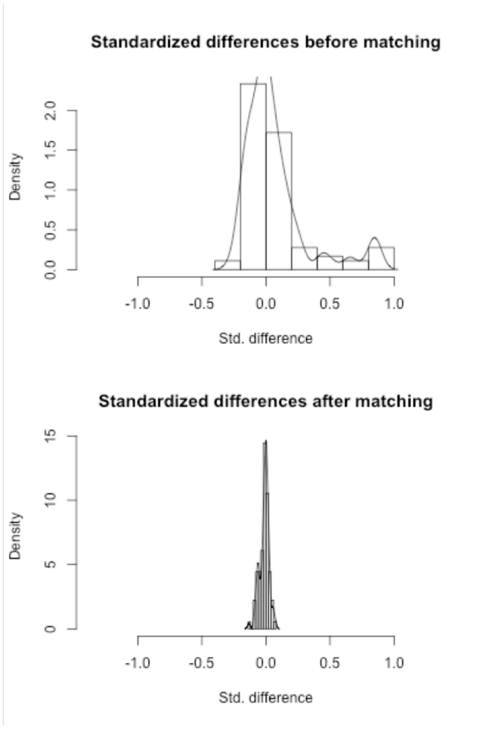


Figure 5.4. Dot plot of standardised mean differences on selected covariates before and after matching.

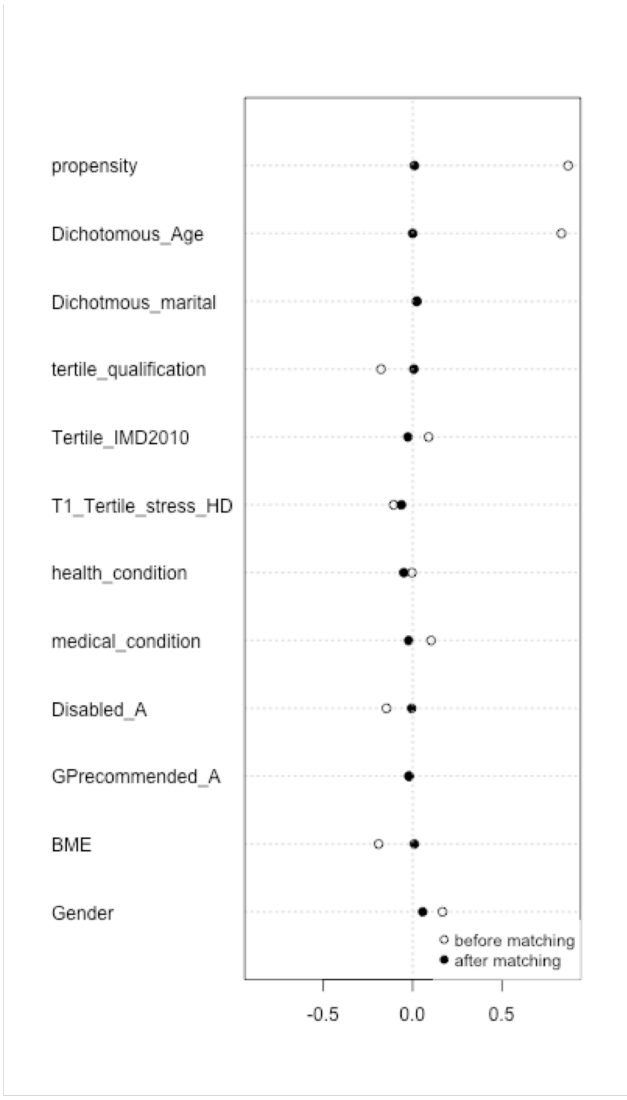
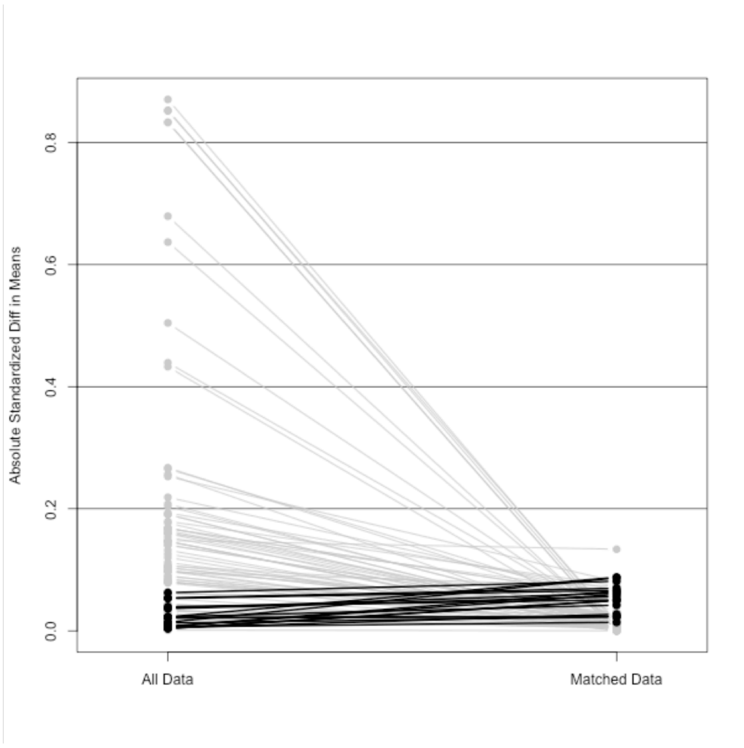


Figure 5.5. Line plot of standardised mean differences before and after matching (standardised mean differences that increase are in bold).



5.4 Outcome analysis of matched *as treated* sample on background variables

Statistical analyses can be run on the matched *as treated* sample after balance between the two groups has been established. The following analyses assess the effect of group walk participation on demographic, pre-existing health, and adversity variables. The alternative hypothesis is there would be a significant difference between matched *as treated* Group Walkers and Non-Group Walkers on the above variables. Assumptions of the chi-square and independent samples *t*-tests (Field, 2009) were assessed prior to analysis. The assumptions for chi-square test (Field, 2009) were met. Due to non-normality, Time 1 and Time 2 stressful life events variables were log-transformed (Tabachnick & Fidell, 2013).

All analyses on the matched *as treated* sample require the sample to be weighted by the propensity score (Thoemmes, 2012)[31]. SPSS can accommodate fractional weights on

[31] "In the case of matching with replacement, weights of control units that were reused are summed across all matches in which the control unit was used" (Thoemmes, 2012, p. 10). Prior to analysis, the propensity score weight 'psweight' was 'turned on' in SPSS using the following syntax: "weight by psweight".

chi-square[32] (Maletta, 2007; UCLA: Statistical Consulting Group, 2013) and *t*-test analyses (F. Theommes, personal communication, 12 February 2013). Significance levels were set at $p < .05$ for all analyses. Pairwise or listwise deletion were not needed because there was no missing data in the matched *as treated* sample on these variables (see Section 5.3.1).

5.4.1 Demographic and health variables

As a whole, the matched *as treated* sample was predominately aged 55 or older (87%), white ethnicity (97%), not disabled (91%), not referred to WfH by a GP (93%), and had no health conditions (84%). About two-thirds of the sample were female (66%), married, civil partnered or cohabiting (71%), and had no medical conditions (65%). Half the matched *as treated* sample were university (tertiary) educated (50%).

The null hypothesis was accepted. There was no relationship between the two matched *as treated* groups on any of the demographic and health variables ($p > .05$ for all) (see Table 5.3), suggesting that 'ignorability' had been achieved.

[32] SPSS Crosstabs can analyse fractional weights in the Cell Display/Noninteger Weights/No Adjustment dialog box, which uses case weights "as is" (SPSS help/crosstabs/crosstabs cell display)

Table 5.3. Comparison of statistically matched *as treated* Group Walkers and Non-Group Walkers on demographic and health variables.

	Group Walkers % (*n*) n = 1,200	**Non-group Walkers** % (*n*) n = 450	$\chi^{2\,a}$	***df***	***p*-value**	***V***
Sex			1.04	1	.31	.03
Female	65.3 (784)	68.0 (306)				
Male	34.7 (416)	32.0 (144)				
Age			0.000	1	1.00	.000
18-54	13.0 (156)	13.0 (58.5)				
55+	87.0 (1,044)	87.0 (391.5)				
Marital Status			0.19	1	.67	.01
Single/Divorced/Separated/Widowed	29.2 (350)	30.2 (136.13)				
Married/Civil partnered/cohabiting	70.8 (850)	69.8 (313.88)				
Qualifications			2.81	2	.25	.04
No qualifications	6.8 (81)	5.1 (22.88)				
Lower-, Upper- or Post-secondary	41.4 (497)	45.2 (203.25)				
Tertiary education	51.8 (622)	49.8 (223.88)				
Ethnicity[1]			0.03	1	.87	.004
White	96.7 (1160)	96.8 (435.75)				
Non-white ethnicity	3.3 (40)	3.2 (14.25)				
Disability[1]			0.01	1	.91	.003
Disabled	8.6 (103)	8.8 (39.38)				
Not disabled	91.4 (1097)	91.2 (410.63)				
GP referral toWfH?[1]			0.13	1	.72	.01
Yes	6.4 (77)	6.9 (31.13)				
No	93.6 (1123)	93.1 (418.88)				
Health screening[1]			0.80	1	.37	.02
One or more Health conditions	16.0 (192)	17.8 (80.25)				
No Health conditions	84.0 (1008)	82.2 (369.75)				
Medical Conditions[1]			0.17	1	.68	.01
One or more Medical Conditions	34.6 (415)	35.7 (160.50)				
No Medical Conditions	65.4 (785)	64.3 (289.50)				

Note. Matched *as treated* sample; analysis weighted by propensity score weight. *V* = Cramer's *V*. [1] = Data came from the WFH OHQ. [a] = Pearson Chi-square.

5.4.2 Adversity variables

There was no relationship between matched *as treated* Group Walkers and Non-Group Walkers on all adversity variables ($p > .05$ for all). Social deprivation was independent of group walk participation (χ^2 (2) = .39, p = .82, Cramer's V = .02) (see Table 5.4).

Table 5.4. Tertiles of deprivation for matched *as treated* Group Walkers and Non-group Walkers.

	Group Walkers[a] % (*n*)	**Non-group Walkers**[b] % (*n*)
Deprivation % (*n*)		
Most deprived	11.8 (141)	11.6 (52.13)
Moderate deprived	36.1 (433)	34.6 (155.63)
Least deprived	52.2 (626)	53.8 (242.25)

Note. Matched *as treated* sample; analysis weighted by propensity score weight. [a]n = 1,200; [b]n = 450.

Stressful life events at both T1 and T2 were analysed; there was no significant differences between the two matched *as treated* groups on these variables. On average, matched *as treated* Group Walkers experienced the same number of stressful life events in the past year[33] (M = 1.29, SE = .04) as matched *as treated* Non-Group Walkers (M = 1.33, SE = .06), t (1648) = 1.26, p = .21. At Time 2, matched *as treated* Group Walkers experienced the same number of stressful life events in the previous 13-weeks, on average (M = 0.61, SE = .04), as matched *as treated* Non-Group Walkers (M = 0.67, SE = .03), t(1648) = 1.36, p = .17.

5.5 Summary

This chapter reviewed the theory and procedure of propensity score matching (PSM), before applying it to the *as treated* sample of Group Walkers and Non-Group Walkers. The two groups needed to be statistically matched to eliminate the significant differences on sex, age, marital status, education, ethnicity, disability, and medical conditions that were identified in Chapter 4. These significant differences on pre-existing variables confound the effect of group walk participation on well-being, thus making causal inferences to address Objectives 1-3 futile.

[33] Time 1 and Time 2 stressful life events variables were log-transformed variable for the independent samples *t*-test analyses. Non-transformed means and standard errors are presented here.

Group Walkers and Non-Group Walkers were matched using propensity scores. A propensity score is the probability of a participant being in the 'treatment' group given the observed covariates. The outcome of propensity score matching is a matched sample, in which the only difference between the 'treatment' and 'control' group is the treatment condition. *As treated* Group Walkers and Non-Group Walkers were matched on sex, age, marital status, education, ethnicity, IMD, disability, health conditions, medical conditions, GP referral to WfH and number of stressful life events in the previous year. Non-Group Walkers could be 'matched' to more than one Group Walker. The matched *as treated* subsample was comprised of 1,650 participants (1,200 Group Walkers and 450 Non-Group Walkers). Covariate balance, or the zero difference in the observed covariates between the matched two groups, was confirmed statistically, numerically and graphically indicating the PSM procedure was successful. Chi-square and independent samples *t*-tests confirm that demographic, health and adversity variables were independent of the 'treatment' condition. The next chapter will now report the between groups analyses on well-being variables to address Objective 1.

Chapter 6 The well-being benefits from participating in an outdoor walking group

This chapter addresses the benefit to well-being from participating in an outdoor walking group by reporting findings from within and between groups analyses on the propensity score matched *as treated* sample. Specifically this chapter assesses Objective 1 of the thesis:

> Evaluate if individuals who take part in outdoor group walks have better mental and emotional well-being than individuals who do not take part in outdoor group walks.

There are four sections to this chapter. The chapter first details the statistical analyses conducted. The second displays results from the within group analyses used to examine the main effect of time on mental and emotional well-being. The third section presents results from between groups analyses that examine the main effect of group walk participation on mental and emotional well-being. The chapter concludes with a summary of the relationships found.

6.1 Method

6.1.1 Participants

Participants for all analyses were the matched *as treated* sample and comprised of 1,200 Group Walkers and 450 Non-Group Walkers (see Sections 4.1 and 5.3.3). All analyses were weighed by the propensity score 'psweight' (Thoemmes, 2012)[34].

6.1.2 Statistical analyses

Table 6.1 lists the statistical analyses conducted in this chapter. The choice of statistical analyses was influenced by the analyses available in SPSS that can accommodate fractional weights, which include cross tabulations and chi-square (Maletta, 2007; UCLA: Statistical Consulting Group, 2013), *t*-test (F. Theommes, personal communication, 12 February 2013) and ordinary least squares regression models (F.

[34] "In the case of matching with replacement, weights of control units that were reused are summed across all matches in which the control unit was used" (Thoemmes, 2012, p. 10). Prior to analysis, the propensity score weight 'psweight' was 'turned on' in SPSS using the following syntax: "weight by psweight".

Theommes, personal communication, 12 February 2013). ANCOVA were unable to be conducted, as SPSS ANCOVA does not analyse fractional weights[35]. However, hierarchical regression analyses are "the basic analysis of covariance [ANCOVA] problem in regression format" (Tabachnick & Fidell, 2013, p. 138).

[35] ANCOVA analyses are conducted in SPSS through the General Linear Model (GLM) command (Field, 2009). SPSS GLM will round fractional weights to the nearest whole number, thus omitting the propensity weight data (IBM, 2012, Maletta, 2007, UCLA: Statistical Consulting Group, 2013). IBM SPSS sells an 'add-on' package that can analyse fractional weights, called Complex Samples, at a cost of $583.00 per year (https://www112.ibm.com/software/howtobuy/buyingtools/paexpress/Express?part_number=D0ELBLL%2CD0EE2LL%2CD0EL9LL%2CD0EDSLL&catalogLocale=en_US&Locale=null&country=USA&PT=html&TACTICS=%26S_TACT%3D%26S_CMP%3D%26brand%3D&ibm-submit=View+US+prices+%26+buy).

Table 6.1. List of statistical analyses conducted in this chapter, their purpose and the independent and dependent variables.

Construct	Analysis	Purpose	Independent/Predictor Variable	Dependent/Outcome Variable
Well-being	Wilcoxon signed-ranks	Within groups analysis of retrospective change in mental well-being, affect and depression	Time	Retrospective pre-test (RPT) variables: Relaxation, Thinking clearly, Mood, Depression
Well-being	Dependent samples *t*-tests	Within groups analysis of change in mental and emotional well-being from T1 to T2	Time	Mental well-being, positive affect, negative affect, depression
Covariates	Independent samples *t*-tests	Discern differences between the matched *as treated* groups on T1 and T2 covariates	Group Walkers Non-Group Walkers	T1 and T2: Perceived stress, social support, resiliency, connectedness to nature
Well-being	Independent samples *t*-tests	Discern differences between the matched *as treated* groups on T1 and T2 well-being	Group Walkers Non-Group Walkers	T1 and T2: Mental well-being, positive affect, negative affect, depression
Well-being	Backwards stepwise regression	Identify a subset of independent and covariate variables that significantly predict T1 outcome variables	Sex, marital status, age, education, ethnicity, disability, GP referral, health and medical screening, WfH group participation, IMD tertile, Time 1: frequency of non-group walks, stressful life events, perceived stress, resiliency, social support, connectedness to nature	T1 Mental well-being, positive affect, negative affect, depression
Well-being	Backwards stepwise regression	Identify a subset of independent and covariate variables that significantly predict T2 outcome variables	Sex, age, marital status, education, ethnicity, disability, GP referral, health and medical condition, IMD tertile T1: outcome variable, frequency of non-group walks T2: Physical activity, frequency and duration of non-group walks, stressful life events, perceived stress, resiliency, social support, connectedness to nature	T2 Mental well-being, positive affect, negative affect, depression
Well-being	Hierarchical regression	Evaluate the association between group walk participation on T1 mental and emotional well-being, holding significant covariates constant	Group walk participation and significant predictors identified in T1 backwards stepwise regression	T1 Mental well-being, positive affect, negative affect, depression
Well-being	Hierarchical regression	Evaluate the association between group walk participation on T2 mental and emotional well-being, holding significant covariates constant	Group walk participation and significant predictors identified in T2 backwards stepwise regression	T2 Mental well-being, positive affect, negative affect, depression

Within groups analyses

Two sets of within group analyses were conducted: retrospective change in well-being, and change in well-being over the course of the study. In dependent samples *t*-tests the difference (or change) scores (e.g. T2 minus T1) are analysed for normality (Field, 2009, p. 329). All four retrospective pre-test difference scores within each group were not normally distributed. Consequently, the Wilcoxon Signed Ranks test, the non-parametric equivalent for the dependent samples *t*-test, was used to analyse retrospective change in mental and emotional well-being. Alpha levels for these analyses were set at .05. Effect sizes were assessed with *r* (Cohen, 1988; Cohen, 1992; cited in Field, 2009, p. 57).

For the analysis of change in well-being over the course of the study, all four difference scores within each group had excessive positive kurtosis, but were not significantly skewed (i.e. less than ±1). Positive kurtosis is less important in a large sample as the impact from positive kurtosis diminishes in a large sample ($n > 200$) (Tabachnick & Fidell, 2013, p. 80). Thus, it was decided that the dependent variables were normally distributed, and dependent samples *t*-tests could be conducted on these variables. A Bonferroni correction of .01[36] was applied to the significance level in order to control for familywise Type 1 error rate from multiple comparisons. The Bonferroni corrected alpha of .01 ensures that the cumulative significance level for the 4 comparisons, within each group, does not exceed the critical value of .05 (Field, 2009). If any of the results have *p*-values less than .01, the null hypothesis will be rejected.

Independent samples *t*-test

All T1 and T2 dependent variables listed in Table 6.1 were assessed for normality. Normal distributions were assessed by the Kolmogorov-Smirnov (K-S) test, skewness and kurtosis values (less than ±1 was assessed as normal in large sample) (Fife-Schaw, 2003), and histograms. The K-S test was significant for all variables ($p < .001$) indicating significant non-normality. However, as the K-S test is sensitive to small deviations from normality in a large sample (Field, 2009), consequently this output will be of secondary importance. T1 and T2 negative affect and depression for both matched

[36] Bonferroni correction is to divide the alpha of .05 by the number of comparisons (Field, 2009, p. 373). In this case: .05/4 = .0125.

as treated groups demonstrated severe skew and kurtosis. A logarithmic transformation was applied to T1 and T2 negative affect and depression; the transformations were successful at eliminating skewness.

A Bonferroni correction was applied to the alpha level in order to control for familywise Type 1 error rate from multiple comparisons. The Bonferroni corrected alpha of .006[37] ensures that the cumulative significance level for the 8 comparisons did not exceed the critical value of .05 (Field, 2009). The null hypothesis was rejected if *p*-values were less than .006. Pairwise deletion was applied in each set of analyses.

Multiple regression

One of the assumptions of multiple regression is that the variables are measured as dichotomous or continuous (Field, 2009). All outcome variables were continuous; predictor variables were dichotomous, ordinal or continuous (see Table 6.2). Ordinal variables can be treated as continuous "when the underlying scale is thought to be continuous" (Tabachnick & Fidell, 2013, p. 7), which is the case for all five ordinal variables. Ordinal variables of education (Steptoe et al., 2006), social deprivation tertiles (Bell, Glinianaia, Tennant, Bilous, & Rankin, 2012; Fraser, Roderick, Bailey, & Sanderson, 2012; Steptoe et al., 2006), and frequency variables (Hug et al., 2009) have been used in regression analyses by previous researchers.

[37] Bonferroni correction for independent samples *t*-tests was .05/8 = .006.

Table 6.2. Predictor variables and their level of measurement.

Type of variable	Variable name	Level of measure
Demographic	Sex	Dichotomous
	Age	Dichotomous
	Marital status	Dichotomous
	Highest level of education	Ordinal
	Ethnicity*	Dichotomous
	Disability*	Dichotomous
	GP referral to WfH*	Dichotomous
	Health conditions*	Dichotomous
	Medical screening*	Dichotomous
Walk Behaviour	WfH group participation	Dichotomous
	T1 Frequency of non-group walks in green space	Ordinal
	T2 Frequency of non-group walks in green space	Ordinal
	T2 Duration of non-group walks in green space	Ordinal
Physical activity	T2 Physical Activity	Continuous
Adversity	Social deprivation (IMD) tertile	Ordinal
	Log-transformed T1 Stressful life events	Continuous
	T2 log-transformed Stressful life events	Continuous
Covariate	T1 Perceived Stress	Continuous
	T2 Perceived Stress	Continuous
	T1 Resiliency	Continuous
	T2 Resiliency	Continuous
	T1 Social Support	Continuous
	T2 Social Support	Continuous
	T1 Connectedness to nature	Continuous
	T2 Connectedness to nature	Continuous
	T1 Outcome Variable	Continuous

* Data came from Outdoor Health Questionnaire (OHQ) individuals completed at their first WfH walk.

Normality of ungrouped variables (see Table 6.1) were examined prior to analysis; the K-S test was significant for all continuous variables ($p < .001$), indicating non-normality. Stressful life events, negative affect and depression at both T1 and T2 all demonstrated positive skew and kurtosis. Logarithmic transformations were applied to these six variables; transformations were successful at reducing skew.

Normality, linearity and homoscedasticity of residuals were assessed with the histograms, P-P plots and scatterplots from the regression output. Inspection of the histograms and P-P plots indicated normal distribution of the standardised residuals for all regression analyses. The scatterplots of standardised residuals for Time 1 and Time 2 mental well-being and positive affect revealed homoscedasticity. The scatterplot of residuals of log-transformed Time 1 and Time 2 negative affect and depression showed some heteroscedasticity.

Independence of errors was unable to be assessed through the Durbin-Watson statistic (Field, 2009) from the regression output due to propensity score weights[38]. Multicollinearity was assessed through the correlation matrix (r > .80) and collinearity diagnostics (variance inflation factor (VIF) and tolerance statistics) (Field, 2009). No variables demonstrated multicollinearity.

Multivariate outliers for backwards stepwise regression models were assessed with Mahalanobis distance, leverage and Cook's distance. Mahalanobis distance measures the distance a case is from the mean score of all predictors (Field, 2009); no cases exceeded the critical values for T1 (40.79) or Time 2 (45.32)[39] backwards stepwise regressions. Leverage assesses the influence of a case on the outcome variable (Field, 2009). All cases in T1 or T2 backwards stepwise regression models were within the boundary limits of two times the average leverage, indicating no cases had an undue influence on the outcome variable. Cook's distance provides an additional way of assessing the influence of a single case on the outcome variable (Field, 2009); values greater than 1 are a concern (Field, 2009). None of the cases in T1 and T2 backwards stepwise regression models had Cook's distance greater than 1, suggesting none of the cases were having an excessive influence on the regression models. Univariate outliers in dichotomous variables were identified with less than 90-10 splits (Tabachnick & Fidell, 2013). Variables with such splits were ethnicity, disability, GP referral (see Table 5.3); these variables were retained for the regression analyses due to their empirical importance (Coleman et al., 2011; Department of Health, 2011; Office for National Statistics, 2012; Phillips et al., 2011; Trost et al., 2002).

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[38] SPSS was unable to compute the Durbin Watson statistic because "fractional case weights have been found for the variable specified on the WEIGHT command" (error text from SPSS REGRESSION output).

[39] "Mahalanobis distance is distributed as a chi-square variable (X^2), with degrees of freedom equal to the number of IVs. To determine which cases are multivariate outliers, one looks up critical X^2 at the desired alpha level" (Tabachnick & Fidell, 2013, p. 167). The critical value above was based on an alpha level of .001 and 17 predictors at T1, and 20 predictors at T2.

6.2 Results

6.2.1 Retrospective change in well-being

Objective 1 of this study sought to determine whether group walk participation would engender positive mental and emotional well-being. Part of this analysis included a retrospective pre-test (RPT) to determine the impact of participation in WfH. RPT data were collected at T1 to assess participants' mental and emotional well-being prior to joining WfH (Group Walkers) or one year before T1 (Non-Group Walkers), and compare it to their well-being 'now' at the start of the study (i.e. T1) (see Section 3.3.1). Due to the difference in time frames used, each sample was analysed separately. Table 6.3 shows the median scores for RPT variables for both matched *as treated* groups.

Table 6.3. Median scores of retrospective pre-test 'then' and 'now' and percentage change for relaxation, thinking clearly, mood and depression by matched *as treated* group.

Variable	RPT 'then' *Mdn*	Time 1 'now' *Mdn*	Increase Δ % (n)	Decrease Δ % (n)	No Δ % (n)
Group Walkers (n = 1,200)					
Relaxation***	64.00	84.00	75 (895)	6 (69)	20 (236)
Thinking clearly***	81.00	87.00	57 (679)	10 (116)	34 (405)
Mood***	69.00	85.00	71 (849)	7 (80)	23 (271)
Depression***	6.00	4.00	17 (201)	40 (484)	43 (515)
Non-group Walkers (n = 449)					
Relaxation***	55.00	59.13	55 (247)	32 (144)	13 (58)
Thinking clearly***	78.00	81.00	50 (225)	24 (106)	26 (118)
Mood***	67.88	71.50	51 (229)	31 (138)	18 (82)
Depression	9.00	10.00	35 (157)	31 (141)	34 (151)

Note. Matched *as treated* sample; analysis weighed by propensity score weight. Mental well-being assessed by 'relaxed' and 'thinking clearly'. Emotional well-being assessed by 'mood'. Higher scores indicate greater: relaxation, thinking clearly, positive mood and severe depression. Relaxation: 0 = Anxious, 100 = Relaxed; Thinking Clearly: 0 = Not thinking clearly, 100 = Thinking clearly; Mood: 0 = Negative mood, 100 = Positive Mood; Depression: 0 = Not depressed, 100 = Severely Depressed. *** $p < .001$.

Group Walkers

The alternative hypothesis was that median scores for mental well-being, emotional well-being and depression would improve from before joining WfH to the start of the study. Wilcoxon Signed-Ranks tests indicated that the alternative hypothesis was accepted for Group Walkers' mental well-being, emotional well-being and depression. Regarding mental well-being, there was a significant difference from before joining WfH to 'now' for Group Walkers' relaxation (z = -24.43, $p < .001$), with a large effect size ($r = -.71$), and thinking clearly (z = -19.67, $p < .001$) with a large effect size ($r = -.57$). Regarding emotional well-being, there was a significant improvement in mood from before joining WfH to 'now' (z = -23.85, $p < .001$) with a large effect size ($r = -.69$). Median levels of depression significantly reduced from before joining WfH to 'now' (z = -12.07, $p < .001$), with a medium effect size ($r = -.35$). This suggests that participating in outdoor group walks significantly improved Group Walkers' median levels of mental and emotional well-being, and significantly reduced levels of depression (see Table 6.3).

Non-Group Walkers

The alternative hypothesis was that median scores of mental well-being, emotional well-being and depression would improve from one year before T1 to the start of the study. Wilcoxon Signed-Ranks tests indicated that the alternative hypothesis was accepted for Non-Group Walkers' mental and emotional well-being, but rejected for depression. For mental well-being, there was a significant increase from one year before T1 to 'now' for relaxation (z = -3.63, $p < .001$) with a small effect size ($r = -.16$) and thinking clearly (z = 5.86, $p < .001$) with a small effect size ($r = -.26$). For emotional well-being, Non-Group Walkers' median levels of positive mood significantly increased from one year before T1 to 'now' ($z = -4.13$, $p < .001$) with a small effect size ($r = .18$). There was no significant difference in median levels of depression from one year before T1 to 'now' (z = -0.47, $p = .64$). This suggests that individuals who did not participate in group walks significantly improved their median levels of mental and emotional well-being over time, but maintained their levels of depression over time (see Table 6.3).

Summary of retrospective change in well-being

Both matched *as treated* groups demonstrated a significant improvement in mental and emotional well-being from RPT to the start of the study. These results indicate a general trend for greater mental and emotional well-being over time – irrespective of whether one participates in an outdoor walking group. Table 6.3 shows the directionality is the same in both groups for relaxation, thinking clearly and mood; both groups show a significant increase in median scores from 'then' to 'now'. Directionality, however, differs between the two matched *as treated* groups for depression. Group Walkers had a significant reduction in median levels of depression, in contrast to Non-Group Walkers who showed a non-significant increase.

The effect size and magnitude of change also differ between the two groups. Group Walkers demonstrated large effect sizes for retrospective change in relaxation, thinking clearly and mood, and medium effect size for depression whilst Non-Group Walkers demonstrated small effect sizes for retrospective change in relaxation, thinking clearly and mood (Cohen, 1988; Cohen, 1992; cited in Field, 2009, p. 57). The magnitude of change was also larger for Group Walkers than Non-Group Walkers. A larger percentage of Group Walkers showed an increase change in relaxation (75%), thinking clearly (57%), and mood (71%) compared to approximately half of Non-group Walkers who showed improvements on each of these 3 measures (see Table 6.3). The Group Walkers also demonstrated greater reduction in depression (40%), compared to the Non-Group Walkers (31%) (see Table 6.3).

In sum, there was a general trend toward positive mental and emotional well-being over time for both matched *as treated* groups. Group Walkers had a larger effect and more positive change in mental and emotional well-being from RPT to the start of the study than Non-Group Walkers. Moreover, Group Walkers had a significant reduction in depression from RPT to the start of the study, a reduction that was not reflected in the Non-Group Walkers. This suggests the reduction in depression may be due to the group walks, rather than a general trend towards positive well-being assessments.

6.2.2 Effect of time on well-being

Table 6.4 shows the means and standard error of Group Walkers' and Non-Group Walkers' mental well-being, positive affect, negative affect and depression at both T1 and T2. Dependent *t*-tests were conducted to evaluate the effect of time on well-being. The alternative hypothesis was that, within each group, there would be a difference on mental well-being, positive affect, negative affect and depression from Time 1 to Time 2.

Group Walkers

The null hypothesis was accepted for Group Walkers' mental well-being, positive affect, and depression. There was no significant difference between T1 and T2 scores for mental well-being (t (1199) = 0.40, p = .69), positive affect (t (1199) = -1.28, p = .20), and depression (t (1199) = 1.92, p = .06). The alternative hypothesis was accepted for negative affect, as there was a significant decrease in negative affect between T1 and T2 (t (1199) = 3.68, p < .001) with a small effect size (r = .10). These findings suggests that continued participation in an outdoor walking group could help maintain positive well-being, and may result in a small but significant reduction in negative affect (see Table 6.4).

Table 6.4. Mean scores of Time 1 to Time 2 mental and emotional well-being for matched *as treated* Group walkers and Non-Group Walkers.

	Time 1		**Time 2**	
Variable	***M***	**SE**	***M***	**SE**
Group Walkers (***n*** **= 1,200)**				
Mental well-being	52.96	0.24	52.88	0.21
Positive Affect	34.47	0.21	34.69	0.20
Negative Affect^ ***	14.91	0.14	14.45	0.14
Depression^	6.95	0.17	6.65	0.17
Non-Group Walkers (***n*** **= 450)**				
Mental well-being	51.23	0.42	50.94	0.41
Positive Affect ***	33.42	0.36	32.12	0.38
Negative Affect^ ***	17.01	0.31	16.06	0.29
Depression^	9.32	0.38	9.42	0.37

Note. Matched *as treated* sample; analysis weighed by propensity score weight. Higher scores indicate greater: mental well-being (range 14-70), depression (range 0-50), positive affect (range 10-50), negative affect (range 10-50). ^ = log-transformed variable; untransformed means shown. *** = p = .001, which exceeds Bonferroni corrected significance level of .01.

Non-Group Walkers

The null hypothesis was accepted for Non-Group Walkers' mental well-being and depression. There was no significant difference between T1 and T2 scores for mental well-being (t (449) = 0.94, p = .35), and depression (t (449) = -0.35, p = .72). The null hypothesis was rejected for positive and negative affect. Non-Group Walkers experienced a significant reduction between T1 to T2 scores for both positive affect (t (449) = 4.37, p < .001) with a small effect size (r = .20), and negative affect (t (449) =

3.92, $p < .001$) with a small effect size ($r = .18$). The results suggest that, over time, Non-Group Walkers maintained their level of mental well-being and depression, and a small but significant reduction in positive and negative affect (see Table 6.4).

Summary for the effect of time on well-being

Both matched *as treated* groups showed no significant change over time on mental well-being and depression, as well as a significant change over time on negative affect. These results suggest maintenance of mental well-being and depression, and reduction in negative affect over time irrespective of whether one participates in a walking group. Non-Group Walkers experienced a significant but small deterioration in positive affect over time, whilst Group Walkers showed no change. This suggests that individuals who continue to participate in an outdoor walking group maintained their level of positive affect over time, whilst those who continued to not participate in an outdoor walking group show a decrease in positive affect over time.

6.2.3 Effect of group walk participation on covariates and well-being

Independent samples *t*-tests analysed the effect of group walk participation on T1 and T2 covariates (perceived stress, social support, resiliency, and connectedness to nature) and well-being outcome variables (mental well-being, positive affect, negative affect, and depression). Two separate independent samples *t*-tests for Time 1 and Time 2 variables were conducted. The alternative hypothesis was that there was a significant difference between matched *as treated* Group Walkers and Non-Group Walkers, at Time 1 or Time 2, on covariates and well-being variables.

Between group differences at Time 1

Table 6.5 lists the means and standard error for the T1 covariate and well-being variables for each group. The null hypothesis was accepted for covariates resiliency, social support, and connectedness to nature. There was no significant difference between matched *as treated* Group Walkers and Non-Group Walkers on T1 social support (t (1648) = 0.646, $p = .52$), resiliency (t (755.72) = 0.31, $p = .76$), and connectedness to nature (t (718.67) = -0.32, $p = .75$). The null hypothesis was rejected for perceived stress. There was a significant difference between the two matched *as treated* groups on T1 perceived stress, (t (734.47) = 4.66, $p < .001$) with a small effect size (r = .17). On average, Group Walkers expressed less perceived stress than Non-Group Walkers at the start of the study.

The null hypothesis was accepted for T1 positive affect (t (759.77) = -2.55, p = .01). On average, Group Walkers expressed similar levels of positive affect as Non-Group Walkers at T1 (see Table 6.5). The alternative hypothesis was accepted for mental well-being, negative affect and depression. The independent samples *t*-tests indicate a significant difference between Group Walkers and Non-Group Walkers on T1 mental well-being (t (750.56) = -3.60, p < .001) with a small effect size (r = .13), negative affect (t (692.97) = 6.22, p < .001) with a small effect size (r = .23), and depression (t (1648) = 5.56, p < .001) with a small effect size (r = .14). At the start of the study, on average, Group Walkers experienced significantly more mental well-being and significantly less negative affect, and depression than Non-Group Walkers (see Table 6.5).

Table 6.5. Mean scores for *as treated* Group Walkers and Non-Group Walkers on Time 1 social support, perceived stress, resiliency, connectedness to nature, mental well-being, depression, and positive and negative affect.

	Group Walkers (n = 1,200)		**Non-Group Walkers** (n = 450)	
Variable	***M***	***SE***	***M***	***SE***
Social Support	22.68	.17	22.90	.30
Perceived Stress***	13.33	.17	15.00	.32
Resiliency	27.61	.18	27.72	.32
Connectedness to Nature	48.38	.18	48.26	.33
Mental well-being***	52.96	.24	51.23	.42
Depression^ ***	6.95	.17	9.32	.38
Positive Affect	34.47	.21	33.42	.36
Negative Affect^ ***	14.91	.14	17.01	.31

Note: Matched *as treated* sample; analysis weighed by propensity score weight. Dotted line separates covariates and well-being variables. Higher scores indicate greater: social support (range 0 – 30); perceived stress (range 0-40); resiliency (range 0-40); connectedness to nature (14 -70); mental well-being (range 14-70); positive affect (range 10-50); negative affect (range 10-50); and depression (range 0-50). ^ = log-transformed variable; untransformed mean shown. *** = Significant at Bonferroni corrected alpha level, p < .006.

<u>Between group differences at Time 2</u>

Table 6.6 lists the means and standard error for T2 covariates and well-being variables by group. The null hypothesis was accepted for covariates social support, resiliency and

connectedness to nature at T2. There was no significant difference between Group Walkers and Non-Group Walkers on T2 social support (t (1648) = 0.757, p = .45), resiliency (t (729.83) = -1.23, p = .22), and connectedness to nature (t (740.89) = -0.41, p = .68). The alternative hypothesis was accepted for T2 perceived stress. There was a significant difference between the two matched *as treated* groups on T2 perceived stress, (t (723.52) = 6.18, p < .001) with a small effect size (r = .22). On average, Group Walkers experienced significantly less perceived stress than Non-Group Walkers at T2.

The alternative hypothesis was accepted for T2 mental well-being, positive affect, negative affect, and depression. There was a significant difference between Group Walkers and Non-Group Walkers on T2 mental well-being (t (707.59) = -4.21, p < .001) with a small effect size (r = .16), positive affect (t (721.70) = -6.03, p < .001) with a small effect size (r = .22) negative affect (t (726.84) = 5.30, p < .001) with a small effect size (r = .19), and depression (t (759.35) = 6.85, p < .001) with a small effect size (r = .24). On average, Group Walkers experienced significantly more mental well-being and positive affect and significantly less negative affect and depression than Non-Group Walkers at T2 (see Table 6.6).

Table 6.6. Mean scores for matched *as treated* Group Walkers and Non-Group Walkers on Time 2 social support, perceived stress, resiliency, connectedness to nature, mental well-being, depression, and positive and negative affect.

	Group Walkers (n = 1,200)		**Non-Group Walkers** (n = 450)	
	M	***SE***	***M***	***SE***
Social Support	22.76	.19	23.03	.31
Perceived Stress ***	11.38	.18	13.72	.33
Resiliency	28.46	.18	28.01	.33
Connectedness to Nature	51.69	.22	51.50	.40
Mental well-being ***	52.88	.21	50.94	.41
Positive Affect ***	34.69	.20	32.12	.38
Negative Affect^ ***	14.45	.14	16.06	.29
Depression^ ***	6.65	.17	9.42	.37

Note. Matched *as treated* sample; analysis weighed by propensity score weight. Dotted line separates covariates and well-being variables. Higher scores indicate greater: social support (range 0 – 30); perceived stress (range 0-40); resiliency (range 0-40); connectedness to nature (14 -70); mental well-being (range 14-70); positive affect (range 10-50); negative affect (range 10-50); and depression (range 0-50). ^ = log-transformed variable; untransformed mean shown. *** = Significant at Bonferroni corrected alpha level, p < .006.

Summary of independent samples *t*-tests

Group Walkers had significantly greater mental well-being, and less negative affect and depression, at both time points, than Non-Group Walkers. Positive affect did not significantly differ between these two groups at T1, but did significantly differ at T2 where Group Walkers had greater positive affect than Non-Group Walkers.

The analyses also show the potential contribution of covariates to the difference in well-being. There was no main effect for group on social support, resiliency and connectedness to nature at either time point. Perceived stress was the only covariate that significantly differed by group walk participation. Section 2.1 discussed perceived stress as a risk factor for negative mental and emotional well-being. As such, the significant group difference in perceived stress could also account for any group differences on mental and emotional well-being. Perceived stress is thus an important covariate to control for in the relationship between group walking and well-being.

The results from the independent *t*-tests suggest that individuals who participate in outdoor group walks have more positive mental and emotional well-being than individuals who do not participate in outdoor group walks. However, the analyses are simplistic; they do not control for the contribution of other covariates of well-being. As such, hierarchical multiple regression analyses were conducted to determine the unique contribution of group walk participation on mental and emotional well-being, above and beyond the effect of perceived stress, social support and other significant covariates.

6.2.4 Effect of group walk participation on well-being, controlling for covariates

This section first details results from the backward stepwise regression before presenting results from the hierarchical multiple regressions for T1 and T2 mental well-being, positive affect, negative affect and depression. This section ends with a summary of the results from these analyses.

Backwards stepwise regression

Preliminary backwards stepwise regression was used to identify a subset of predictor variables that significantly predicted T1 and T2 outcome variables mental well-being, positive affect, negative affect and depression. Variables that did not provide additional prediction were removed from the regression analyses.

Each Time 1 outcome variable was regressed on the following 17 predictor variables:

- Group walk participation
- Sex
- Age
- Marital status
- Education
- Ethnicity
- Disability
- GP referral
- Health conditions
- Medical conditions
- IMD tertile
- T1 stressful life events
- T1 frequency of non-group walks in green space
- T1 social support
- T1 perceived stress
- T1 resiliency
- T1 connectedness to nature

Each Time 2 outcome variable was regressed on the following 20 predictor variables:

- Group walk participation
- Sex
- Age
- Marital status
- Education
- Ethnicity
- Disability
- GP referral
- Health conditions
- Medical conditions
- IMD tertile
- T2 stressful life events
- T2 frequency of non-group walks in green space
- T2 duration of non-group walks in green space (new)
- T2 physical activity (new)
- T1 outcome variable (new)
- T2 social support
- T2 perceived stress
- T2 resiliency
- T2 connectedness to nature

Group walk participation variable was dummy coded. The reference group was matched *as treated* Non-Group Walkers.

The sample size required for a stepwise regression analysis is based on the "cases-to-IVs ratio of 40 to 1" (Tabachnick & Fidell, 2013, p. 124). Thus, sample sizes of 680 and 800 were required for the T1 and T2 backward stepwise regressions, respectively. The total matched *as treated* sample exceeded the required sample sizes with 1,647 participants for the T1 analysis and 1,620 participants for the T2 analysis.

For all backwards stepwise regression analyses, predictor variables were entered into the regression in the first block with 'backwards' method. The alpha probability for entry and removal of variables in stepwise regression were set at .05 and .051, respectively (Denis, 2011). This was to ensure only significant predictors were retained in the final model of the backwards regression.

Table 6.7 shows the final step in the four backward stepwise regressions of Time 1 outcome variables. The final model for each outcome variable contained 7 predictors and was reached in 11 steps. The final model for each outcome variable was significant. Predictor variables identified as significant were incorporated into the T1 hierarchical regression analyses to examine the effect of group walk participation on T1 well-being.

Table 6.8 shows the final step in the four backward stepwise regressions of Time 2 outcome variables. The final model for T2 mental well-being contained 9 predictors. The final model for T2 positive affect contained 8 predictors. The T2 negative affect final model for contained 5 predictors. The final model for T2 depression contained 7 predictors. The final model for each outcome variable was significant. Predictor variables identified as significant were incorporated into the T2 hierarchical regression analyses to examine the effect of group walk participation on T2 well-being.

Table 6.7. Final step of backwards stepwise regression for T1 mental well-being, positive affect, negative affect and depression (*n* = 1,647).

Predictor	T1 Mental well-being			T1 Positive Affect			T1 Negative Affect^			T1 Depression^		
	B	**SE B**	**β**	***B***	**SE B**	**β**	***B***	**SE B**	**β**	***B***	**SE B**	**β**
Constant	37.16	1.39		14.97	1.52		1.06	0.024		0.69	0.05	
Group walk participation	0.72	0.29	.04*				-0.03	0.005	-.09***	-0.06	0.01	-.07***
Age	0.98	0.38	.04*									
Marital status	0.78	0.28	.04**	0.66	0.30	.04*						
Education				0.56	0.22	.05*	0.01	0.004	.04*			
Disability										0.05	0.02	.04*
Health screening										0.03	0.02	.04*
IMD tertile							-0.01	0.003	-.05*			
T1 Stressful life events^							0.03	0.010	.05*	0.11	0.03	.08***
T1 Frequency of non-group walks				0.23	0.07	.06**						
T1 Social support	0.27	0.02	.20***	0.18	0.02	.15***	-0.001	0.000	-.05*	-0.01	0.001	-.12***
T1 Perceived stress	-0.66	0.03	-.49***	-0.35	0.03	-.30***	0.01	.000	.61***	0.03	0.001	.54***
T1 Resiliency	0.36	0.03	.27***	0.35	0.03	.31***	-0.001	0.000	-.07**	-0.004	0.001	-.08***
T1 Social support	0.27	0.02	.20***	0.18	0.02	.15***	-0.001	0.000	-.05*	-0.01	0.001	-.12***
T1 Connectedness to nature	0.13	0.02	.10***	0.15	0.02	.13***						
Adjusted R^2	.634			.425			.484			.460		
F-test	$F(7, 1639) = 407.60$***			$F(7, 1646) = 174.96$***			$F(7, 1639) = 221.89$***			$F(7, 1639) = 201.61$***		

Note. Matched *as treated* sample; analysis weighed by propensity score weight. *B* = Raw regression coefficient; β = Standardised regression coefficient. Group walk participation: 0 = Non-Group Walkers, 1 = Group Walkers. Age: 0 = 18-54, 1 = 55 and over. Marital status: 0 = unpartnered (single, widowed, divorced), 1 = partnered (cohabitating, married, civil partnered). Education: 1 = No qualifications, 2 = Secondary education, 3 = Tertiary education. Disability: 0 = No 1 = Yes. Health screening: 0 = No health condition, 1 = One or more health conditions. IMD (Index of Multiple Deprivation) tertile: 1 = Most deprived, 3 = Least deprived. Higher scores indicate greater: stressful life events (range 0-11), frequency of non-group walks (range 1 – 9); social support (range 0 - 30); perceived stress (range 0 - 40); resiliency (range 0 - 40); and connectedness to nature (range 14 - 70). ^ = log-transformed variable.* $p < .05$; ** $p < .01$, *** $p < .001$.

Table 6.8. Final step of backwards stepwise regression for T2 mental well-being, positive affect, negative affect and depression (*n* = 1,620).

	T2 Mental well-being			T2 Positive Affect			T2 Negative Affect^			T2 Depression^		
Predictor	***B***	**SE B**	**β**	***B***	**SE B**	**β**	***B***	**SE B**	**β**	***B***	**SE B**	**β**
Constant	29.12	1.36		10.46	1.19		0.63	0.02		0.23	0.03	
Group walk participation				1.23	0.27	.08***				-0.03	0.01	-.04*
Sex	-0.79	0.26	-.05**									
Marital Status	1.05	0.26	.06***	0.71	0.26	.04*	-0.01	0.01	-.04*			
Education							0.01	0.003	.04*	0.02	0.01	.04*
GP referral										0.07	0.02	.05**
T2 Stressful life events^	1.38	0.61	.04*				0.03	0.01	.05**	0.07	0.03	.04*
T2 Physical activity	0.27	0.06	.06***	0.43	0.06	.11***				-0.01	0.003	-.06**
T1 Outcome variable	0.30	0.02	.32***	0.39	0.02	.39***	0.33	0.02	.33***	0.34	0.02	.35***
T2 Social support	0.07	0.02	.06**	0.05	0.02	.05*						
T2 Perceived stress	-0.42	0.03	-.35***	-0.28	0.02	-.25***	0.01	0.000	.52***	0.02	0.001	.48***
T2 Resiliency	0.22	0.03	.18***	0.20	0.03	.17***						
T2 Connectedness to nature	0.06	0.02	.06***	0.08	0.02	.08***						
Adjusted R^2	.631			.591			.607			.584		
F-test	$F(9, 1610) = 309.08$***			$F(8, 1611) = 292.97$***			$F(5, 1614) = 501.51$***			$F(5, 1614) = 325.791$***		

Note. Matched *as treated* sample; analysis weighed by propensity score weight. *B* = Raw regression coefficient; β = Standardised regression coefficient. Group walk participation: 0 = Non-Group Walkers, 1 = Group Walkers. Sex: 0 = Female 1 = Male. Marital status: 0 = unpartnered (single, widowed, divorced), 1 = partnered (cohabitating, married, civil partnered). Education: 1 = No qualifications, 2 = Secondary education, 3 = Tertiary education. GP referral to WfH: 0 = No GP referral, 1 = Referred by GP to WfH. Higher scores indicate greater: T2 stressful life events (range 0 -11); T2 physical activity (range 0 – 7 days); T1 outcome variable (i.e. mental well-being, positive affect, log-transformed negative affect or log-transformed depression); T2 social support (range 0 - 30); T2 perceived stress (range 0 - 40); T2 resiliency (range 0 - 40), and T2 connectedness to nature (range 14 - 70). ^ = log-transformed variable. * $p < .05$; ** $p < .01$, *** $p < .001$.

Hierarchical multiple regression

Hierarchical regression was used to investigate the effect of outdoor group walk participation on T1 and T2 mental well-being, positive and negative affect, and depression, holding significant covariates constant. Separate hierarchical multiple regression analyses were conducted for each outcome variable. For all hierarchical regression analyses, significant covariates identified in the preliminary backwards stepwise regression analysis (see Tables 6.7 and 6.8) were entered in the first block with 'enter' method (Step 1). Group walk participation dummy variables were entered in the second block (Step 2). The reference group was matched *as treated* Non-Group Walkers. This sequence of entry of variables ensured that the proportion of the variance attributable to WfH group participation was calculated *after* the variance due to significant covariates were already accounted for (Tabachnick & Fidell, 2013, p. 143). Listwise deletion applied in all regression analyses. Significance levels for all analyses were set at $p < .05$.

T1 hierarchical regression analyses

Table 6.9 shows the results from the final step in the hierarchical regression analyses for T1 mental well-being, positive affect, negative affect and depression[40]. The final regression model for all four outcome variables was significant. All four T1 outcome variables were predicted by covariates T1 social support, perceived stress and resiliency. All relationships were in the expected direction. As one's social support increased, mental well-being ($B = 0.27$, $p < .001$) and positive affect ($B = 0.18$, $p < .001$) increased, and log-transformed negative affect ($B = -0.001$, $p = .02$) and depression ($B = -0.01$, $p < .001$) decreased. A one point increase in perceived stress was associated with a decrease in mental well-being ($B = - 0.66$, $p < .001$) and positive affect ($B = - 0.34$, $p < .001$), and an increase in log-transformed negative affect (B = 0.01, $p < .001$) and depression ($B = 0.03$, $p < .001$). As one's resiliency increased, mental well-being ($B = 0.36$, $p < .001$) and positive affect ($B = 0.36$, $p < .001$) increased, and log-transformed negative affect ($B = -0.001$, $p = .002$) and depression ($B = -0.004$, $p < .001$) decreased.

[40] Only the final step was reported for parsimony.

The primary question of interest was whether outdoor group walk participation made a difference to T1 mental and emotional well-being, over and above the effects of significant covariates. If outdoor group walks were to have a beneficial effect on mental and emotional well-being, a positive relationship with mental well-being and positive affect, and a negative relationship with negative affect and depression would be expected. This hypothesis was supported for T1 mental well-being (B = .70, p = .01), and log-transformed negative affect (B = -.03, p < .001) and depression (B = -.05, p < .001) (see Table 6.9). Group walk participation was not a significant predictor of T1 positive affect (B = .48, p = .12) (see Table 6.9). However, T1 positive affect was significantly positively associated with another variable that involved interacting with natural environment – frequency of non-group walks in green space (B = 0.22, p = .004).

Standardised β coefficients are in the same standard deviation units, and therefore directly comparable to one another (Field, 2009). As such, the β coefficients can be used to highlight the "'importance' of a predictor" to the model (Field, 2009, p. 239). Looking at the β coefficients in Table 6.9, group walk participation (β = .04) was just as important to the prediction of T1 mental well-being as age and marital status (β = .04 for both). For T1 negative affect, the standardised β values show group walk participation (β = -.09) was a more important predictor than education (β = .04), IMD (β = -.05), stressful life events (β = .05), social support (β = -.05) or resiliency (β = -.07). For log-transformed T1 depression, group walk participation (β = -.07) was a more important predictor than pre-existing health condition or disability (β = .04 for both).

Table 6.9.Final step of the hierarchical regression analyses for T1 mental well-being, positive affect, negative affect and depression.

Predictors		T1			
		Mental Well-being	**Positive Affect**	**Negative Affect**	**Depression**
		n = 1,650	*n* = 1,647	*n* = 1,650	*n* = 1,650
Age					
	B =	0.96			
	SE B =	0.38			
	β =	.04			
	p =	.01			
Marital status					
	B =	0.80	0.66		
	SE B =	0.28	0.30		
	β =	.04	.04		
	p =	.004	.03		
Education					
	B =		0.55	0.01	
	SE B =		0.22	0.004	
	β =		.05	.04	
	p =		.01	.02	
Disability					
	B =				0.05
	SE B =				0.02
	β =				.04
	p =				.03
Health screening					
	B =				0.03
	SE B =				0.02
	β =				.04
	p =				.05
IMD tertile					
	B =			-0.01	
	SE B =			0.003	
	β =			-.05	
	p =			.01	
T1 Stressful life events^					
	B =			0.03	0.12
	SE B =			0.01	0.03
	β =			.05	.08
	p =			.01	< .001
T1 frequency of non-group walks					
	B =		0.22		
	SE B =		0.08		
	β =		.06		
	p =		.004		
T1 Social support					
	B =	0.27	0.18	-0.001	-0.01
	SE B =	0.02	0.02	0.000	0.001
	β =	.20	.15	-.05	-.12
	p =	< .001	< .001	.02	< .001

T1 Perceived stress					
	B =	-0.66	-0.34	0.01	0.03
	SE B =	0.03	0.03	0.000	0.001
	β =	-.49	-.29	.61	.54
	p =	< .001	< .001	< .001	< .001
T1 Resiliency					
	B =	0.36	0.36	-0.001	-0.004
	SE B =	0.03	0.03	0.000	0.001
	β =	.27	.31	-.07	-.08
	p =	< .001	< .001	.002	< .001
T1 Connectedness to nature					
	B =	0.13	0.15		
	SE B =	0.02	0.02		
	β =	.10	.13		
	p =	< .001	< .001		
Group walk participation					
	B =	0.70	0.48	-0.03	-0.05
	SE B =	0.29	0.31	0.01	0.01
	β =	.04	.03	-.09	-.07
	p =	.01	.12	< .001	< .001
Step 2 Adjusted R^2		.633***	.426***	.484***	.459***
ΔR^2		.001*	.001	.008***	.005***

Note. Matched *as treated* sample; analysis weighed by propensity score weight. *B* = Raw regression coefficient; β = Standardised regression coefficient. Sex: 0 = female, 1 = male. Age: 0 = 18-54 years old, 1 = 55 years or older. Marital status: 0 = unpartnered (single, widowed, divorced), 1 = partnered (cohabitating, married, civil partnered). Education: 1 = No qualifications, 2 = lower, upper or post-secondary education, 3 = Tertiary education. Disability: 0 = No 1 = Yes. Health condition: 0 = No health condition 1= One or more health conditions. IMD (Index of Multiple Deprivation) tertile: 1 = Most deprived, 3 = Least deprived.
Higher scores indicate greater: T1 stressful life events; social support (range 0 - 30); perceived stress (range 0 - 40); resiliency (range 0 - 40); and connectedness to nature (range 14 - 70).
Group walk participation: 0 = matched *as treated* Non-Group Walkers, 1 = matched *as treated* Group Walkers. ^ = log-transformed variable. *** $p < .001$.

T2 hierarchical regression analyses

Table 6.10 shows the results from the final step in the hierarchical regression analyses for T2 mental well-being, positive affect, negative affect and depression. The final regression model for each four outcome variable was highly significant. All T2 outcome variables were predicted by the level of the respective measure at T1, and T2 perceived stress. There was a significant positive association between T1 and T2 mental well-being, as well as T1 and T2 positive affect, T1 and T2 negative affect and T1 and T2 depression ($p < .001$ for all). The results indicate that one's mental and emotional well-being at T2 was predicted by one's level of well-being at T1. Time 2 perceived stress was negatively associated with T2 mental well-being ($B = - 0.42$, $p < .001$) and positive affect ($B = - 0.29$, $p < .001$), and positively associated with T2 log-transformed negative affect ($B = 0.01$, $p < .001$) and depression ($B = 0.02$, $p < .001$).

Stressful life events in the previous 13-weeks had a positive association with mental well-being ($B = 1.46$, $p = .02$), and log-transformed negative affect ($B = 0.03$, $p = .001$) and depression ($B = 0.07$, $p = .02$). This relationship with mental well-being is contrary to expectations. Physical activity had a positive association with mental well-being ($B = 0.27$, $p < .001$) and positive affect ($B = 0.45$, $p < .001$), and a negative association with log-transformed depression ($B = -.01$, $p < .001$), indicating that an increase in physical activity by one day was associated with a significant increase in mental and emotional well-being. Social support, resiliency and connectedness to nature had a positive association on T2 mental well-being and positive affect only (see Table 6.10).

Table 6.10. Final step of the hierarchical regression analyses for T2 mental well-being, positive affect, negative affect and depression.

		T2			
Predictors		**Mental Well-being**	**Positive Affect**	**Negative Affect^**	**Depression^**
		n = 1,641	*n* = 1,641	*n* = 1,650	*n* = 1,641
Sex					
	B =	-0.79			
	SE B =	0.26			
	β =	-.05			
	p =	.002			
Marital status					
	B =	1.05	0.79	-0.01	
	SE B =	0.26	0.26	0.00	
	β =	.06	.05	-.03	
	p =	< .001	.002	.03	
Education					
	B =			0.01	0.02
	SE B =			0.00	0.01
	β =			.04	.04
	p =			.02	.02
GP referral					
	B =				0.07
	SE B =				0.02
	β =				.05
	p =				.001
T2 Stressful life events^					
	B =	1.46		0.03	0.07
	SE B =	0.61		0.01	0.03
	β =	.04		.05	.04
	p =	.02		.001	.02
T2 Physical activity					
	B =	0.27	0.45		-0.01
	SE B =	0.07	0.06		0.003
	β =	.07	.12		-.06
	p =	< .001	< .001		< .001
T1 outcome variable					
	B =	0.30	0.39	0.32	0.34
	SE B =	0.02	0.02	0.02	0.02
	β =	.32	.39	.33	.35
	p =	< .001	< .001	< .001	< .001
T2 Social support					
	B =	0.07	0.05		
	SE B =	0.02	0.02		
	β =	.06	.04		
	p =	.001	.02		
T2 Perceived stress					
	B =	-0.42	-0.29	0.01	0.02
	SE B =	0.03	0.02	0.00	0.001
	β =	-.35	-.25	.52	.47
	p =	< .001	< .001	< .001	< .001

T2 Resiliency					
	B =	0.22	0.20		
	SE B =	0.03	0.03		
	β =	.18	.17		
	p =	< .001	< .001		
T2 Connectedness to nature					
	B =	0.06	0.08		
	SE B =	0.02	0.02		
	β =	.06	.08		
	p =	< .001	< .001		
Group walk participation					
	B =	0.27	1.19	0.001	-0.03
	SE B =	0.27	0.27	0.01	0.01
	β =	.02	.07	.002	-.04
	p =	.32	< .001	.89	.02
Step 2 Adjusted R^2		.627***	.587***	.607***	.583***
ΔR^2		.000	.005***	.000	.001*

Note. Matched *as treated* sample; analysis weighed by propensity score weight. *B* = Raw regression coefficient; β = Standardised regression coefficient. Sex: 0 = female, 1 = male. Marital status: 0 = unpartnered (single, widowed, divorced), 1 = partnered (cohabitating, married, civil partnered). Education: 1 = No qualifications, 2 = lower, upper or post-secondary education, 3 = Tertiary education. GP referral to WfH: 0 = No GP referral, 1 = Yes, referred by GP to WfH. T1 outcome variable = T1 mental well-being, positive affect, negative affect or depression.
Higher scores indicate greater: T1 stressful life events; social support (range 0 - 30); perceived stress (range 0 - 40); resiliency (range 0 - 40); and connectedness to nature (range 14 - 70).
Group walk participation: 0 = matched *as treated* Non-Group Walkers, 1 = matched *as treated* Group Walkers. ^ = log-transformed variable. *** $p < .001$.

The primary question of interest was whether outdoor group walk participation made a difference to T2 mental and emotional well-being, over and above the effects of significant covariates. Outdoor group walk participation was a significant predictor of T2 positive affect and depression only, after controlling for significant covariates. At T2, Group Walkers were associated with greater positive affect ($B = 1.19$, $p < .001$), and less log-transformed depression ($B = -.03$, $p = .02$) than Non-Group Walkers, after the mean scores were adjusted for the covariates. This suggests that group walk participation had an independent relationship with T2 positive affect and depression. Group walk participation was not a significant predictor of T2 mental well-being ($B = 0.27$, $p = .32$) and negative affect ($B = 0.001$, $p = .89$), after controlling for covariates. The analysis suggests group walk participation in the 13-week ‘intervention’ period did not effect these measures of well-being, above and beyond the level of T1 well-being and other predictors. However, as T1 levels of mental well-being and negative affect were significantly predicted by group walk participation (see Table 6.9), it could imply that Group Walkers and Non-Group Walkers maintained their level of well-being on these measures through the continued participation (or not) in outdoor group walks.

Standardised β values in Table 6.10 show the relative "importance" of each predictor (Field, 2009, p. 239). For positive affect, outdoor group walk participation (β = .07) was a more important predictor than either marital status (β = .05) or T2 social support (β = .04). For T2 depression, outdoor group walk participation (β = -.04) was just as important a predictor as education (β = .04) and recent stressful life events (β = .04).

Summary of hierarchical regression analyses

This section tested the independent association of outdoor group walk participation on mental and emotional being, over and above the effects of significant covariates. The results from the hierarchical regression analyses demonstrate several findings. Overall, the effect of group walk participation on well-being was either beneficial or non-significant; participating in a group walk was not detrimental to mental or emotional well-being. Compared to Non-Group Walkers, Group Walkers were significantly associated with greater mental well-being at T1 and positive affect at T2, and less negative affect at T1 and depression at both T1 and T2. In these instances, the effects of group walk participation on well-being are independent of (and cannot be explained by) the other covariates in the sample. Group walk participation did not significantly contribute to the variance of T1 positive affect, and T2 mental well-being and negative affect, after controlling for the effect of significant covariates.

6.3 Discussion

This chapter sought to answer Objective 1 of the thesis, which is to assess whether individuals who take part in outdoor group walks have better mental and emotional well-being than individuals who do not take part in outdoor group walks. Two hypotheses addressed Objective 1:

1. Matched *as treated* Group Walkers' and Non-Group Walkers' scores of mental well-being, depression, and positive and negative affect will change over time.
2. Matched *as treated* Group Walkers will have better mental well-being, depression and positive and negative affect than matched *as treated* Non-Group Walkers.

Within group analyses

Table 6.11 summarises the within groups analyses to assess change in well-being over time. For certain variables, both Group Walkers and Non-Group Walkers demonstrated the same results with regards to mental and emotional well-being over time. Both matched *as treated* groups demonstrated significant increases in retrospective pre-test measures of mental and emotional well-being. Analyses of change from the start of the study to T2 found that both groups demonstrated a significant reduction in negative affect, and maintenance of mental well-being and depression. These similar results for both groups suggest a general trend in positive change or maintenance of well-being over time that has nothing to do with outdoor group walk participation.

Moreover, these results highlight the importance of a comparison group in studies that seek to understand change over time. Single-group before-and-after research designs have threats to internal validity, such as maturation or history effects, that make causal assumptions suspect (Stangor, 2007). For example, without the Non-Group Walkers comparison group, one could attribute change in the Group Walkers' well-being over time to participation in the walking group. The need for a comparison group in research designs to improve causality is especially necessary when 80% of green exercise evaluations do not use a comparison group (Brown et al., 2011).

Table 6.11. Summarised results of within group analyses.

Variable	Mental well-being	Positive Affect	Negative Affect	Depression
Group Walkers (n = 1,200)				
Retrospective change[1]	↑+	↑+	-	↓+
Change T1 to T2[2]	→	→	↓+	→
Non-Group Walkers (n = 450)				
Retrospective change[1]	↑+	↑+	-	→
Change T1 to T2[2]	→	↓+	↓+	→

Note. Dash indicates that data from retrospective change in negative affect not shown because data collected on negative affect only was not collected. Retrospective change in emotional well-being was assessed with a single item semantic differential measure (0 = negative affect; 100 = positive affect).
[1] Wilcoxon Signed Ranks test. [2] Dependent samples t-test.
↑+ a statistically significant difference was reported with an increase in the variable.
↓+ a statistically significant difference was reported with an decrease in the variable.
→ no statistically significant difference was reported.

There were, however, instances where results differed within each group in their directionality. Retrospective pre-test analyses indicated that Group Walkers showed a significant reduction in depression, whilst Non-Group Walkers showed no change (see Table 6.11). Analysis of change from T1 to T2, Group Walkers demonstrated maintenance of positive affect, whilst Non-Group Walkers showed a significant decrease in positive affect. These results suggest that participating in an outdoor walking group may positively influence depression and positive affect over time.

Between groups analyses

Table 6.12 provides a visual summary of the results from the between group analyses. Independent samples *t*-test were used to test the second hypothesis. The analyses found a significant effect of group walk participation at T1, indicating that Group Walkers reported significantly greater mental well-being, and less depression and negative affect than Non-Group Walkers. These differences were maintained 13-weeks later at T2. There was no significant difference between the groups on T1 positive affect, but a significant group difference on positive affect at T2. The effect of group walk participation on covariates social support, perceived stress, resiliency and connectedness to nature was also tested. There was no effect of group walk participation for social support, resiliency and connectedness to nature, but an effect of group walk participation for T1 and T2 perceived stress (not shown in Table 6.12). Group Walkers reported significantly less perceived stress than Non-Group Walkers at both T1 and T2.

Table 6.12. Summarised results of between group analyses.

	Mental well-being		**Positive Affect**		**Negative Affect**		**Depression**	
Variable	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**
				Independent samples *t*-tests				
Group Walk Participation	↑+	↑+	→	↑+	↑+	↑+	↑+	↑+
				Hierarchical regression analyses				
Group Walk Participation	↑+	→	→	↑+	↑+	→	↑+	↑+

Note. Group Walk Participation: 0 = matched *as treated* Non-Group Walkers, 1 = matched *as treated* Group Walkers.
↑+ a statistically significant difference was reported; the direction was beneficial.
→ no statistically significant differences were reported.

Hierarchical multiple regression

Hierarchical multiple regression was performed in order to determine whether the effect of group walk participation witnessed in the independent samples *t*-tests would hold after controlling for significant covariates. On the whole, the results of the hierarchical analyses support those from the independent samples *t*-test, with two exceptions: T2 mental well-being and negative affect (see Table 6.12). The significant effect of outdoor group walk participation for T2 mental well-being and T2 negative affect witnessed in the independent *t*-tests disappeared after controlling for the outcome variable at T1, and other significant covariates. Outdoor group walk participation was associated with greater mental well-being, and reduced negative affect and depression at T1, as well as greater positive affect and reduced depression at T2 (see Table 6.12), over and above other covariates. Results from the hierarchical multiple regression suggest that participating in an outdoor walking group independently contributes to positive mental and emotional well-being.

Conclusion

In conclusion, this Chapter sought to answer Objective 1 of the thesis, by showing that individuals who took part in an WfH outdoor group walks reported significantly more beneficial change in mental and emotional well-being than individuals who did not take part in outdoor group walks. The results suggest that participating in outdoor group walks may contribute to positive mental and emotional well-being.

The next question of interest is *how* does participating in an outdoor walking group positively effect mental and emotional well-being? Research identified in Chapter 1 suggests that outdoor group walks could effect well-being through the physical activity of walking, the social environment, or the natural environment. The next chapter will explore the mechanisms that contribute to the relationship between group walk participation and positive mental and emotional well-being using mediation analysis. Mediation can help explain how an external physical event, such as walking in a group, can influence internal psychological constructs, like mental well-being (Baron & Kenny, 1986).

Chapter 7 How does participating in an outdoor walking group effect well-being?

The previous chapter investigated the differences in well-being from participating in an outdoor walking group. The aim of this chapter was to explain *how* participating in an outdoor walking group affects well-being. Outdoor group walks could affect mental and emotional well-being through physical activity (Biddle & Mutrie, 2008; Maas, Verheij, Spreeuwenberg, & Groenewegen, 2008; Mitchell & Popham, 2008; Ulrich et al., 1991), social well-being (Groenewegen, van den Berg, Maas, Verheij, & de Vries, 2012; Maas et al., 2009), connectedness to nature (Crawford, 2012; Mayer et al., 2009), resiliency (Warber, Bialko, DeHudy, & Irvine, 2012), or stress reduction (Stigsdotter et al., 2010). This chapter addresses Objective 2:

> Explore the mechanisms that contribute to the relationship between outdoor group walk participation and positive mental and emotional well-being.

The first section of this chapter will identify potential mediators, introduce mediation, and review the literature about the direct and indirect relationships of outdoor group walks and well-being. The second section will present the preliminary results of the mediation analyses, followed by the main mediation results for T1 and T2 mental well-being, positive affect, negative affect and depression. The chapter concludes with a summary of the results.

7.1 Introduction

In Chapter 6, the effect of participating in outdoor group walks on mental and emotional well-being, social support, perceived stress, resiliency and connectedness to nature was explored. Results showed that Group Walkers had significantly better mental and emotional well-being than Non-Group Walkers. But, in some instances, these differences between the two groups became non-significant after controlling for significant covariates. This suggests that the relationship between group walk participation and well-being could be mediated through one or more covariates.

To date, six mediators of the relationship between natural environments and well-being have been proposed (Health Council of the Netherlands and Dutch Advisory Council for Research on Spatial Planning, Nature and the Environment, 2004; Mayer et al., 2009; Ward Thompson & Aspinall, 2011):

1. Restoration of directed attention fatigue and recovery from stress;
2. Physical activity;
3. Social contact;
4. Encouraging development in children;
5. Opportunities for personal development and a sense of purpose;
6. Connectedness to nature.

Of the above mechanisms, recovery from stress and restoration of attention fatigue have been the most extensively researched (Health Council of the Netherlands and Dutch Advisory Council for Research on Spatial Planning, Nature and the Environment, 2004, p. 50; Mayer et al., 2009). Recently, the contribution of physical activity (Fan, Das, & Chen, 2011; Groenewegen et al., 2012; Hawkins, 2012; Maas et al., 2008; Mytton, Townsend, Rutter, & Foster, 2012; Sugiyama et al., 2008), social contact (Fan et al., 2011; Groenewegen et al., 2012; Maas et al., 2009; Sugiyama et al., 2008) and connectedness to nature (Mayer et al, 2009) have been analysed. The results are generally supportive of these mechanisms as mediators. Of the above six proposed mediators, this chapter will investigate stress reduction, physical activity, social contact and connectedness to nature. Resiliency will also be investigated as a potential mediator of the relationship between outdoor group walks and well-being.

7.1.1 What is mediation?

Mediation explains environment-behaviour relationships (Evans & Lepore, 1997). Mediators "explain *how* external physical events take on internal psychological significance" (Baron & Kenny, 1986, p. 1176) [emphasis added]. Figure 7.1 shows an unmediated relationship in which predictor *X* effects outcome *Y* via path *c.* This is called the total effect (Kenny, 2012; Tabachnick & Fidell, 2013, p. 160). Figure 7.2 illustrates a mediated relationship in which the predictor variable *X* influences the outcome variable *Y* indirectly through the mediator variable *M* (Evans & Lepore, 1997; Miles & Shevlin, 2001). The indirect effect is indicated with paths *a* and *b* in Figure 7.2

(Kenny, 2012). The direct effect is the relationship between *X* and the *Y* when controlling for *M* (Tabachnick & Fidell, 2013, p. 160); this is represented as path *c'* in Figure 7.2.

Figure 7.1. Total effect (unmediated) model of relationship between predictor *X* and outcome variable *Y* (path *c*).

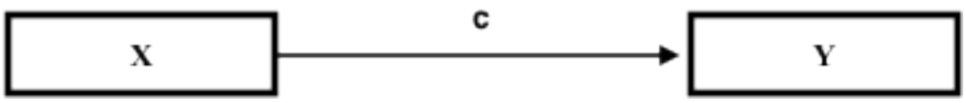
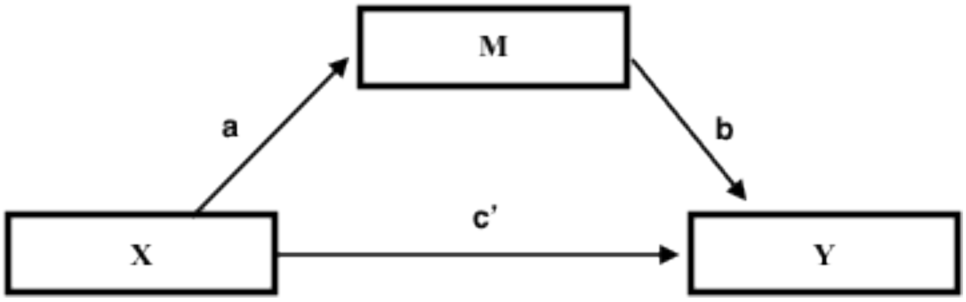


Figure 7.2. Mediation model with predictor *X*, outcome *Y* and mediator *M* demonstrating the indirect effect (paths *a* and *b*) and the direct effect (path *c'*).



The causal steps method (Baron & Kenny, 1986; Kenny, 2012) is one method used to assess mediation, which requires the following four steps must be met (Baron & Kenny, 1986, p. 1177)[41]:

1. The predictor variable is a significant predictor of the outcome variable (path *c* in Figure 7.1);
2. The predictor variable is a significant predictor of the mediator variable (path *a* in Figure 7.2);
3. The mediator is a significant predictor of the outcome variable (path *b* in Figure 7.2), when controlling for the predictor variable; and

[41] Although some researchers do not agree that Step 1 is necessary to demonstrate mediation (MacKinnon, Krull, & Lockwood, 2000, MacKinnon, Fairchild, & Fritz, 2007, Preacher & Kelley, 2011, A. B. Taylor, MacKinnon, & Tein, 2008, Zhao, Lynch, & Chen, 2010).

4. The effect of the predictor variable on the outcome variable, controlling for the mediator, is zero (complete mediation) or reduced (partial mediation) (path *c'* in Figure 7.2).

Complete mediation is when the mediator *M* completely explains the relationship between the predictor *X* and outcome *Y*. This is evidenced when the direct effect (path *c'*) is non-significant after controlling for the mediator. Partial mediation is evidenced when the direct effect (path *c'*) is still significant, albeit the regression coefficient is reduced, after controlling for the mediator. Partial mediation suggests there are multiple mediators to explain the total effect (path *c*) (Baron & Kenny, 1986). Multiple mediators may occur in parallel or in serial (Hayes, 2012). Parallel multiple mediators means that multiple mediators are not related to each other. Serial multiple mediators occur in a sequence in which one mediator occurs after another (Hayes, 2012) (e.g. unified theory of stress). This analysis will test multiple mediators working in parallel, as conceptualised by other researchers (Groenewegen et al., 2012).

7.1.2 Relationships underlying the beneficial impact of outdoor group walks on well-being

The following reviews the evidence of the relationships between outdoor group walks, mental and emotional well-being and five proposed mediators: stress reduction, physical activity, social contact, connectedness to nature and resiliency. The previous literature was reviewed for:

- The total effect of outdoor group walks on well-being (path *c*);
- The total effect between outdoor group walks and the five mediators (path *a*);
- The relationship between each mediator and well-being (path *b*); and
- The indirect effect (paths *a* and *b*) of each mediator of the outdoor group walk–well-being relationship.

Research into the well-being benefits from interacting with natural environments will also be used to help explain these relationships when data on outdoor group walks is unavailable. Based on previous WfH research, it is assumed that a majority of outdoor group walks occur in natural environments (Hynds & Allibone, 2009).

Total effect of outdoor group walks on well-being (path *c*)

Previous research has investigated the total effect (path *c* in Figure 7.1) of outdoor group walk participation on well-being. The benefits from participating in outdoor group walks on mental and emotional well-being were covered in Chapter 1. Outdoor group walks have been shown to reduce depression (Armstrong & Edwards, 2003; Armstrong & Edwards, 2004), improve mood (Hine et al., 2011; Johansson et al., 2011; Mayer et al., 2009; Peacock et al., 2007; Roe & Aspinall, 2011) and improve self esteem (Peacock et al., 2007).

Total effect of outdoor group walks on proposed mediators (path *a*)

The following discusses the previous literature with regards to the total effect of outdoor group walks, or interaction with nature, on each proposed mediator: stress reduction, physical activity, social contact, connectedness to nature and resiliency. Extensive experimental evidence had demonstrated that interacting with natural environments reduces physiological (Hartig et al., 2003; Parsons, Tassinary, Ulrich, Hebl, & Grossman-Alexander, 1998; Ulrich et al., 1991; van den Berg & Custers, 2011; Ward Thompson et al., 2012) and psychological (perceived) stress (Beil & Hanes, 2013; Stigsdotter et al., 2010; Ward Thompson et al., 2012). Outdoor group walk participation has been shown to significantly decrease perceived stress (Roe & Aspinall, 2011).

Participating in Walking for Health group walks (WfH) has been shown to positively influence physical activity (Phillips et al., 2012). WfH walkers who were physically active three or more days per week prior to joining the programme were more likely to maintain their level of physical activity compared to ‘inactive’ WfH walkers who were physically active 3 or more days a week prior to joining WfH (Phillips et al., 2012). Moreover, participation in WfH can increase levels of physical activity for the most sedentary of individuals (Phillips et al., 2012).

Qualitative studies suggest that participating in WfH group walks may increase social interaction and social connectedness (Phillips et al., 2011; South et al., 2013) and reduce loneliness or social isolation (South et al., 2013; The Countryside Agency, 2006). Maas et al. (2009) found the amount of green space in the residential environment was significantly negatively associated with measures of loneliness and lack of social contacts. Social support has been positively associated with the total acreage of parks within a half mile from the home (Fan et al., 2011).

A qualitative study suggests that participating in WfH may enhance connectedness to nature (Phillips et al., 2011). Quantitative studies of the impact of outdoor group walks on connectedness to nature (CNS) are inconsistent. CNS is positively associated with spending time in natural environments (Szachniewicz, 2012). Mayer et al. (2009) found that a 10-minute group walk in a natural environment resulted in higher state CNS scores compared to a group walk in an urban environment. However, Hine et al. (2011) found no significant change in CNS after an outdoor group walk.

The effects of interacting with nature on measures of resiliency have been less researched. One study has shown that resiliency significantly increased following a 3-week adventure education course involving a variety of outdoor activities in various natural settings (Ewert & Yoshino, 2011). However, another study found no significant change in resiliency following a three-week wilderness camp intervention (Warber et al., 2012).

Total effect of proposed mediators on well-being (path *b*)

The following section briefly provides evidence of the relationship between each proposed mediator (restoration from stress, physical activity, social contact, connectedness to nature and resiliency) and mental and emotional well-being. This is path *b* in Figure 7.2. Perceived stress has negative correlations with mental well-being (Hawkins, 2012; Ward Thompson et al., 2012) and positive affect (Watson, 1988), and positive correlations with negative affect (Watson, 1988) and depression (Cohen et al., 1983; Olsen et al., 2004).

There is an abundance of literature linking physical activity to well-being (Biddle & Mutrie, 2008). Physical activity has been positively associated with mental well-being (Deacon et al., 2010, p. 17; Hawkins, 2012, p. 110) and negatively associated with depression (Biddle & Mutrie, 2008; Department of Health, 2011). There is inconsistency in the literature between physical activity and affect. For example, Watson et al. (1988) found frequency of physical activity was significantly positively correlated with positive affect, but not related to negative affect. Whilst, other researchers have found a single bout of exercise increased positive affect and decreased negative affect (Pretty, Peacock, Sellens, & Griffin, 2005).

Social well-being measures are positively associated with both mental and emotional well-being. Social support has been found to be positively correlated with mental well-being (Hawkins, 2012) and negatively correlated with depression (Cohen et al., 1985). Social interaction was significantly positively correlated with positive affect, and significantly negatively correlated with negative affect (Watson, 1988).

Connectedness to nature may be important for group walkers' mental and emotional well-being (Wensley & Slade, 2012). CNS is significantly associated with positive affect (Mayer et al., 2009). Non-significant correlations were found between negative affect and CNS (Mayer et al., 2009). No studies linking depression and CNS were found.

Resiliency has been associated with all four outcome variables of interest in this study. Resiliency has been found to be positively associated with mental well-being (Smith et al., 2010) and positive affect (Burns & Anstey, 2010; Fredrickson et al., 2003; Tugade & Fredrickson, 2004), and negatively associated with depression (Fredrickson et al., 2003; Smith et al., 2008; Tugade & Fredrickson, 2004; Wingo et al., 2010). The relationship between resiliency and negative affect is inconsistent with some studies showing a negative correlation (Burns & Anstey, 2010; Fredrickson et al., 2003; Smith et al., 2008; Smith et al., 2010), and another showing no effect (Tugade & Fredrickson, 2004).

Indirect effects of proposed mediators on well-being (paths *a* and *b*)

Perceived stress was found to completely mediate the relationship between the quantity of streetscape greenery and mental health (Groenewegen et al., 2012). Perceived stress was also a partial mediator of the relationship between quality of streetscape greenery and mental health (Groenewegen et al., 2012).

Social well-being variables have been found to mediate the relationship between green space and indicators of mental health. Shortage of social support was a complete mediator of the relationship between the amount of green space near the home and mental health (Maas et al., 2009). Loneliness was a partial mediator of the relationship between the amount of residential green space and mental health (Maas et al., 2009). Social cohesion was a complete mediator of the relationship between the quantity of streetscape greenery and mental health (Groenewegen et al., 2012), and as well as a partial mediator of the relationship between quality of streetscape greenery and mental health (Groenewegen et al., 2012). Social coherence was a partial mediator of the relationship between residential greenness and mental health (Sugiyama et al., 2008).

Physical activity has been investigated as a possible mediator between residential green space and health (Groenewegen et al., 2012; Maas et al., 2008; Mytton et al., 2012; Sugiyama et al., 2008). Walking partially mediated the relationship between residential greenness and mental health (Sugiyama et al., 2008). Green exercise activities (i.e. walking and cycling) were a partial mediator of the relationship between the quantity and quality of streetscape greenery and mental and physical health (Groenewegen et al., 2012).

Connectedness to nature was a partial mediator of the relationship between an outdoor group walk and positive affect (Maas et al., 2009). Mayer et al. (2009) found no evidence of mediation with negative affect, as there was no significant relationship between a group walk in the natural environment and negative affect.

No studies were found that specifically tested resiliency as a mediator between outdoor walking or interaction with nature and well-being. However, an indirect effect (paths *a* and *b*) may be able to be assumed. Findings from previous studies discussed above show a relationship between natural environments on resiliency (path *a*), as well as a relationship between resiliency on mental and emotional well-being (path *b*).

7.2 Method

7.2.1 Participants and measures

Participants were the matched *as treated* sample comprised of 1,200 Group Walkers and 450 Non-Group Walkers (see Section 5.3.3). All analyses were weighed by ‘psweight’ (see Chapter 5). Frequency of non-group walks in green space was analysed as another variable of physical activity. The measures used in this analysis were outlined in Chapter 3.

7.2.2 Preliminary analysis

A prerequisite for mediation analyses is that the proposed mediator variable is significantly related to both the outcome (i.e. mental and emotional well-being) and the predictor variable (i.e. WfH group walk participation) (Baron & Kenny, 1986). All variables were checked to ensure they met the assumptions of mediation (Baron & Kenny, 1986), meaning paths *a, b* and *c* (see Figures 7.1 and 7.2) all needed to be significant in *a-priori* correlation tests. Table 7.1 demonstrates the point-biserial correlations between group walk participation and all proposed mediators (path *a*). Group walk participation was significantly correlated with T1 and T2 perceived stress, T1 frequency of non-group green space walks and T2 physical activity only. Group walk participation was not significantly correlated with resiliency, social support and connectedness to nature at both T1 and T2, and T2 frequency of non-group walks.

The proposed mediator must be correlated with the outcome variable (path *b*) (Baron & Kenny, 1986). Appendix M lists the correlations between all outcome variables and proposed mediators. Except for T1 CNS, all proposed mediators were significantly correlated with all outcome variables (i.e. T1 and T2 mental well-being, positive affect, negative affect and depression) with p values < .01 (see Appendix M). All mediators, except for T1 CNS, met the requirement for path *b* in Figure 7.2.

The independent variable must be correlated with the outcome variable (path *c*) (Baron & Kenny, 1986). Outdoor group walk participation satisfied this requirement by being significantly correlated with all outcome variables (i.e. T1 and T2 mental well-being, positive affect, negative affect and depression) with p values < .01 (see Appendix M).

Thus, mediation analyses could be carried out with mediator variables T1 and T2 perceived stress, T1 frequency non-group walks in green space, and T2 physical activity. These four mediator variables satisfied both paths *a* and *b* for mediation analyses (Baron & Kenny, 1986).

Table 7.1. Point bi-serial correlations matrix of group walk participation and potential mediator variables at T1 and T2 for the matched *as treated* sample.

	Variables	2	3	4	5	6	7	8	9	10	11	12
1	Group Walk Participation	**-.120*** **	**-.159*** **	**-.008**	**.032**	**-.016**	**-.019**	**.008**	**.01**	**.78** **	**.001**	**.118*** **
2	T1 perceived stress	-	.668***	-.573***	-.558***	-.287***	-.334***	-.041	-.090***	-.092***	-.119***	-.109***
3	T2 perceived stress		-	-.431***	-.597***	-.244***	-.376***	-.032	-.134***	-.093***	-.137***	-.128***
4	T1 Resiliency			-	.766***	.297***	.285***	.178***	.202***	.134***	.130***	.114***
5	T2 Resiliency				-	.255***	.362***	.170***	.252***	.145***	.159***	.136***
6	T1 Social Support					-	.691***	.174***	.188***	.097***	.103***	.026
7	T2 Social Support						-	.190***	.260***	.106***	.121***	.051*
8	T1 Connectedness to Nature							-	.678***	.180***	.193***	.134***
9	T2 Connectedness to Nature								-	.187***	.232***	.149***
10	T1 non-group walks in green space									-	.630***	.409***
11	T2 non-group walks in green space										-	.413***
12	T2 Physical Activity											-

Note. Group Walk Participation in bold because this is the variable of interest for the mediation analyses. Pairwise deletion applied; *n* varies.
* p < .05. ** p < .01. *** p < .001.

7.2.3 Primary analyses hypotheses

The primary analyses of this chapter test whether the relationship between outdoor group walks and mental and emotional well-being was mediated by T1 frequency of non-group walks in green space, T2 physical activity, and T1 and T2 perceived stress. Five hypotheses were tested:

Hypothesis 1: Outdoor group walk participation will positively influence mental well-being and positive affect, and negatively influence depression and negative affect (path *c* in Figure 7.1).

Hypothesis 2: Outdoor group walk participation will positively influence frequency of non-group walks and physical activity, and negatively influence perceived stress (path *a* in Figure 7.2).

Hypothesis 3: Frequency of non-group walks and physical activity will positively influence mental well-being and positive affect, and negatively influence depression and negative affect (path *b* in Figure 7.2).

Hypothesis 4: Perceived stress will negatively influence mental well-being and positive affect, and positively influence depression and negative affect (path *b* in Figure 7.2).

Hypothesis 5: Frequency of non-group walks, physical activity, and perceived stress will mediate the influence of group walks on mental well-being, positive affect, depression and negative affect (path *c'* in Figure 7.2).

7.2.4 Statistical analyses

The causal steps method (Baron & Kenny, 1986; Kenny, 2012) was used to assess mediation, which requires the four steps listed in 7.1.1 must be met. Hierarchical regression was used for all mediation analyses[42]. Three separate regression analyses per outcome variable were conducted in order satisfy the causal steps method (Baron & Kenny, 1986; Kenny, 2012):

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[42] Due to the limitations of the sample, structural equation modelling and the SPSS computational aid PROCESS (Hayes, 2012) were unable to be utilized, as both programmes do not accommodate sampling weights (Hayes, 2012, IBM, 2010). AMOS and PROCESS would have been superior quantitative analyses methods for a parallel mediation model because both programmes are parsimonious, compute the indirect effect and estimate the significance of the indirect relationship through bootstrapping (Hayes, 2012, Sindall, 2012). AMOS would have been able to assess the goodness of fit of the parallel mediation model to the observed data (Sindall, 2012).

- The first regression analysed path *c*;
- The second regression examined path *a*; and
- The third, and final regression, tested path *b* and path *c'* simultaneously (Miles & Shevlin, 2001, p. 190).

Table 7.2 lists the entry of variables in the three hierarchical regression analyses to assess paths *c*, *a*, and *b* and *c'*. Covariates of the well-being outcome variable were included in each set of analyses in order to calculate the indirect and total effects (Kenny, 2012). The other mediator was included as a covariate to ensure the indirect relationships were independent of the other mediator (Hayes, 2012).

To assess path *c*, mental or emotional well-being was the outcome variable. Step 1 of the hierarchical regression entered covariates and the other mediator variable (e.g. T1 frequency of non-group walks) into the model. In Step 2, the predictor variable, group walk participation, was entered into the model. To test path *a,* the mediator (e.g. T1 perceived stress) was entered in the hierarchical regression as the outcome variable. In the first step of the model, covariates and the other mediator (e.g. T1 frequency of non-group walks) were entered into the model. In the second step, group walk participation, was entered into the model as the predictor variable. To examine paths *b* and *c'*, mental or emotional well-being was the outcome variable. In Step 1 of the hierarchical regression, covariates and the other mediator (e.g. T1 frequency of non-group walks) were entered into the model. Group walk participation and the mediator (e.g. T1 perceived stress), were entered into the model at Step 2 as predictor variables, .

Table 7.2. Entry of variables into the hierarchical regression model to assess mediation via the causal steps method

	Hierarchical regression		
Causal step	**Step 1 variables**	**Step 2 variable(s)**	**Outcome variable**
Path *c*	• Covariates • Mediator 2	• Group walk participation	• Mental well-being or • Positive affect or • Negative affect or • Depression
Path *a*	• Covariates • Mediator 2	• Group walk participation	• Mediator 1
Paths *b* and *c'*	• Covariates • Mediator 2	• Group walk participation • Mediator 1	• Mental well-being or • Positive affect or • Negative affect or • Depression

Note. For the mediation analyses of T1 frequency of non-group walks (Mediator 1), T1 perceived stress would be Mediator 2 and vice versa. For the mediation analysis of T2 physical activity (Mediator 1), T2 perceived stress was be Mediator 2, and vice versa.

Calculating the indirect effect can be done in two different ways. The first is the product of the coefficients of paths *a* and *b* (*a**b* or *ab*) (Kenny, 2012). The second method of calculating the indirect effect is the difference in coefficients from the total and direct effects, *c* - *c'* (Kenny, 2012). Testing the significance of the indirect effect can occur using the Sobel test or bootstrapping (Kenny, 2012). The Sobel test assesses the difference between the total effect (path *c* in Figure 7.1) and direct effect (path *c'* in Figure 7.2) (Tabachnick & Fidell, 2013, p. 161). Bootstrapping is a non-parametric method for testing the significance of the indirect effect by calculating a confidence interval from a bootstrapped sample[43].

For this analysis, the test of the indirect effect was conducted using the product of the regression coefficients from the *a* and *b* paths (Preacher & Hayes, 2008). If *ab* is significantly different from zero, an indirect effect is present (Kenny, 2012). The significance of the indirect effect was determined by the Aroian version of the Sobel test[44], as based on previous research (Baron & Kenny, 1986; Preacher & Leonardelli, 2012). The effect size used was the proportion of the total effect that was mediated

[43] SPSS AMOS (Sindall, 2012) and PROCESS (Hayes, 2012) can compute a bootstrapped confidence interval. Although, neither programme can accommodate regression weights (Hayes, 2012).
[44] Sobel test was conducted using online calculators developed by Preacher and Leonardelli (2012).

calculated as *ab* / *ab* + *c'* (Preacher & Kelley, 2011). This effect size measure is appropriate for use here as the sample size is greater than 500 (MacKinnon, Fairchild, & Fritz, 2007; Preacher & Kelley, 2011).

<u>Assumptions of multiple regression</u>

Normality was assessed prior to analyses (see Chapter 6). A logarithmic transformation was applied to T1 and T2 stressful life events, negative affect and depression. Normality, linearity and homoscedasticity of residuals were assessed with the histograms, P-P plots and scatterplots from the regression output. Inspection of the histograms and P-P plots indicated normal distribution for the standardised residuals for all regression analyses. The scatterplots of standardised residuals for T1 and T2 mental well-being, and T1 and T2 log-transformed depression and negative affect revealed some heteroscedasticity. Scatterplots of standardised residuals for T1 and T2 positive affect show assumptions of homoscedasticity were met. Independence of errors was unable to be assessed through the Durbin-Watson statistic (Field, 2009), due to the use of propensity score weights[45]. No variables demonstrated multicollinearity. Univariate outliers in dichotomous variables were identified with less than 90-10 splits (Tabachnick & Fidell, 2013); variables with such splits were ethnicity, disability, GP referral (see Table 5.3). These variables were retained in the regression analyses due to their empirical importance (Coleman et al., 2011; Department of Health, 2011; Office for National Statistics, 2012; Phillips et al., 2011; Trost et al., 2002). Multivariate outliers for the direct effect models were assessed with Mahalanobis distance, leverage, and Cook's distance. Mahalanobis distance showed that all outcome variables had multivariate outliers. Leverage assesses the influence of a case on the outcome variable (Field, 2009). T1 and T2 mental well-being, positive affect and negative affect and T1 depression all had 10 or fewer cases in the direct effect models that exceeded three times the average leverage value. Time 2 log-transformed depression had 23 cases that exceeded three times the average leverage value of .015. However, none of the cases had Cook's distance greater than 1, suggesting none of the cases were having an excessive influence on the regression model (Field, 2009, p. 245). Due to the Cook's

[45] SPSS was unable to compute the Durbin-Watson statistic because "fractional case weights have been found for the variable specified on the WEIGHT command" (error text from SPSS REGRESSION output).

distance statistics stating that none of the outliers were having an excessive influence on the regression model, it was decided to retain all multivariate outliers in the model.

7.3 Results

The results of the mediation analyses are presented below. The analyses of T1 frequency of non-group walks are presented first, followed by analyses of T2 physical activity, and then the results for T1 and T2 perceived stress.

7.3.1 Frequency of non-group walks as a mediator of outdoor group walks and mental and emotional well-being

The following section presents the results from the mediation analyses of T1 frequency of non-group walks. The results are presented by outcome variable, in order, starting with T1 mental well-being first, followed by positive affect, negative affect and ending with depression.

T1 Mental well-being

Table 7.3 shows the results of T1 frequency of non-group walks in green space as a mediator of the relationship between outdoor group walking and T1 mental well-being. Paths *c* and *a* were both significant; outdoor group walk participation was significantly positively associated with greater T1 mental well-being (β = .037, p = .014) and T1 frequency of non-group walks in green space (β = .075, p = .002), after controlling for T1 perceived stress and covariates. However, path *b* was not significant (β = .017, p = .277), indicating that frequency of non-group walks in green space was not significantly related to T1 mental well-being, after controlling for group walk participation, T1 perceived stress and other significant covariates. Similarly, the Sobel test was non-significant (z = 0.98, p = .33). Hypothesis 5 was not supported.

Table 7.3. Mediation of T1 frequency of non-group walks between outdoor group walk and T1 mental well-being.

	B	**SE**	**β**	***p***
Group Walk on T1 frequency of non-group walks, controlling for covariates (path *a*)				
Age	-0.11	0.14	-.02	.406
Marital Status	0.09	0.10	.02	.346
T1 Resiliency	-0.01	0.01	-.02	.541
T1 Social Support	0.01	0.01	.04	.151
T1 Connectedness to nature	0.05	0.01	.16	< .001
T1 Perceived Stress	0.03	0.01	.09	.005
Group Walk	0.316	0.102	.075	.002
T1 frequency on non-group walks on T1 WEMWBS, controlling for group walk and covariates (path *b*)				
Age	0.99	0.38	.04	.010
Marital Status	0.77	0.28	.04	.005
T1 Resiliency	0.36	0.03	.27	< .001
T1 Social Support	0.27	0.02	.20	< .001
T1 Connectedness to nature	0.13	0.02	.10	< .001
T1 Perceived Stress	-0.66	0.03	-.49	< .001
T1 Frequency of non-group walks	0.075	0.069	.017	.277
Total effect of group walk on T1 WEMWBS, controlling for covariates (path *c*)				
Group Walk	0.700	0.285	.037	.014
Direct effect of group walk on T1 WEMWBS, controlling for mediator and covariates (path *c'*)				
Group Walk	0.699	0.286	.037	.015
Indirect effect				
T1 Frequency of non-group walks	0.024			

Note. All analyses control for significant covariates of T1 mental well-being, which were age, marital status, T1 resiliency, social support, connectedness to nature, and perceived stress. WEMWBS = Warwick Edinburgh Mental Well-being Scale.

T1 Positive Affect

The causal steps method in Table 7.4 shows that total effect (path *c*) of group walks on T1 positive affect was not significant (β = .033, *p* = .09), after controlling for covariates; the first of Baron and Kenny's (1986) causal steps for mediation was not satisfied. However, it is possible to have mediation when the total effect (path *c*) is not significant – if both paths *a* and *b* are significant (MacKinnon et al., 2000; MacKinnon et al., 2007; Preacher & Hayes, 2008; Taylor, MacKinnon, & Tein, 2008; Zhao, Lynch, & Chen, 2010). This is a test of indirect only mediation (Zhao et al., 2010). Table 7.4 shows an indirect only mediation of group walk participation and T1 positive affect by frequency of non-group walks in green space, as both path *a* (β = .076, *p* = .002) and *b* (β = .056, *p* = .004) were significant. Participating in an outdoor walking group was associated with an increase in the frequency of non-group walks in green space, which were positively associated with greater T1 positive affect. The Sobel test was significant (z = 2.07, p = .04), supporting Hypothesis 5. The proportion of the total effect mediated by T1 frequency of non-group walks was estimated as 12.6%.

Table 7.4. Mediation of T1 frequency of non-group walks between outdoor group walk and T1 positive affect.

	B	**SE**	**β**	***p***
Group Walk on T1 frequency of non-group walks controlling for covariates (path *a*)				
Marital Status	0.10	0.10	.03	.30
Education	-0.23	0.07	-0.08	.002
T1 Resiliency	0.03	0.01	.09	.003
T1 Social Support	0.01	0.01	.04	.10
T1 Connectedness to nature	0.05	0.01	.15	< .001
T1 Perceived Stress	0.00	0.01	-0.02	.63
Group Walk	0.319	0.102	.076	.002
Frequency of non-group walks on T1 PA controlling for group walk and covariates (path *b*)				
Marital Status	0.66	0.30	.04	.03
Education	0.55	0.22	.05	.01
T1 Resiliency	0.36	0.03	.31	< .001
T1 Social Support	0.18	0.02	.15	< .001
T1 Connectedness to nature	0.15	0.02	.13	< .001
T1 Perceived Stress	-0.34	0.03	-.29	< .001
T1 Frequency of non-group walks	0.217	0.075	.056	.004
Total effect of group walk on T1 PA, controlling for covariates (path *c*)				
Group Walk	0.530	0.308	.033	.09
Direct effect of group walk on T1 PA, controlling for mediator and covariates (path *c'*)				
Group Walk	0.481	0.309	.030	.12
Indirect effect				
T1 Frequency of non-group walks	0.069			

Note. All analyses control for significant covariates of T1 positive affect, which were marital status, education, and T1 social support, resiliency, connectedness to nature, and perceived stress. PA = Positive Affect

T1 Negative affect

Table 7.5 shows the results from the analysis of T1 frequency of non-group walks in green space as a mediator of the relationship between outdoor group walks and T1 negative affect. Path b was not significant (β = .013, p = .463). Frequency of non-group walks in green space was not related to T1 log-transformed negative affect, after controlling for outdoor group walk participation, T1 perceived stress and other significant covariates. The Sobel test was non-significant (z = 0.92, p = .36). Frequency of non-group walks in green space did not mediate the relationship between outdoor group walks and T1 negative affect.

Table 7.5. Mediation of T1 frequency of non-group walks in green space between group walk and T1 negative affect.

	B	SE	β	*p*
Group Walk on T1 frequency of non-group walks in green space, controlling for covariates (path *a*)				
Education	-0.26	0.08	-.08	.001
IMD	-0.04	0.07	-.02	.503
T1 Stressful life events^	0.24	0.20	.03	.222
T1 Resiliency	0.04	0.01	.12	< .001
T1 Perceived Stress	0.00	0.01	-0.01	.847
T1 Social Support	0.02	0.01	.07	.011
Group Walk	0.336	0.103	.080	.001
T1 frequency of non-group walks on T1 NA^ controlling for group walk and covariates (path *b*)				
Education	0.01	0.00	.04	.022
IMD	-0.01	0.00	-.05	.011
T1 Stressful life events^	0.03	0.01	.05	.011
T1 Resiliency	0.00	0.00	-.07	.002
T1 Social Support	0.00	0.00	-.05	.012
T1 Perceived Stress	0.01	0.00	.61	< .001
T1 Frequency of non-group walks	0.001	0.001	.013	.463
Total effect of group walk on T1 NA^, controlling for covariates (path *c*)				
Group Walk	-0.027	0.005	-.092	< .001
Direct effect of group walk on T1 NA^, controlling for mediator and covariates (path *c'*)				
Group Walk	-0.028	0.005	-.094	< .001
Indirect effect				
T1 Frequency of non-group walks	0.0003			

Note. All analyses control for significant covariates of T1 log-10 negative affect, which were education, IMD and T1 stressful life events, resiliency, social support and perceived stress. ^ = log-transformed variable. NA = Negative Affect.

T1 depression

Table 7.6 shows that path b was not significant, indicating that frequency of non-group walks in green space was not related to T1 depression (β = -.024, p = .20), when controlling for T1 perceived stress group, walk participation and covariates. The Sobel test was non-significant (z = -1.18, p = .24), indicating that T1 frequency of non-group walks in green space did not mediate the significant relationship between outdoor group walk participation and log-transformed T1 depression (see path *c*).

Table 7.6. Mediation of T1 frequency of non-group walks in green space between group walk and T1 depression.

	B	SE	β	*p*
Group Walk on T1 non-group walks, controlling for covariates (path *a*)				
Health Condition	-0.38	0.13	-.08	.002
Disability	-0.38	0.17	-.06	.025
T1 Stressful life events^	0.30	0.20	.04	.132
T1 Resiliency	0.03	0.01	.11	< .001
T1 Social Support	0.02	0.01	.06	.021
T1 Perceived Stress	0.00	0.01	.00	.920
Group Walk	0.330	0.103	.079	.001
T1 non-group walks on T1 depression^ controlling for group walk and covariates (path *b*)				
Health Condition	0.03	0.02	.04	.059
Disability	0.05	0.02	.04	.036
T1 Stressful life events^	0.11	0.03	.08	< .001
T1 Resiliency	0.00	0.00	-.08	< .001
T1 Social Support	-0.01	0.00	-.12	< .001
T1 Perceived Stress	0.03	0.00	.54	< .001
T1 Frequency of non-group walks	-0.004	0.003	-.024	.202
Total effect of group walk on T1 depression^, controlling for covariates (path *c*)				
Group Walk	-0.054	0.014	-.070	< .001
Direct effect of group walk on T1 depression^, controlling for mediator and covariates (path *c'*)				
Group Walk	-0.054	0.014	-.071	< .001
Indirect effect				
T1 Frequency of non-group walks	-0.001			

Note. All analyses control for significant covariates of T1 log-transformed depression, which were health condition, disability and T1 stressful life events, resiliency, social support and perceived stress. ^ = log-transformed variable.

7.3.2 Physical activity as a mediator of outdoor group walks and mental and emotional well-being

The following section presents the results from the mediation analyses of T2 physical activity. The results are presented by outcome variable with T2 mental well-being first, followed by T2 positive affect, negative affect and depression.

<u>T2 Mental well-being</u>

Table 7.7 shows that path *c* ($\beta = .021$, $p = .176$) was not significant. The first causal step of mediation was not met (Baron & Kenny, 1986). However, it is possible to have mediation when the total effect (path *c*) is not significant – if both paths *a* and *b* are significant (MacKinnon et al., 2000; MacKinnon et al., 2007; Preacher & Hayes, 2008; Taylor et al., 2008; Zhao et al., 2010). This is a test of indirect only mediation (Zhao et al., 2010). Table 7.7 shows an indirect only mediation of group walk participation and T2 mental well-being by physical activity, as both paths *a* ($\beta = .100$, $p < .001$) and *b* ($\beta = .065$, $p < .001$) were significant. Participating in an outdoor walking group was associated with an increase in physical activity, which, in turn, was positively associated with T2 mental well-being. The Sobel test was significant ($z = 2.87$, $p = .004$), supporting Hypothesis 5. The proportion of the total effect mediated by physical activity was estimated at 29.6%.

Table 7.7. Mediation of T2 physical activity between group walk and T2 mental well-being.

	B	SE	β	*p*
Group Walk on T2 Physical activity, controlling for covariates (path *a*)				
Sex	0.13	0.10	.03	.207
Marital Status	0.11	0.10	.03	.269
T1 Mental Well-being	0.02	0.01	.07	.033
T2 Stressful life events^	0.07	0.23	.01	.760
T2 Resiliency	0.01	0.01	.05	.164
T2 Social Support	-0.01	0.01	-.04	.162
T2 Connectedness to nature	0.03	0.01	.13	< .001
T2 Perceived Stress	-0.01	0.01	-.04	.293
Group Walk	0.423	0.104	.100	< .001
T2 Physical activity on T2 WEMWBS, controlling for group walk and covariates (path *b*)				
Sex	-0.79	0.26	-0.05	.002
Marital Status	1.05	0.26	.06	< .001
T1 Mental Well-being	0.30	0.02	.32	< .001
T2 Stressful life events^	1.46	0.61	.04	.016
T2 Resiliency	0.22	0.03	.18	< .001
T2 Social Support	0.07	0.02	.06	.001
T2 Connectedness to nature	0.06	0.02	.06	< .001
T2 Perceived Stress	-0.42	0.03	-0.35	< .001
T2 Physical Activity	0.271	0.065	.065	< .001
Total effect of group walk on T2 WEMWBS, controlling for covariates (path *c*),				
Group Walk	0.367	0.271	.021	.176
Direct effect of group walk on T2 WEMWBS, controlling for mediator and covariates (path *c'*)				
Group Walk	0.273	0.272	.016	.315
Indirect effect				
T2 Physical Activity	0.115			

Note. All analyses control for significant covariates of T2 mental well-being, which were sex, Marital status, T1 mental well-being and T2 stressful life events, resiliency, social support, connectedness to nature and perceived stress. WEMWBS = Warwick Edinburgh Mental Well-being Scale. ^ = log-transformed variable.

T2 positive affect

Table 7.8 shows that outdoor group walk participation was significantly associated with greater positive affect (see path *c*) and T2 physical activity (see path *a*), physical activity was significantly associated with greater T2 positive affect (see path *b*), after controlling for group walk participation, T2 perceived stress and other covariates. The effect of outdoor group walk participation on T2 positive affect reduced from β = .082, $p < .001$ (path *c*) to β = .072, $p < .001$ (path *c'*) when controlling for T2 physical activity. Physical activity was thus a partial mediator of the relationship between outdoor group walk and T2 positive affect. The Sobel test was significant ($z = 3.49$, $p < .001$), supporting Hypothesis 5. The proportion of the total effect mediated by T2 physical activity was estimated at 13.7%.

Table 7.8. Mediation of T2 physical activity between group walk and T2 positive affect.

	B	SE	β	*p*
Group Walk on T2 Physical activity, controlling for covariates (path *a*)				
Marital Status	0.12	0.10	.03	.233
T1 Positive Affect	0.04	0.01	.14	< .001
T2 Resiliency	0.01	0.01	.02	.532
T2 Social Support	-0.02	0.01	-.06	.045
T2 Connectedness to nature	0.03	0.01	.12	< .001
T2 Perceived Stress	-0.01	0.01	-.04	.188
Group Walk	0.417	0.103	.099	< .001
Physical activity on T2 PA controlling for group walk and other covariates (path *b*)				
Marital Status	0.79	0.26	.05	.002
T1 Positive Affect	0.39	0.02	.39	< .001
T2 Resiliency	0.20	0.03	.17	< .001
T2 Social Support	0.05	0.02	.04	.022
T2 Connectedness to nature	0.08	0.02	.08	< .001
T2 Perceived Stress	-0.29	0.02	-.25	< .001
T2 Physical Activity	0.453	0.064	.116	< .001
Total effect of group walk on T2 PA, controlling for covariates (path *c*)				
Group Walk	1.347	0.271	.082	< .001
Direct effect of group walk on T2 PA, controlling for mediator and covariates (path *c'*)				
Group Walk	1.191	0.268	.072	< .001
Indirect effect				
T2 Physical Activity	0.189			

Note. All analyses control for significant covariates of T2 positive affect, which were Marital status, T1 positive affect, and T2 resiliency, social support, connectedness to nature and perceived stress. PA = Positive Affect.

T2 negative affect

Table 7.9 shows that there was a non-significant total effect (path *c*) of outdoor group walk participation on log-transformed T2 negative affect, after controlling for perceived stress, T1 negative affect and other covariates ($\beta = .002$, $p = .89$). Indirect only mediation (Zhao et al., 2010) was not present. Table 7.9 shows that whilst path *a* was significant ($\beta = .101$, $p < .001$), path *b* was not ($\beta = -.010$, $p = .512$). Physical activity had no effect with T2 negative affect. Similarly, the Sobel test was not significant ($z = -.94$, $p = .35$); Hypothesis 5 was not supported.

Table 7.9. Mediation of T2 physical activity between group walk and T2 negative affect.

	B	SE	β	*p*
Group Walk on T2 Physical Activity controlling for covariates (path *a*)				
Marital Status	0.11	0.10	.03	.277
Education	-0.22	0.08	-.07	.003
T1 Negative Affect^	0.35	0.43	.03	.421
T2 Stressful life events^	0.24	0.23	.03	.311
T2 Perceived Stress	-0.04	0.01	-.13	< .001
Group Walk	0.425	0.105	.101	< .001
Direct effects of Physical Activity on T2 NA controlling for group walk and covariates (path *b*)				
Marital Status	-0.01	0.00	-.04	.022
Education	0.01	0.00	.04	.020
T1 Negative Affect^	0.32	0.02	.33	< .001
T2 Stressful life events^	0.03	0.01	.05	.001
T2 Perceived Stress	0.01	0.00	.52	< .001
T2 Physical Activity	-0.001	0.001	-.010	.512
Total effect of group walk on T2 NA, controlling for covariates (path c)				
Group Walk	0.001	0.005	.002	.89
Direct effect of group walk on T2 NA, controlling for mediator and covariates (path c')				
Group Walk	0.002	0.005	.007	.677
Indirect effect				
T2 Physical Activity	-0.0004			

Note. All analyses control for significant covariates of T2 log-transformed negative affect, which were marital status, education, T1 log-transformed negative affect and T2 stressful life events and perceived stress. ^ = log-transformed variable. NA = Negative Affect.

T2 depression

Table 7.10 shows that outdoor group walk participation was significantly negatively associated with T2 log-transformed depression (see path *c*) and significantly positively associated with physical activity (see path *a*). Physical activity was significantly negatively associated with of T2 log-10 depression (see path *b*), after controlling for group walk participation, T2 perceived stress and other covariates. T2 physical activity was a partial mediator of the relationship between group walk participation and T2 log-transformed depression. The effect of outdoor group walk on T2 log-transformed depression reduced from $\beta = -.045$, $p = .005$ (path *c*) to $\beta = -.039$, $p = .02$ (path *c'*) when controlling for T2 physical activity. The Sobel test was significant ($z = -2.50$, $p = .01$), supporting Hypothesis 5. The proportion of the total effect mediated by T2 physical activity was 12.8%.

Table 7.10. Mediation of T2 physical activity between outdoor group walk and T2 depression.

	B	SE	β	*p*
Group Walk on T2 Physical Activity controlling for covariates (path *a*)				
GP referral to WfH	-0.14	0.19	-.02	.451
Education	-0.22	0.08	-.07	.004
T1 Depression^	-0.18	0.16	-.03	.269
T2 Stressful life events^	0.24	0.23	.03	.309
T2 Perceived Stress	-0.03	0.01	-.10	.001
Group Walk	0.411	0.104	.097	< .001
Physical Activity on T2 depression controlling for group walk and covariates (path *b*)				
GP referral to WfH	0.07	0.02	.05	.001
Education	0.02	0.01	.04	.015
T1 Depression^	0.34	0.02	.35	< .001
T2 Stressful life events^	0.07	0.03	.04	.015
T2 Perceived Stress	0.02	0.00	.47	< .001
T2 Physical Activity	-0.010	0.003	-.057	< .001
Total effect of group walk on T2 depression, controlling for covariates (path *c*)				
Group Walk	-0.033	0.012	-.045	.005
Direct effect of group walk on T2 depression, controlling for mediator and covariates (path *c'*)				
Group Walk	-0.028	0.012	-.039	.018
Indirect effect				
T2 Physical Activity	-0.004			

Note. All analyses control for significant covariates of T2 log-transformed depression, which were GP referral, education, T1 log-transformed depression and T2 stressful life events and T2 perceived stress. ^ = log-transformed variable.

7.3.3 Perceived stress as a mediator of outdoor group walks and mental and emotional well-being

The following section presents the results from the mediation analyses of T1 and T2 perceived stress. The results are presented by outcome variable with T1 mental well-being first, followed by T2 mental wellbeing. Results for T1 and T2 positive affect are presented next, followed by results from T1 and T2 negative affect. This section ends with the perceived stress mediation results for T1 and T2 depression.

<u>T1 mental well-being</u>

Table 7.11 shows the causal steps paths *c*, *a* and *b* were significant. Group walk participation was a significantly positively associated T1 mental well-being (β = .099, $p < .001$) and significantly negatively associated with T1 perceived stress (β = -.127, $p < .001$). T1 perceived stress was significantly negatively associated with T1 mental well-

being (β = -.485, $p < .001$), after controlling for group walk participation, T1 frequency of non-group walks and other covariates. T1 perceived stress was a partial mediator of the relationship between group walk participation and T1 mental well-being; the regression coefficient for outdoor group walks on T1 mental well-being reduced from β = .099, $p < .001$ (path *c*) to β = .037, $p = .015$ (path *c'*) when controlling for T1 perceived stress. The Sobel test was significant ($z = 6.32$, $p < .001$), supporting Hypothesis 5. The proportion of the total effect of group walk participation on T1 mental well-being that travelled through T1 perceived stress was an estimated 62.5%.

Table 7.11. Mediation of T1 perceived stress between outdoor group walk and T1 mental well-being.

	B	SE	β	*p*
Group Walk on T1 PSS controlling for covariates (path *a*)				
Age	-2.313	0.362	-.125	< .001
Marital Status	0.098	0.266	.007	.714
T1 Resiliency	-0.520	0.020	-.533	< .001
T1 Social Support	-0.158	0.021	-.155	< .001
T1 Connectedness to nature	0.087	0.020	.088	< .001
T1 frequency of non-group walks	-0.041	0.066	-.012	.541
Group Walk	-1.776	0.272	-.127	< .001
T1 PSS on T1 WEMWBS, controlling for group walk and other covariates (path *b*)				
Age	0.986	0.380	.040	.010
Marital Status	0.770	0.276	.042	.005
T1 Resiliency	0.357	0.025	.271	< .001
T1 Social Support	0.271	0.022	.197	< .001
T1 Connectedness to nature	0.128	0.021	.096	< .001
T1 frequency of non-group walks	0.075	0.069	.017	.277
T1 Perceived Stress	-0.655	0.026	-.485	< .001
Total effect of group walk on T1 WEMWBS, controlling for covariates (path *c*)				
Group Walk	1.863	0.334	.099	< .001
Direct effect of group walk on T1 WEMWBS, controlling for covariates (path *c'*)				
Group Walk	0.699	0.286	.037	.015
Indirect effect				
T1 Perceived Stress	1.163			

Note. All analyses control for significant covariates of T1 mental well-being, which were age, marital status, T1 resiliency, social support, connectedness to nature and frequency of non-group walks in green space. PSS = perceived stress scale; WEMWBS = Warwick Edinburgh Mental Well-being Scale.

T2 mental well-being

Table 7.12 shows that paths *c* (β = .056, p = .001), *a* (β = -.114, p < .001) and *b* (β = -.351, p < .001) were all significant. T2 perceived stress was a complete mediator of the relationship between outdoor group walk participation and Time 2 mental well-being. Outdoor group walk participation had no effect on T2 mental well-being, after controlling for T2 perceived stress (β = .016, p = .32) (see path *c'* in Table 7.12). The Sobel test was significant (z = 5.99, p < .001), supported Hypothesis 5. The proportion of the total effect of group walk participation that was mediated by T2 perceived stress was estimated to be 72.1%.

Table 7.12. Mediation of T2 perceived stress between outdoor group walk and T2 mental well-being.

	B	SE	β	*p*
Group Walk on T2 PSS, controlling for covariates (path *a*)				
Sex	-1.190	0.249	-.086	< .001
Marital Status	-0.027	0.256	-.002	.92
T1 Mental Well-being	-0.239	0.018	-.307	< .001
T2 Stressful life events^	5.603	0.571	.172	< .001
T2 Resiliency	-0.367	0.023	-.357	< .001
T2 Social Support	-0.128	0.020	-.126	< .001
T2 Connectedness to nature	0.043	0.015	.052	.01
T2 Physical Activity	-0.066	0.062	-.019	.293
Group Walk	-1.682	0.260	-.114	< .001
T2 PSS on T2 WEMWBS, controlling for controlling for group walk and other covariates (path *b*)				
Sex	-0.789	0.259	-.048	.002
Marital Status	1.049	0.264	.061	< .001
T1 Mental Well-being	0.297	0.020	.319	< .001
T2 Stressful life events^	1.458	0.607	.038	.02
T2 Resiliency	0.223	0.026	.182	< .001
T2 Social Support	0.071	0.021	.058	.001
T2 Connectedness to nature	0.056	0.016	.057	< .001
T2 Physical Activity	0.271	0.065	.065	< .001
T2 Perceived Stress	-0.419	0.026	-.351	< .001
Total effect of group walk on T2 WEMWBS, controlling for covariates (path *c*)				
Group Walk	0.978	0.290	.056	.001
Direct effect of group walk on T2 WEMWBS, controlling for covariates and mediator (path *c'*)				
Group Walk	0.273	0.272	.016	.32
Indirect effect				
T2 Perceived Stress	0.705			

Note. All analyses control for significant covariates of T2 mental well-being, which were sex, marital status, T1 mental well-being, and T2 stressful life events, resiliency, social support, connectedness to nature and physical activity. PSS = Perceived Stress Scale; WEMWBS = Warwick Edinburgh Mental Well-being Scale. ^ = log-transformed variable.

T1 positive affect

Table 7.13 shows that causal steps paths *c*, *a* and *b* were significant. Group walk participation was positively associated with T1 positive affect (β = .067, $p < .001$) and negatively associated with T1 perceived stress (β = .127, $p < .001$). T1 perceived was significantly negatively associated with T1 positive affect (β = -.293, $p < .001$), after controlling for group walk participation, frequency of non-group walks in green space and other covariates. T1 perceived stress was a complete mediator of the relationship between outdoor group walk participation and Time 1 positive affect. Group walk participation had no effect on T1 positive affect (β = .030, $p = .12$) (path *c'*) when controlling for T1 perceived stress. The Sobel test was significant ($z = 5.72$, p < .001), supporting Hypothesis 5. The proportion of the total effect of outdoor group walk participation on T1 positive affect that travelled through T1 perceived stress was estimated to be 55.7%.

Table 7.13. Mediation of T1 perceived stress between outdoor group walk and T1 positive affect.

	B	SE	β	*p*
Group Walk on T1 PSS, controlling for covariates (path *a*)				
Marital Status	0.11	0.27	.01	.69
Education	0.01	0.20	.00	.96
T1 Resiliency	-0.53	0.02	-.55	< .001
T1 Social Support	-0.14	0.02	-.14	< .001
T1 Connectedness to nature	0.08	0.02	.08	< .001
T1 Frequency of non-group walks	-0.03	0.07	-.01	.63
Group Walk	-1.776	0.276	-.127	< .001
PSS on T1 PA controlling for group walk and other covariates (path *b*)				
Marital Status	0.66	0.30	.04	.03
Education	0.55	0.22	.05	.01
T1 Resiliency	0.36	0.03	.31	< .001
T1 Social Support	0.18	0.02	.15	< .001
T1 Connectedness to nature	0.15	0.02	.13	< .001
T1 Frequency of non-group walks	0.22	0.08	.06	.004
T1 Perceived Stress	-0.341	0.027	-.293	< .001
Total effect of group walk on T1 PA, controlling for covariates (path *c*)				
Group Walk	1.086	0.319	.067	.001
Direct effect of group walk on T1 PA, controlling for covariates and mediator (path *c'*)				
Group Walk	0.481	0.309	.030	.12
Indirect effect				
T1 Perceived Stress	0.606			

Note. All analyses control for significant covariates of T1 positive affect, which were marital status, education and T1 resiliency, social support, connectedness to nature and frequency of non-group walks in green space. PA = Positive Affect.

T2 positive affect

Table 7.14 shows that outdoor group walk participation was significantly positively associated with T2 positive affect (see path *c*) and significantly negatively associated with T2 perceived stress (see path *a*). T2 perceived stress was significantly negatively associated with T2 positive affect (see path *b*). T2 perceived stress partially mediated the relationship between outdoor group walk participation and T2 positive affect. The effect of outdoor group walk participation on T2 positive affect reduced from $\beta = .108$, $p < .001$ (see path *c*) to $\beta = .072$, $p < .001$ (see path *c'*), after controlling for T2 perceived stress. The Sobel test was significant ($z = 6.30$, $p < .001$), supporting Hypothesis 5. The proportion of the total effect mediated by T2 perceived stress was estimated at 32.9%.

Table 7.14. Mediation of T2 perceived stress between outdoor group walk and T2 positive affect.

	B	SE	β	*p*
Group Walk to T2 PSS, controlling for covariates (path *a*)				
Marital Status	-0.30	0.27	-.02	.28
T1 Positive Affect	-0.11	0.02	-.12	< .001
T2 Resiliency	-0.49	0.02	-.48	< .001
T2 Social Support	-0.18	0.02	-.18	< .001
T2 Physical Activity	-0.09	0.07	-.03	.19
T2 Connectedness to nature	0.06	0.02	.07	.001
Group Walk	-2.047	0.279	-.139	< .001
PSS on T2 PA controlling for group walk and other covariates (path *b*)				
Marital Status	0.79	0.26	.05	.002
T1 Positive Affect	0.39	0.02	.39	< .001
T2 Resiliency	0.20	0.03	.17	< .001
T2 Social Support	0.05	0.02	.04	.022
T2 Connectedness to nature	0.08	0.02	.08	< .001
T2 Physical Activity	0.45	0.06	.12	< .001
T2 Perceived Stress	-0.285	0.023	-.254	< .001
Total effect of group walk on T2 PA, controlling for covariates (path *c*)				
Group Walk	1.774	0.276	.108	< .001
Direct effect of group walk on T2 PA, controlling for covariates and mediator (path *c'*)				
Group Walk	1.191	0.268	.072	< .001
Indirect effect				
T2 Perceived Stress	0.583			

Note. All analyses control for significant covariates of T2 positive affect, which were marital status, T1 positive affect and T2 resiliency, social support, connectedness to nature and physical activity. PSS = Perceived Stress Scale. PA = Positive Affect.

T1 negative affect

Table 7.15 shows that outdoor group walk participation was negatively associated with log-transformed T1 negative affect (path *c*) and T1 perceived stress (path *a*). T1 perceived stress was positively associated with log-transformed T1 negative affect (see path *b*). The effect of outdoor group walks on T1 log-transformed negative affect reduced from $\beta = -.168$, $p < .001$ (path *c*) to $\beta = -.094$, $p < .001$ (path *c'*) when controlling for T1 perceived stress. T1 perceived stress was a partial mediator of the relationship between group walk participation and T1 log-transformed negative affect. The Sobel test was significant ($z = -6.27$, $p < .001$), supporting Hypothesis 5. The proportion of group walk participation travelling through T1 perceived stress was estimated at 44.0%.

Table 7.15. Mediation of T1 perceived stress between group walk and T1 negative affect^

	B	SE	β	*p*
Group Walk on T1 PSS, controlling for covariates (path *a*)				
Education	-0.034	0.198	-.003	.862
IMD	-0.476	0.174	-.053	.006
T1 Stressful life events^	4.624	0.504	.177	< .001
T1 Resiliency	-0.510	0.020	-.523	< .001
T1 Social Support	-0.132	0.021	-.130	< .001
T1 Frequency of non-group walks	-0.013	0.065	-.004	.847
Group Walk	-1.692	0.270	-.121	< .001
PSS on T1 NA^ controlling for group walk and covariates (path *b*)				
Education	0.009	0.004	.041	.022
IMD	-0.009	0.003	-.045	.011
T1 Stressful life events^	0.026	0.010	.047	.011
T1 Resiliency	-0.001	0.000	-.069	.002
T1 Social Support	-0.001	0.000	-.048	.012
T1 Frequency of non-group walks	0.001	0.001	.013	.463
T1 Perceived Stress	0.013	0.000	.611	< .001
Total effect of group walk on T1 NA, controlling for covariates (path *c*)				
Group Walk	-0.050	0.006	-.168	< .001
Direct effect of group walk on T1 NA, controlling for covariates (path *c'*)				
Group Walk	-0.028	0.005	-.094	< .001
Indirect effect				
T1 Perceived Stress	-0.02			

Note. All analyses control for significant covariates of T1 log-10 negative affect, which were education, IMD and T1 stressful life events, resiliency, social support and frequency of non-group walk in green space. ^ = log-transformed variable. NA = Negative Affect.

T2 negative affect

Table 7.16 shows there was a non-significant total effect (path *c*) of WfH group walk participation on log-transformed T2 negative affect, after controlling for physical activity and other covariates (β = -.020, p = .28). Thus, the first causal step of mediation (Baron & Kenny, 1986) was not met. An indirect only mediation (Zhao et al., 2010) was present, as both paths *a* (β = -.051, p = .009) and *b* (β = .523, p < .001) were significant. Similarly, the Sobel test was significant (z = -3.03, p = .003).

However, the results in Table 7.16 show evidence of inconsistent mediation and suppression. Inconsistent mediation exists when the regression coefficient of the direct effect (path *c'*) has an opposite sign to the indirect effect (Kenny, 2012). The regression coefficient of the direct effect of outdoor group walk on T2 negative affect, controlling for T2 perceived stress and other covariates had a positive sign (B = 0.002), while the indirect effect regression coefficient had a negative sign (B = -0.008). Suppression is indicated when the regression coefficient of the direct effect becomes *larger* when the mediator is included in the regression equation (MacKinnon et al., 2000). This is the opposite of mediation (Baron & Kenny, 1986). Table 7.16 shows evidence of T2 perceived stress as a suppressor variable; the regression coefficient of the direct effect, β = .007 (path *c'*), was larger when T2 perceived stress was included into the regression model than when it was not included into the model in the total effect, β = -.020 (path *c*). Furthermore, the proportion of the direct effect travelling through T2 perceived stress was estimated at 132%. Thus, Hypothesis 5 is not supported because T2 perceived stress was a suppressor variable for T2 negative affect, and not a mediator.

Table 7.16. Mediation of T2 perceived stress between outdoor group walk and T2 negative affect^

	B	SE	β	*p*
Group Walk on T2 PSS, controlling for covariates (path *a*)				
Marital Status	-0.468	0.275	-.033	.089
Education	-0.454	0.205	-.042	.027
T1 Negative Affect^	28.055	0.965	.570	< .001
T2 Stressful life events^	4.962	0.628	.153	< .001
T2 Physical activity	-0.288	0.067	-.083	< .001
Group Walk	-0.755	0.287	-.051	.009
PSS on T2 NA controlling for group walk and covariates (path *b*)				
Marital Status	-0.010	0.004	-.035	.022
Education	0.008	0.003	.036	.020
T1 Negative Affect^	0.324	0.019	.327	< .001
T2 Stressful life events^	0.033	0.010	.051	.001
T2 Physical activity	-0.001	0.001	-.010	.512
T2 Perceived stress	0.011	0.000	.523	< .001
Total effect of group walk on T2 NA, controlling for covariates (path *c*)				
Group Walk	-0.006	0.006	-.020	.28
Direct effect of group walk on T2 NA, controlling for mediator and covariates (path *c'*)				
Group Walk	0.002	0.005	.007	.677
Indirect effect				
T2 Perceived Stress	-0.008			

Note. All analyses control for significant covariates of T2 log-transformed negative affect, which were marital status, education, T1 log-transformed negative affect and T2 stressful life events and physical activity. ^ = log-transformed variable.

T1 depression

Table 7.17 shows that outdoor group walk participation was significantly associated with a reduction in T1 depression (path *c*) and T1 perceived stress (path *a*). T1 perceived stress was significantly associated with an increase in log-transformed T1 depression (path *b*), after controlling for group walk participation, frequency of non-group walks, and other covariates. T1 perceived stress was a partial mediator of the relationship between outdoor group walk participation and T1 log-transformed depression. The effect of outdoor group walk participation on T1 log-transformed depression reduced from $\beta = -.136$, $p < .001$ (path *c*) to $\beta = -.071$, $p < .001$ (path *c'*), when controlling for T1 perceived stress. The Sobel test was significant ($z = -6.10$, $p < .001$), supporting Hypothesis 5. The proportion of the total effect mediated by T1 perceived stress was estimated at 47.5%.

Table 7.17. Mediation of T1 perceived stress between outdoor group walk and T1 depression.

	B	SE	β	*p*
Group Walk on T1 PSS, controlling for covariates (path *a*)				
Health Condition	-0.002	0.332	.000	.996
Disability	0.065	0.445	.003	.884
T1 Stressful life events^	4.650	0.509	.178	< .001
T1 Resiliency	-0.510	0.020	-.523	< .001
T1 Social Support	-0.132	0.021	-.129	< .001
T1 Frequency of non-group walks	-0.007	0.065	-.002	.920
Group Walk	-1.686	0.270	-.121	< .001
PSS on T1 depression^ controlling for group walk and covariates (path *b*)				
Health Condition	0.032	0.017	.035	.059
Disability	0.048	0.023	.040	.036
T1 Stressful life events^	0.114	0.027	.080	< .001
T1 Resiliency	-0.004	0.001	-.081	< .001
T1 Social Support	-0.007	0.001	-.122	< .001
T1 Frequency of non-group walks	-0.004	0.003	-.024	.202
T1 Perceived Stress	0.029	0.001	.539	< .001
Total effect of group walk on T1 depression^, controlling for covariates (path *c*)				
Group Walk	-0.103	0.016	-.136	< .001
Direct effect of group walk on T1 depression^, controlling for mediator and covariates (path *c'*)				
Group Walk	-0.054	0.014	-.071	< .001
Indirect effect				
T1 Perceived Stress	-0.049			

Note. All analyses control for significant covariates of T1 log-transformed depression, which were health condition, disability and T1 stressful life events, resiliency, social support and frequency of non-group walks in green space. ^ = log-transformed variable.

T2 depression

Table 7.18 shows that outdoor group walks was significantly negatively associated with T2 log-transformed depression (path *c*) and T2 perceived stress (path *a*), and T2 perceived stress was significantly positively associated with T2 log-transformed depression (path *b*). T2 perceived stress was a partial mediator of the relationship between outdoor group walk participation and T2 log-transformed depression. The effect of outdoor group walk participation on T2 depression reduced from $\beta = -.075$, $p < .001$ (path *c*) to $\beta = -.039$, $p = .02$ (path *c'*), after controlling for T2 perceived stress. The Sobel test was significant ($z = -3.79$, $p < .001$), supporting Hypothesis 5. The proportion of the total effect mediated by T2 perceived stress was estimated as 49.4%.

Table 7.18. Mediation of T2 perceived stress between outdoor group walk and T2 depression.

	B	SE	β	*p*
Group Walk on T2 PSS, controlling for covariates (path *a*)				
GP referral to WfH	-0.12	0.53	-.01	.82
Education	-0.23	0.21	-.02	.27
T1 Depression^	10.09	0.39	.52	< .001
T2 Stressful life events^	5.46	0.65	.17	< .001
T2 Physical Activity	-0.24	0.07	-.07	.001
Group Walk	-1.141	0.297	-.078	< .001
T2 PSS on T2 depression controlling for group walk and covariates (path *b*)				
GP referral to WfH	0.07	0.02	.05	.001
Education	0.02	0.01	.04	.02
T1 Depression^	0.34	0.02	.35	< .001
T2 Stressful life events^	0.07	0.03	.04	.02
T2 Physical Activity	-0.01	0.00	-.06	< .001
T2 Perceived Stress	0.024	0.001	.474	< .001
Total effect of group walk on T2 depression, controlling for covariates (path *c*)				
Group Walk	-0.055	0.014	-.075	< .001
Direct effect of group walk on T2 depression, controlling for mediator and covariates (path *c'*)				
Group Walk	-0.028	0.012	-.039	.02
Indirect effect				
T2 Perceived Stress	-0.03			

Note. All analyses control for significant covariates of T2 log-transformed depression, which were GP referral, education, T1 log-transformed depression and T2 stressful life events and T2 physical activity. ^ = log-transformed variable. PSS = Perceived Stress Scale.

7.4 Discussion

This chapter examined the mechanisms that might explain the relationship between outdoor group walking and mental well-being, positive affect, negative affect and depression. The mechanisms tested were frequency of non-group walks, physical activity, and perceived stress.

7.4.1 Potential mechanisms behind the outdoor group walk–well-being relationship

Preliminary analyses found no significant correlations between outdoor group walking and social support, connectedness to nature and resiliency. As such, these three variables were not mediators of the relationship between outdoor group walk participation and well-being in this study. The non-significant result of group walk participation and social well-being presented in this chapter is supported by previous research, which found no difference in levels of social support between women in a outdoor walking group and women in a non-physical activity support group (Armstrong & Edwards, 2003; Armstrong & Edwards, 2004). The lack of a significant relationship of group walks and connectedness to nature is also supported by previous research, which found no change in connectedness to nature after an outdoor group walk (Hine et al., 2011). The research on the relationship between outdoor group walks or interaction with nature and resilience is limited and the non-significant result presented here may be the first to examine resiliency and outdoor group walks.

7.4.2 Indirect influence of outdoor group walks on well-being

Table 7.19 summarises the results from all mediation analyses. Both stress reduction and physical activity have been suggested as possible mediators of nature and health (Health Council of the Netherlands and Dutch Advisory Council for Research on Spatial Planning, Nature and the Environment, 2004). The findings here support both perceived stress reduction and physical activity as mediators of group walk participation and well-being.

Table 7.19. Summarised results of all mediation analyses.

Mediator variable	Mental Well-being	Positive Affect	Negative Affect	Depression
		Time 1		
Frequency of non-group walks	*ns*		*ns*	*ns*
Type of mediation		Indirect		
Proportion of the total effect mediated		12.6%		
Perceived stress				
Type of mediation	Partial	Complete	Partial	Partial
Proportion of the total effect mediated	62.5%	55.7%	44%	47.5%
		Time 2		
Physical activity			*ns*	
Type of mediation	Indirect	Partial		Partial
Proportion of the total effect mediated	29.6%	13.7%		12.8%
Perceived stress			*ns*	
Type of mediation	Complete	Partial		Partial
Proportion of the total effect mediated	72.1%	32.9%		49.4%

ns = variable is not a mediator of the group walk-well-being relationship.

Perceived stress mediated the relationship between group walk participation and all well-being variables, expect T2 negative affect (see Table 7.19). Participation in an outdoor walking group reduced perceived stress, which in turn had a negative effect on well-being. Except for T2 negative affect, perceived stress was either a complete or partial mediator of the relationship between outdoor group walks and mental and emotional well-being (see Table 7.19). T1 perceived stress was a complete mediator of the relationship between outdoor group walks and T1 positive affect. T2 perceived stress completely mediated the relationship between outdoor group walks and T2 mental well-being. Whilst, a complete mediator is one that completely explains the relationship between the predictor and outcome variables (Baron & Kenny, 1986), it does not preclude other mediators contributing to the predictor-outcome relationship (e.g. Groenewegen et al., 2012; Maas et al., 2009). The results presented in Table 7.19 are consistent with previous research by Groenewegen et al. (2012) who found perceived stress reduction completely mediated the relationship between the quantity of streetscape greenery and mental health, and partially mediated the relationship between quality of streetscape greenery and mental health.

Physical activity mediated the relationship between group walk participation and Time 2 mental well-being, positive affect and depression. Participation in outdoor group walks was associated with an increase in physical activity, which in turn was associated with increased Time 2 mental well-being, positive affect, and decreased depression. Physical activity was a partial mediator of the association between group walk participation and T2 positive affect and depression (see Table 7.19). The indirect mediation of physical activity on T2 mental well-being occurred because T2 perceived stress was a complete mediator of the relationship between outdoor group walks and T2 mental well-being. Previous studies have found walking, a form of physical activity, to be a partial mediator of the relationship between amount of green space and mental health (Groenewegen et al., 2012; Sugiyama et al., 2008).

T1 frequency of non-group walks in green space was an mediator for T1 positive affect only. Participating in an outdoor walking group was associated with an increase in the frequency of non-group walks in green space, which in turn was associated with an increase in T1 positive affect. Frequency of non-group walks in green space was an indirect only mediation (see Table 7.19) because T1 perceived stress completely mediated the relationship between outdoor group walks and T1 positive affect.

Perceived stress was the most important mechanism by which outdoor group walks affected well-being. With the exception of T2 negative affect, perceived stress explained a greater proportion of the total effect between outdoor group walking and mental and emotional well-being than any other mediator (see Table 7.19). T1 frequency of non-group walks in green space and T2 physical activity both explained a smaller proportion of the total effect between group walk participation and well-being than perceived stress (see Table 7.19). Previous research also found perceived stress reduction to be the more important mediator (Groenewegen et al., 2012). The authors (Groenewegen et al., 2012) found stress reduction accounted for 40% of the total effect of quantity of streetscape greenery and mental health, whilst social cohesion mediated 30% of the total effect, and physical activity outdoors (i.e. walking or cycling) mediated less than 10% of the total effect between quantity of streetscape greenery and mental health.

How does walking in a group reduce perceived stress? Previous researchers have shown that perceived stress is reduced following engagement in physical activity (Aldana, Sutton, Jacobson, & Quirk, 1996; Schnohr, Kristensen, Prescott, & Scharling, 2005), perceived social support from others (Cohen, 2004) or interaction with the natural environment (Hawkins, 2012; Roe & Aspinall, 2011; Stigsdotter et al., 2010; Ward Thompson et al., 2012). Frequency of non-group walks and physical activity cannot explain the reduction in perceived stress, as these variables were controlled for in the analyses of the effect of outdoor group walking on perceived stress (path *a*). Thus, the effect of group walk participation on perceived stress was independent of frequency of non-group walks and physical activity. Social support from walking in a group is unlikely to be a cause as there was no effect of outdoor group walks on this variable. Interacting with the natural environment could be the mechanism through which group walk participation reduced perceived stress. The majority of WfH walking groups occur in natural environments (Hynds & Allibone, 2009). The proposed integration of the Attention Restoration Theory (ART) and coping (see Chapter 2) suggested that interacting with nature reduces perceived stress through the restoration of directed attention fatigue (S. Kaplan, 1995). Perhaps the restoration of directed attention, facilitated by a group walk in the natural environment, can explain the reduction of perceived stress? Previous research has found that a solo walk in natural environments restores directed attention (Berman et al., 2008; Berman et al., 2012; Hartig et al., 2003). Further research is required to understand the mechanisms that would explain the reduction in perceived stress from participating in a walking group, and specifically investigate whether directed attention could be a mediator.

7.4.3 Limitations

The directionality of relationship described here was based on the unified model of stress (Cohen et al., 1997), theories of restorative environments (Hartig & Evans, 1993; R. Kaplan & Kaplan, 1989; Ulrich, 1983), and previous mediation analyses (Groenewegen et al., 2012; Hawkins, 2012; Maas et al., 2008; Mayer et al., 2009; Mytton et al., 2012; Sugiyama et al., 2008). However, feedback or reverse causality could also account for the results (Baron & Kenny, 1986). For example, high levels of mental well-being may reduce perceived stress or people with high levels of mental well-being are more likely to participate in a walking group or other types of physical activity. As such, the opposite direction of the mediation relationship may exist.

The second limitation is that not all Group Walkers were walking in a natural environment. At Time 1, it is unknown how many matched *as treated* Group Walkers walked in natural environments, as this information was not available. At Time 2, 6% (n = 72) of the 1,200 matched *as treated* Group Walkers stated that their WfH group walk took place in the urban environment (e.g. streets, shopping centre, plaza). Thus, the assumption that a group walk in the natural environment may cause perceived stress reduction via restoration of directed attention is not valid for these participants. Further analyses of the thesis data could investigate whether the mechanisms that explain the outdoor group walk–well-being relationship differ for these 72 urban Group Walkers.

7.4.4 Future research

Whilst a strength of this research is the number of mediators investigated of the outdoor group walks–well-being relationship, other mediators may exist that were not tested here, such as social interaction (Maas et al., 2009) or self-esteem (Peacock et al., 2007; Pretty et al., 2007; Pretty et al., 2005). Recently, positive affect has been suggested as a mediator (Irvine et al., 2013; Tugade & Fredrickson, 2004). Additional analyses of the GRIN data could test this hypothesis by using positive affect as a mediator between outdoor group walks and mental well-being, negative affect and depression. The data presented here demonstrates such an mediation analysis may be possible, as both path *a*, the influence of outdoor group walks on positive affect, and path *c,* the total effect of outdoor group walks on mental well-being, depression and negative affect, have been confirmed.

Outside the aims of this study, further research of the GRIN data could examine serial multiple mediation analyses between adversity and well-being based on the unified theory of stress. Are the effects of adversity on well-being mediated in sequence by coping variables (i.e. social support, resiliency, connectedness to nature, physical activity) and perceived stress? Previous research has shown that social support, physical activity, resiliency and connectedness to nature have a negative influence on perceived stress (Connor & Davidson, 2003; Fan et al., 2011; Hawkins, 2012; León et al., 2010; Smith et al., 2008; Szachniewicz, 2012). Such a research question would further the work of stress and resilience researchers by investigating the coping variables that reduce stress on multiple indicators of well-being.

7.5 Conclusion

The purpose of this chapter was to answer Objective 2 of the thesis: explore the mechanisms that contribute to the relationship between outdoor group walk participation and positive mental and emotional well-being. The results reported here suggest, of the mediators explored, outdoor group walks indirectly influence mental and emotional well-being through an increase in physical activity and frequency of non-group walks, and a decrease in perceived stress. These mediators have been previously identified as mechanisms behind the relationship between nature and health (Health Council of the Netherlands and Dutch Advisory Council for Research on Spatial Planning, Nature and the Environment, 2004) and have been supported in previous mediation analyses (Groenewegen et al., 2012). The study results reported in this chapter find that perceived stress explained more of the total effect between group walks and mental and emotional well-being than either physical activity or frequency of non-group walks. Two mediators identified in previous literature - social support and connectedness to nature - were not identified as mediators in this study. Resiliency, a potential mediator on theoretical grounds, was also not found to be a mediator.

This research is the one of the first to examine the mechanisms by which participating in an outdoor walking group affects well-being. Previous research has shown that group walks improve various indicators of well-being (Barton et al., 2012; Hine et al., 2011; Peacock et al., 2007; Roe & Aspinall, 2011), but did not investigate how this occurs. Of the studies that have investigated the mechanisms between nature and health, the majority are epidemiological type studies that analyse the relationship between the amount of natural environment near the home and indicators of well-being (Groenewegen et al., 2012; Maas et al., 2008; Maas et al., 2009; Mytton et al., 2012). In these studies actual use of the environment is unknown.

In conclusion, the results in this chapter suggest that outdoor group walks could be used for coping with stress. As coping with stress and adversity can contribute to optimal human functioning (Boniwell, 2012), this may be another manner in which outdoor group walks could contribute to population public health. The next chapter will investigate whether participating in an outdoor walking group can facilitate resilience from adversity. This contributes to the aim of the thesis by investigating outdoor group walks as a potential public health intervention for positive mental and emotional well-being by promoting resilience. Previous research has shown that interaction with nature can foster resilience (Cimprich & Ronis, 2003; de Vries et al., 2003; Leather, Pyrgas, Beale, & Lawrence, 1998; Maas et al., 2006; Mitchell & Popham, 2007; Mitchell & Popham, 2008; Ottosson & Grahn, 2008; Stuart, 2005; van den Berg et al., 2010; Ward Thompson et al., 2012; Wells & Evans, 2003), but none have investigated outdoor walking groups.

Chapter 8 Group walks as a buffer between adversity and well-being

This chapter examines whether participating in an outdoor walking group fosters psychological resilience. Chapter 2 highlighted psychological resilience and restorative environments as important theoretical frameworks for maintaining and generating health. An integration of the two theories was proposed in order to understand how interacting with nature could foster resilience against adversity (see Section 2.2.4). This chapter addresses Objective 3 of the thesis:

> Investigate whether outdoor group walks facilitate resilience by moderating the effects of adversity on mental and emotional well-being.

The first section of this chapter will briefly discuss the theories of resilience, and restorative environments, followed by a review of the literature investigating green space as a moderator from stressful life events and social deprivation. The second section will describe the statistical analyses. The third section will present the results of moderation analyses examining whether outdoor group walks act as a buffer from adversity, thus facilitating resilience. This chapter concludes with a summary of the relationships found.

8.1 Introduction

8.1.1 Resilience

The theory of resilience was introduced in Chapter 2. Resilience is the maintenance or recovery of well-being following exposure to adversity or risk (Bonanno, 2004; Mancini & Bonanno, 2010; Ryff et al., 1998). It is conceptualised in this thesis as a process that involves adversity, positive adaptation and protective factors (Harrop et al., 2007; Masten, 2001). The following discusses these three components of the resilience process as investigated in this chapter.

<u>Adversity</u>

Adversity is defined as a threat to individual functioning and development that could result in a negative outcome (Masten & Reed, 2005). For this study, adversity is operationalised as stressful life events and social deprivation. At T1, the stressful life events variable was the sum of all stressful events experienced in the year prior to the start of the study. At T2, the stressful life events variable was the sum of all stressful events experienced during the 13-week 'intervention' period between the T1 and T2 questionnaires. Social deprivation was measured as the tertile of the overall English Index of Multiple Deprivation (IMD) 2010. See Chapter 3 for more details on these variables.

Stressful life events can negatively affect one's health through physiological responses to stress (e.g. coritsol) or detrimental behavioural coping responses (e.g. drinking alcohol) (Cohen et al., 1997; Cohen, 2004). Prolonged exposure to stress can lead to physical or psychiatric disease (Cohen et al., 1997; Cohen, 2004). An accumulation of stressful life events is associated with greater perceived stress (Cohen, 2000), increased risk of common mental disorders (Jordanova et al., 2007; Kessler, 1997; Shevlin et al., 2007), higher psychological distress (Seery et al., 2010) and lower life satisfaction (Seery et al., 2010).

Social deprivation is one measure of social inequality in health and well-being (Siegrist & Marmot, 2006). Social inequalities in health address "the difference in power and resources that are related to socio-economic status" (Siegrist & Marmot, 2006, p. 4). In other words, as one moves up the social ladder the better their physical and mental health (Siegrist & Marmot, 2006). Low socio-economic status is a risk factor for physical and mental health (Friedli, 2009; Siegrist & Marmot, 2006). Marmot et al. (1997) found socio-economic status had a positive relationship with physical health and psychological well-being, and an inverse relationship with depression. Higher rates of income and socio-economic status are associated with higher levels of mental well-being and lower levels of mental ill health (Huppert, 2008).

Living in a deprived neighbourhood is associated with increased risk of poor well-being. Residents of the most deprived communities in Britain have the poorest physical health and well-being (HM Government, 2011; McManus et al., 2009). Living in a deprived neighbourhood is associated with an increased risk of premature mortality, over and above the effects of socio-economic status (van Lenthe, 2006). Ellaway et al. (2012) found that individuals living in the most deprived areas of western Scotland have ill health 16 years earlier in life than those living in the least deprived areas. In England, living in highly deprived area is associated with low psychological well-being (Shields & Price, 2005, p. 524).

Positive adaptation

Positive adaptation is identified as maintenance of functioning despite exposure to adversity, recovery of functioning following adversity, or similar functioning as others who have not experienced adversity (Harrop et al., 2007, p. 32). In adults, positive adaptation is generally assessed with self-report psychological measures of well-being or distress (Atkinson et al., 2009; Ryff et al., 1998; Seery et al., 2010; Steinhardt & Dolbier, 2008). In this study, positive adaptation is defined as having similar scores of well-being as others in the same cohort who have not experienced adversity. Statistically, this is manifest as a nonsignificant difference in well-being by adversity.

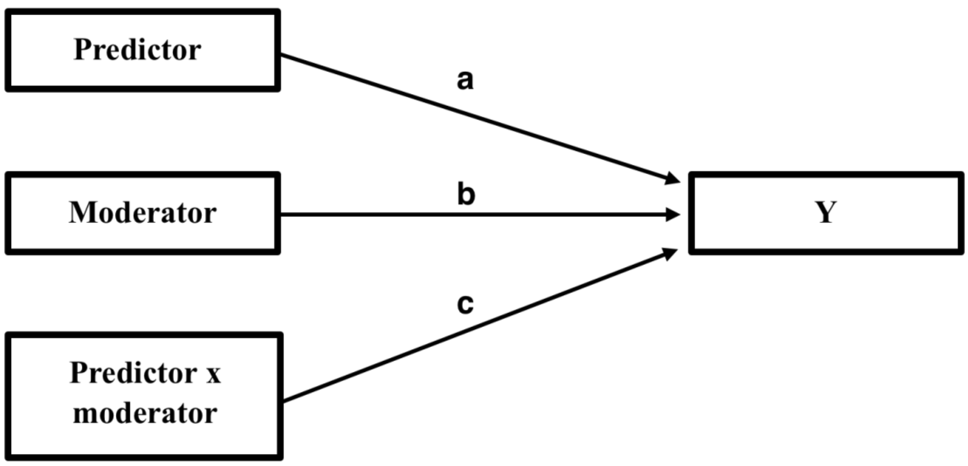
Protective factors

Protective factors weaken the effect of adversity on outcomes in order to make positive adaptation more likely (Werner, 1995; Yates & Masten, 2004). Protective factors are key to resilience research (Harrop et al., 2007); they identify interventions to encourage resilience in at-risk individuals. In adults, protective factors occur at three different levels: individual (e.g. personality characteristics), family (e.g. social support) and community (e.g. community organisations; public safety) (Harrop et al., 2007; Luthar et al., 2000; Zautra et al., 2010).

Interacting with natural environments has been mentioned as a potential protective factor in the resilience literature. Zautra and colleagues (2010) identified "green space and engaging in the natural environment through community gardening" (p. 10) as a community level protective factor. Wilderness camps were suggested as a resilience promoting intervention for children and adolescents (Masten & Reed, 2005). Wilderness experiences provide the opportunity for children and adolescents to master new skills and succeed at a task, such actions develop feelings of self-confidence and self-efficacy (Masten & Reed, 2005). Natural environments may also foster post-adversity growth by promoting hope or the belief that life has meaning (Masten & Wright, 2009).

Protective factors are often statistically analysed as moderators (Masten, 2001; Masten & Obradovic, 2006). A moderator changes the direction or strength of a relationship between the predictor variable and an outcome variable (Baron & Kenny, 1986). Figure 8.1 demonstrates a moderation model. Moderation effects are indicated by the interaction between the predictor and the moderator variables on the outcome variable (identified as path *c*). If the interaction term is significant, then moderation is considered to be present (Baron & Kenny, 1986).

Figure 8.1. Moderation model with paths *a*, *b* and *c*, as set out by Baron and Kenny (1986).



8.1.2 Theories of restorative environments

Many people seek out natural environments in time of stress (Stigsdotter et al., 2010), suggesting natural places could be a coping resource against stress or a protective factor against adversity. Section 2.2.3 presented two theories of restorative environments, which described how natural environments could affect well-being through the restoration of mental fatigue (Attention Restoration Theory) and the reduction of physiological stress responses (psycho-evolutionary model). Attention Restoration Theory (ART) posits natural environments contain stimuli that allow for the restoration from mental fatigue, which is the depletion of one's ability to direct attention (R. Kaplan & Kaplan, 1989). Mental fatigue can be a consequence of sustained psychological or physiological stress responses to an adverse event (S. Kaplan, 1995). According to this theory, the benefits of natural environments are clearing one's head, restoration of directed attention, thinking about life matters, and self-reflection (R. Kaplan & Kaplan, 1989). The psycho-evolutionary model posits that nature initiates an immediate emotional reaction, which subsequently affects one's physiological arousal, cognitive appraisal, affect and behaviour (Hartig & Evans, 1993; Ulrich, 1983). According to this theory, the benefits of nature are reduced negative affect and physiological arousal, and enhanced positive affect and attention (Ulrich et al., 1991).

8.1.3 Moderating effects of green space on adversity and well-being

If natural environments act as a protective factor, a moderating effect would mean that the natural environment would interact with adversity in order to weaken the impact of adversity on well-being. Previous researchers have investigated the positive effects of natural environments on mental and emotional well-being for individuals experiencing adversity. The following reviews the evidence of natural environments as a moderator (or buffer) between stressful life events or social deprivation and well-being.

Stressful life events

Eight research studies have investigated the protective effects of natural environments from stressful life events. Five of these studies explicitly examined moderating effects of natural environments on the relationship between stressful life events and well-being (Corraliza & Collado, 2011; Leather et al., 1998; Ottosson & Grahn, 2008; van den Berg et al., 2010; Wells & Evans, 2003). Wells and Evans (2003) found the amount of nature in and around the home moderated the effect of stressful life events on children's psychological distress and global self-worth. In other words, the effect of stressful life events on children's distress and self-worth varied by the amount of nature near the home. Corraliza and Collado (2011) found the amount of nature near a child's school moderated the impact of stressful life events on his or her perceived stress. The authors found "this positive effect of contact with the natural environment has a greater effect on those children that are most vulnerable" (Corraliza & Collado, 2011, p. 225). van den Berg et al. (2010) found the amount of green space within a 3-kilometre radius around the home moderated the impact of stressful life events on adult's perceived physical health. Adults who experienced a stressful life event, and lived within 3 km of a lot of green space, reported better physical health than individuals who lived in a less green environment. However, these authors (van den Berg et al., 2010) also found the amount of nature near the home did not moderate the effect of stressful life events on perceived mental health. In another study, a view from one's office window of nature (i.e. trees, plants, foliage) moderated the negative impact of job stress on intention to quit and (marginally) general well-being (Leather et al., 1998). Ottosson and Grahn (2008) found that the negative effects of a stressful life event on attention and mental health were weaker for individuals who often spent time looking at nature and wildlife (i.e. trees, clouds, water, squirrels, birds).

Whilst not explicitly testing the moderating effects of nature, the following four studies provide evidence that interacting with the natural environment can help individuals cope with stressful life events. Lechtzin et al. (2010) found cancer patients who viewed simulated nature scenes during bone marrow aspiration and biopsy reported significantly less pain, compared to a standard care group. Cimprich and Ronis (2003) found that women with breast cancer who engaged in nature-based activities three times per week for 20 minutes showed a significant improvement on directed attention tasks, compared to women in the standard care condition. Gardening has been found to reduce feelings of stress, negative affect, depression, and enhance feelings of relaxation and empowerment in victims of domestic violence (Stuart, 2005). A dose-response relationship was found between gardening and affect among female victims of domestic violence; women who spent six hours or more per week gardening experienced more therapeutic and positive feelings than women who spent three hours or less per week gardening (Stuart, 2005). Ottosson and Grahn (2008) found that walking in a natural environment was significantly and positively correlated with coping processes among individuals who were highly affected by a stressful life events.

Social deprivation

The moderating effects of nature near the home on social deprivation and well-being have been investigated by seven studies. In these studies, social deprivation was defined as low income (Kuo, 2001), education level (de Vries et al., 2003; Maas et al., 2006; Maas et al., 2009) or living in a deprived neighbourhood (Mitchell & Popham, 2007; Mitchell & Popham, 2008; Ward Thompson et al., 2012). Kuo (2001) found nature views from the home improved directed attention and the ability to manage life issues among low-income women. In other words, low-income women with nature views from the home coped better with adversity by taking more proactive control over their situation. The amount of green space around the home may reverse socio-inequalities in health (Maas et al., 2009; Mitchell & Popham, 2007; Mitchell & Popham, 2008). Living in a green environment was found to moderate the effect of low education on self-reported physical (de Vries et al., 2003; Maas et al., 2006), and mental health (de Vries et al., 2003). Among lower educated individuals, prevalence rates of disease decreased as the amount of green space within 1 km of the home increased (Maas et al., 2009). Mitchell and Popham (2007) found a positive relationship between green space and general physical health among individuals living in deprived urban and suburban areas. These same authors (Mitchell & Popham, 2008) found the amount of green space near the home moderated the effect of income deprivation on physical health. Social inequalities in physical health were weaker when people lived in the most green residential areas, compared to living in less green residential areas (Mitchell & Popham, 2008). Ward Thompson et al. (2012) found inverse relationship between green space near the home and stress, among individuals living in a high deprived area. The authors conclude, "those residing within areas of greater percentage green space appear to have been more resilient to the negative effects of urban deprivation and the stress-related consequences" (Ward Thompson et al., 2012, p. 227).

8.1.4 Study Focus and Hypotheses

As described above, the majority of the research on the moderating or buffering effects of natural environments has focused on the amount of nature around one's home or workplace. However, a similar limitation exists for studies of nature near the home or work: actual use of nearby nature is assumed, but not known (Mitchell & Popham, 2007; Mitchell & Popham, 2008; van den Berg et al., 2010). Actual use of the natural environment in relation to the resilience process has been investigated in three studies (Cimprich & Ronis, 2003; Ottosson & Grahn, 2008; Stuart, 2005), although, none analysed outdoor group walks as a potential moderator of adversity. To date, outdoor group walking has not been tested as a buffer from adversity. This chapter will address this research gap by investigating the buffering effects of group walk participation on the negative effects of adversity. It was hypothesised that outdoor group walk participation would attenuate the adverse effects of stressful life events or social deprivation on indicators of well-being. An attenuation interaction is when the relationships between the predictor and outcome are weaker at one level of the moderator than another level (Evans & Lepore, 1997).

Stressful life events hypotheses

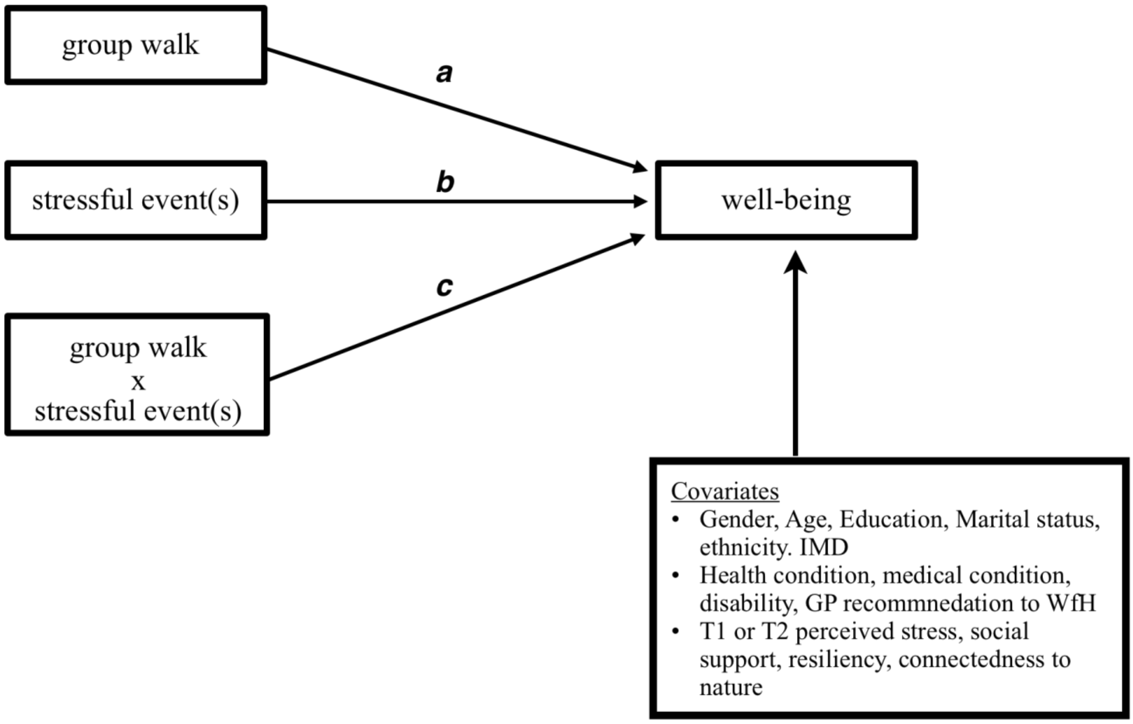
Figure 8.2 details the moderation of stressful life events on mental and emotional well-being by outdoor group walk participation. The hypotheses tested are:

Hypothesis 1. Group Walkers will be associated with higher levels of mental well-being and positive affect, and lower levels of negative affect and depression, compared to the Non-Group Walkers (path *a* in Figure 8.2).

Hypothesis 2. Greater stressful life events will be associated with lower levels of mental well-being and positive affect, and higher levels of negative affect and depression (path *b* in Figure 8.2).

Hypothesis 3. Outdoor group walk participation will interact with stressful life events to have a attenuating effect on the relationship between stressful life events and mental well-being, positive affect, negative affect, and depression (see path *c* in Figure 8.2).

Figure 8.2. Path diagram of stressful life events, group walk and the interaction of both on indicators of well-being.



Note. Covariates were drawn from the backwards stepwise regression (conducted in Chapter 6) for each outcome variable. Index of Multiple Deprivation (IMD), the other adversity variable, was also included as a covariate in these analyses.

Social deprivation hypotheses

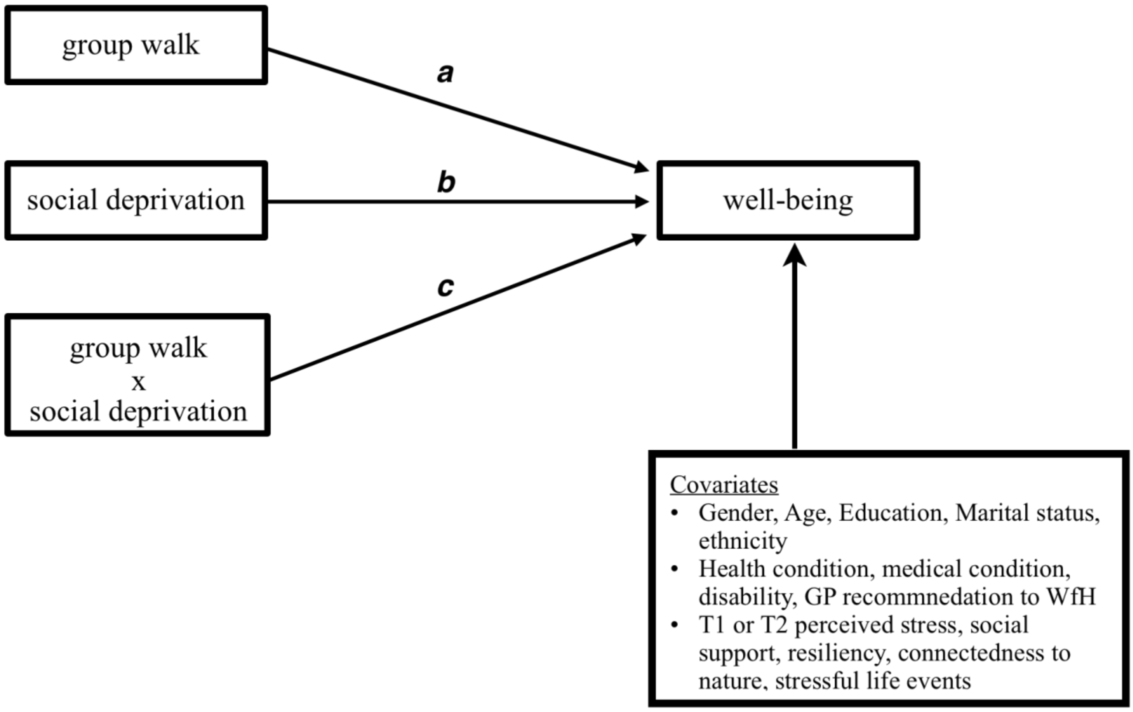
A number of hypotheses can be articulated for the moderation of social deprivation on mental and emotional well-being by outdoor group walk participation (see Figure 8.3). The hypotheses tested are:

Hypothesis 4. Group Walkers will be associated with higher levels of mental well-being and positive affect, and lower levels of negative affect and depression, compared to the Non-Group Walkers (see path *a* in Figure 8.3).

Hypothesis 5. A reduction in social deprivation will be associated with higher levels of mental well-being and positive affect, and lower levels of negative affect and depression (see path *b* in Figure 8.3).

Hypothesis 6. Outdoor group walk participation will interact with social deprivation to have an attenuating effect on the relationship between social deprivation and mental well-being, positive affect, negative affect, and depression (see path *c* in Figure 8.3).

Figure 8.3. Path diagram of social deprivation, group walk and the interaction of both on indicators of well-being.



Note. Covariates were drawn from the backwards stepwise regression (conducted in Chapter 6) for each outcome variable. Stressful life events, the other adversity variable, was also included as a covariate in these analyses.

8.2 Method

8.2.1 Participants and measures

Participants were the matched *as treated* sample comprised of 1,200 Group Walkers and 450 Non-Group Walkers (see Section 5.3.3).

The outcome variables in all analyses were T1 and T2 mental well-being, positive affect, negative affect and depression. The moderator variable in all analyses was outdoor group walk participation. Predictor variables of adversity were T1 and T2 stressful life events, and overall IMD tertile. Ordinal variables, like IMD tertile, can be treated as continuous "when the underlying scale is thought to be continuous" (Tabachnick & Fidell, 2013, p. 7). IMD tertiles have been used as a continuous variable in other regression analyses (Bell et al., 2012; Fraser et al., 2012; Steptoe et al., 2006). The measures used for this analysis are outlined in Chapter 3. Covariates of the outcome variable, identified in Chapter 6, were included in each analysis. In order to analyse the independent effect of a specific adversity variable on well-being (e.g. T1 stressful life events), the other adversity variable (e.g. IMD) was also controlled for in all analyses.

8.2.2 Statistical analyses

All analyses were weighted by 'psweight' (see Chapter 5). Pearson correlations analysed the relationships between T1 and T2 outcome variables, both adversity variables, and the mediator[46]. This analysis details the significant relationships between well-being, adversity and group walk participation.

Moderated multiple regression was used for all moderation analyses. Multiple regression was used rather than ANCOVA as the former could accommodate the propensity score matching sampling weights[47], and retain the continuous predictor variables. Multiple regression is the preferred analysis method with a continuous predictor variable and a categorical moderator (Evans & Lepore, 1997, p. 274).

The procedure for a moderation analysis with multiple regression involves two main steps: 1) centring all continuous variables and; 2) computing an interaction term between the predictor variable and the moderator (Miles & Shevlin, 2001, p. 176). Both moderation analyses – stress buffering and deprivation buffering – followed the same two steps. Centring variables creates a meaningful value of zero for the regression coefficients (Aiken & West, 1991, p. 38), and reduces the correlation between the predictor variable and interaction term (Evans & Lepore, 1997; Tabachnick & Fidell,

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[46] Correlations of group walk participation and the outcome variables were conducted with point-biserial correlations.
[47] ANCOVA analyses are conducted in SPSS through the General Linear Model (GLM) (Field, 2009). SPSS GLM will round a propensity score sampling weight to the nearest whole number, thus omitting the sampling weights (IBM, 2012, Maletta, 2007, UCLA: Statistical Consulting Group, 2013).

2013). All continuous covariates and predictor variables were centred round the mean[48]. Dichotomous covariate variables (0/1) remained as coded. Education tertile was recoded[49]. Outdoor group walk participation was recoded using orthogonal contrast codes (-1 = Non-Group walker; 1 = Group Walker), as recommended by Tabachnick and Fidell (2013); this reduced multicollinearity with the interaction term. An interaction term was computed in both sets of analyses by multiplying the contrast coded outdoor group walk participation variable by the centred predictor variable (e.g. group walk participation * centred T1 stressful life events) (Evans & Lepore, 1997; Hoyle & Robinson, 2004; Miles & Shevlin, 2001).

The entry of variables for the stressful life events and social deprivation moderation analyses are illustrated in Figures 8.4 and 8.5, respectively. Entry of variables was identical to previous research (Hawkins, 2012; Wells & Evans, 2003). Regression analyses were run separately for each outcome variable. Listwise deletion was applied in all analyses.

Figure 8.4 details the entry of variables for the stressful life events moderation analyses with T1 variables. Covariates of the outcome variable and the other adversity variable (i.e. IMD) were entered in the first step. The moderator variable – outdoor group walk participation – was entered in the second step. The centred predictor variable – log-transformed Time 1 stressful life events – was entered in third step. The interaction term was entered in Step 4. The same procedure was performed with T2 variables.

[48] Centring involves subtracting the mean score of a continuous variable from each participant's score on that variable ($X - M$), so the mean score of the predictor variable was zero (Aiken & West, 1991, p. 37).
[49] The lowest category 'No education' was recoded from 1 to 0. The 'secondary education' category was recoded to 1. The 'tertiary education' category was recoded as 2.

Figure 8.4. Flow chart steps for Time 1 stressful life events moderation analyses.

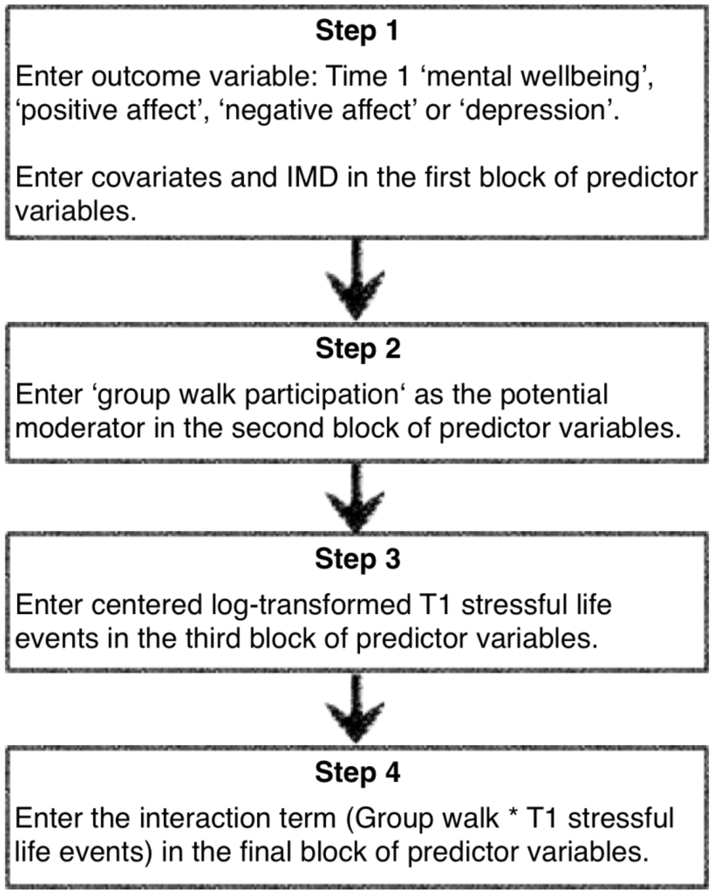
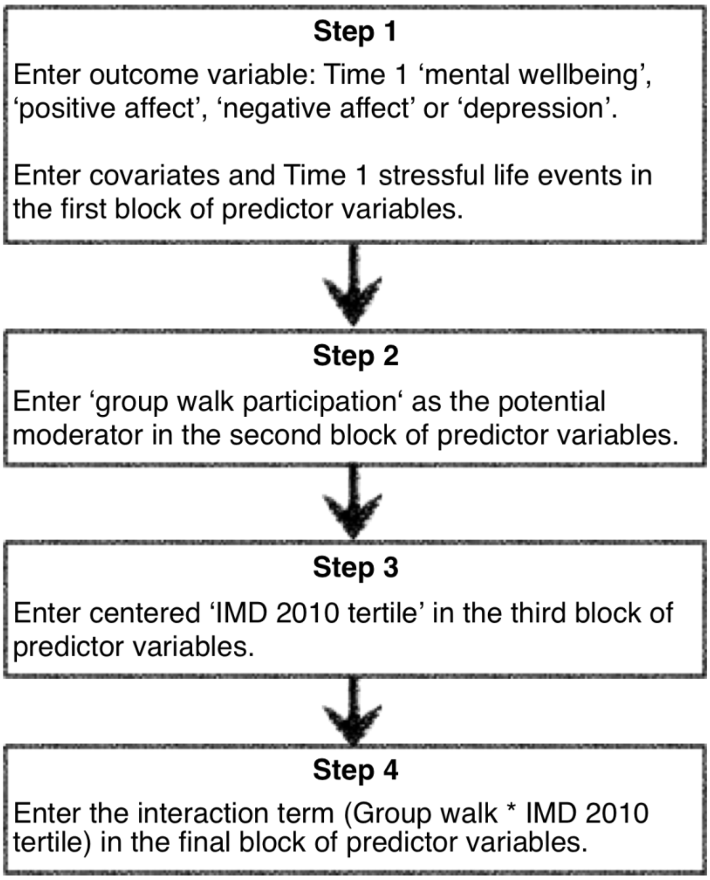


Figure 8.5 details the entry of variables for the social deprivation moderation analyses with T1 variables. The same procedure was performed with T2 variables. Covariates of the outcome variable, and the other adversity variable (i.e. stressful life events) were entered in the first step. The moderator variable – outdoor group walk participation – was entered in the second step. The centred predictor variable – IMD 2010 tertile – was entered in step 3. The interaction term was entered in Step 4.

Figure 8.5. Flow chart steps for Time 1 social deprivation moderation analyses.



Significant interactions were plotted and further analysed by simple slopes (Tabachnick & Fidell, 2013). Graphs of any interactions were created by solving the regression equation for one standard deviation above and below the mean of the centred predictor variable (Tabachnick & Fidell, 2013, p. 159). Simple slopes analysis involved splitting the dataset by matched *as treated* group and analysing the simple regression of the outcome variable on the predictor variable (Aiken & West, 1991; Tabachnick & Fidell, 2013).

8.3 Results

8.3.1 Correlation analyses

Table 8.1 presents the correlations between the adversity and moderator variables with all outcome variables. Greater stressful life events were significantly correlated with lower levels of mental well-being and positive affect, and higher levels of depression and negative affect. These results support Hypothesis 2. Hypothesis 5 found some support; overall IMD tertile was significantly correlated with T1 and T2 depression and negative affect only, indicating that depression and negative affect decreased as the level of social deprivation also decreased. The moderator, outdoor group walk participation, was significantly correlated with higher levels of mental well-being and positive affect, and lower levels of negative affect and depression. Thus, support was also found for Hypotheses 1 and 4.

Table 8.1. Pearson product correlations of outcome variables with adversity predictors and moderator group walk participation.

Variables	T1 Mental well-being	T2 Mental well-being	T1 Positive affect	T2 Positive affect	T1 Negative affect^	T2 Negative affect^	T1 Depression^	T2 Depression^
T1 Stressful life events^	-.16***	-.12***	-.10***	-.09***	.20***	.12***	.22***	.14***
T2 Stressful life events^	-.07**	-.08**	-.03	-.07**	.13***	.21***	.11***	.19***
IMD tertile	.006	.03	.02	.02	-.08**	-.07**	-.05*	-.05*
Group Walk†	.09***	.11***	.07**	.16***	-.16***	-.14***	-.14***	-.17***

Note. Matched *as treated* sample; analysis weighted by propensity score weight.

Higher scores indicate greater stressful life events.

IMD: 0 = Most deprived, 1 = Average deprivation, 2 = Least deprived.

Group Walk: -1 = *matched* Non-Group Walkers, 1 = *matched* Group Walkers.

^ = log-transformed variable.

† Point-biserial correlations were conducted between group walk participation and the outcome variables.

* $p < .05$.** $p < .01$. *** $p < .001$.

8.3.2 *Stressful life events*

The results of the moderated multiple regressions for each outcome variable are presented below. For simplicity, only the coefficients for the final step of the model are shown for each regression. The Adjusted R^2 and R^2 change values for each step of the model are presented adjacent to the last variable entered at that step. Moderated multiple regression results from both T1 and T2 outcome variables are presented in the same table. Unstandardised regression coefficients[50] (*B*) are reported, as recommended in the literature (Baron & Kenny, 1986; Tabachnick & Fidell, 2013, p. 159).

<u>Group walk as a moderator of stressful life events on mental well-being</u>

The results of the stressful life events moderation analyses for T1 and T2 mental well-being are presented in Table 8.2. Participating in an outdoor walking group had a significant main effect for T1 mental well-being ($B = 0.35$ $p = .01$), supporting Hypothesis 1. T1 stressful life events was not a significant predictor of T1 mental well-being ($B = -0.60$, $p = .34$), nor was the interaction term ($B = -0.90$, $p = .14$), indicating that both Hypotheses 2 and 3 were not supported.

Outdoor group walk participation was not a significant predictor of T2 mental well-being ($B = 0.14$, $p = .31$). Contrary to expectations and the correlation in Table 8.1, there was a significant positive relationship between T2 stressful life events and T2 mental well-being ($B = 1.38$, $p = .04$); suggesting that after controlling for T1 mental well-being and other covariates, participants who experienced a recent stressful life event demonstrated greater mental well-being. This is contrary to Hypothesis 2. The interaction term was nonsignificant ($B = 0.18$, $p = .79$); Hypothesis 3 was not supported.

[50] Due to centring the predictor and moderator variables, the unstandardised regression coefficients, *B*, are actually standardised regression coefficients, β (Tabachnick & Fidell, 2013, p. 159).

Table 8.2. Final step for moderation analyses between stressful life events and group walk participation on T1 and T2 mental well-being.

Predictor	*B*	Step 4 SE	*p*	Adj R^2 †	Δ R^2
		DV: T1 Mental Well-being			
Constant	50.93	0.41	< .001		
Age	0.92	0.38	.02		
Marital Status	0.83	0.28	.003		
T1 Perceived Stress	-0.65	0.03	< .001		
T1 Resiliency	0.36	0.03	< .001		
T1 Social Support	0.27	0.02	< .001		
T1 Connectedness to nature	0.13	0.02	< .001		
IMD	-0.23	0.18	.21	.632***	
Group Walk	0.35	0.14	.01	.633***	.001*
T1 Stressful life events^	-0.60	0.62	.34	.633***	.001
Group walk * T1 stressful life	-0.90	0.60	.14	.634***	.000
		DV: T2 Mental Well-being			
Constant	51.82	0.23	< .001		
Sex	-0.79	0.26	.002		
Marital Status	1.03	0.27	< .001		
T1 Mental Well-being	0.30	0.02	< .001		
T2 Physical Activity	0.27	0.07	< .001		
T2 Perceived Stress	-0.42	0.03	< .001		
T2 Resiliency	0.22	0.03	< .001		
T2 Social Support	0.07	0.02	.001		
T2 Connectedness to nature	0.06	0.02	< .001		
IMD	0.16	0.17	.34	.627***	
Group Walk	0.14	0.14	.31	.628***	.000
T2 Stressful life events^	1.38	0.68	.04	.629***	.001*
Group walk * T2 Stressful life	0.18	0.66	.79	.629***	.000

Note. Matched *as treated* sample; analysis weighted by propensity score weight. All continuous variables were centred. *B* = Unstandardised regression coefficient. Age: 0 is 18-54 years old, 1 = 55 years or older. Marital status: 0 = unpartnered (single, widowed, divorced), 1 = partnered (cohabiting, married, civil partnered). Sex: 0 = woman; 1 = man. Group Walk: -1 = *matched* Non-Group Walkers, 1 = *matched* Group Walkers. Higher scores indicate greater: perceived stress, resiliency, social support, connection to nature, physical activity and mental well-being. Higher IMD scores indicate less deprivation. †Adjusted R^2 and Δ R^2 for each step of the model are presented adjacent to the last variable entered at each step. ^ = log-transformed variable. * $p < .05$. *** $p < .001$.

<u>Group walk as a moderator of stressful life events on positive affect</u>

The results of the stressful life events moderation analyses for T1 and T2 positive affect are presented in Table 8.3. For T1 positive affect, neither outdoor group walk participation ($B = 0.25$, $p = .11$) nor T1 stressful life events ($B = -0.11$, $p = .87$) were significant predictors, after controlling for covariates. The interaction term was also nonsignificant ($B = -0.88$, $p =. 18$). Hypotheses 1, 2 and 3 was not supported for T1 positive affect.

Participating in a outdoor walking group had a significant main effect for T2 positive affect (B = 0.60, p < .001), supporting Hypothesis 1. Stressful life events were not a significant predictor of positive affect at T2 (B = 0.81, p =.23), nor was the interaction term (B = -1.04, p = .11), indicating that both Hypotheses 2 and 3 were not supported.

Table 8.3. Final step for moderation analyses between stressful life events and group walk participation on T1 and T2 positive affect.

	Step 4				
Variable	***B***	**SE**	***p***	**Adj R^2 †**	**ΔR^2**
	DV: T1 Positive Affect				
Constant	32.83	0.41	< .001		
Marital Status	0.64	0.30	.03		
Education	0.54	0.23	.02		
T1 Frequency of non-group walks	0.22	0.08	.003		
T1 Perceived Stress	-0.34	0.03	< .001		
T1 Resiliency	0.36	0.03	< .001		
T1 Social Support	0.18	0.02	< .001		
T1 Connectedness to nature	0.15	0.02	< .001		
IMD	0.13	0.20	.52	.425***	
Group Walk	0.25	0.16	.11	.425***	.001
T1 Stressful life events^	-0.11	0.67	.87	.425***	.000
Group walk * T1 stressful life events^	-0.88	0.65	.18	.426***	.001
	DV: T2 Positive Affect				
Constant	33.16	0.22	< .001		
Marital Status	0.77	0.26	.003		
T1 Positive Affect	0.39	0.02	< .001		
T2 Physical Activity	0.45	0.06	< .001		
T2 Perceived Stress	-0.29	0.02	< .001		
T2 Resiliency	0.19	0.03	< .001		
T2 Social Support	0.05	0.02	.02		
T2 Connectedness to nature	0.08	0.02	< .001		
IMD	0.04	0.17	.83	.582***	
Group Walk	0.60	0.13	< .001	.587***	.005***
T2 Stressful life events^	0.81	0.67	.23	.587***	.000
Group walk * T2 stressful life events^	-1.04	0.65	.11	.587***	.001

Note. Matched *as treated* sample; analysis weighted by propensity score weight. All continuous variables were centred. B = Unstandardised regression coefficient. Marital status: 0 = unpartnered (single, widowed, divorced), 1 = partnered (cohabiting, married, civil partnered). Education: 0 = No qualifications, 1 = lower, upper or post-secondary education, 2 = Tertiary education. Group Walk: -1 = *matched* Non-Group Walkers, 1 = *matched* Group Walkers. Higher scores indicate greater: frequency of non-group walks, perceived stress, resiliency, social support, connection to nature, physical activity, positive affect and stressful life events. Higher IMD scores indicate less deprivation. †Adjusted R^2 and ΔR^2 for each step of the model are presented adjacent to the last variable entered at each step. ^ = log-transformed variable. * p < .05. *** p < .001.

Group walk as a moderator of stressful life events on negative affect

The results of the stressful life events moderation analyses for T1 and T2 negative affect are presented in Table 8.4. Outdoor group walk participation had a significant main effect on T1 log-transformed negative affect (B = -0.014, p < .001), supporting Hypothesis 1. Hypothesis 2 was also supported; stressful life events had a significant predictive effect on T1 log-transformed negative affect (B = 0.042, p < .001). There was a significant interaction between outdoor group walk participation and T1 stressful life events on T1 log-transformed negative affect (B = -0.03, p = .01), indicating Hypothesis 3 was supported.

Table 8.4. Final step for moderation analyses between stressful life events and group walk participation on T1 and T2 negative stress.

	Step 4				
Variable	***B***	**SE**	***p***	**Adj R^2 †**	**Δ R^2**
	DV: T1 Negative Affect^				
Constant	1.161	0.006	< .001		
Education	0.009	0.004	.03		
T1 Perceived Stress	0.013	0.000	< .001		
T1 Resiliency	-0.001	0.000	.002		
T1 Social Support	-0.001	0.000	.02		
IMD	-0.009	0.003	.01	.475***	
Group Walk	-0.014	0.003	< .001	.483***	.008***
T1 Stressful life events^	0.042	0.012	< .001	.484***	.002**
Group walk * T1 stressful life events^	-0.030	0.011	.01	.486***	.002**
	DV: T2 Negative Affect^				
Constant	1.145	0.006	< .001		
Marital status	-0.009	0.004	.04		
Education	0.009	0.003	.01		
T1 Negative Affect^	0.321	0.019	< .001		
T2 Perceived Stress	0.011	0.000	< .001		
IMD	-0.005	0.003	.12	.605***	
Group Walk	0.000	0.002	.92	.605***	.000
T2 Stressful life events^	0.036	0.012	.002	.607***	.003**
Group walk * T2 stressful life events^	-0.003	0.011	.79	.607***	.000

Note. Matched *as treated* sample; analysis weighted by propensity score weight. All continuous variables were centred. B = Unstandardised regression coefficient. Education: 0 = No qualifications, 1 = lower, upper or post- Secondary education, 2 = Tertiary education. IMD: 0 = Most deprived, 1 = Average deprivation, 2 = Least deprived. Marital status: 0 = unpartnered (single, widowed, divorced), 1 = partnered (cohabiting, married, civil partnered). Group Walk: -1 = *matched* Non-Group Walkers, 1 = *matched* Group Walkers. Higher scores indicate greater perceived stress, resiliency, social support, connection to nature, negative affect and stressful life events. Higher IMD scores indicate less deprivation. †Adjusted R^2 and Δ R^2 for each step of the model are presented adjacent to the last variable entered at each step. ^ = log-transformed variable. * p < .05. ** p < .01.*** p < .001.

Figure 8.6 illustrates an attenuated interaction (Evans & Lepore, 1997) in which the positive relationship between stressful life events in the past year and T1 log-transformed negative affect was weaker for Group Walkers than Non-Group Walkers. In order to discern which matched *as treated* group was significantly different from zero, simple slopes analysis of the effect of T1 stressful life events on T1 log-transformed negative affect were conducted (Aiken & West, 1991). For Non-Group Walkers, T1 stressful life events were a significant predictor of T1 negative affect (B = 0.06, p = .004), after controlling for significant covariates, $\Delta R^2 = .008$, F_{inc} (1,443) = 8.26, p = .004. The results indicate Non-Group Walkers demonstrated a positive association between greater stressful life events and negative affect. In contrast, for Group Walkers, T1 stressful life events were a nonsignificant predictor of T1 negative affect (B = 0.02, p = .16), after controlling for significant covariates, $\Delta R^2 = .001$, F_{inc} (1,1193) = 2.02, p =.16. Group Walkers show evidence of positive adaptation or resilience, in that those who experienced more stressful life events had similar levels of negative affect as those who experienced fewer stressful life events.

Figure 8.6. Moderation of T1 log-10 stressful life events on T1 log-10 negative affect by group walk participation.

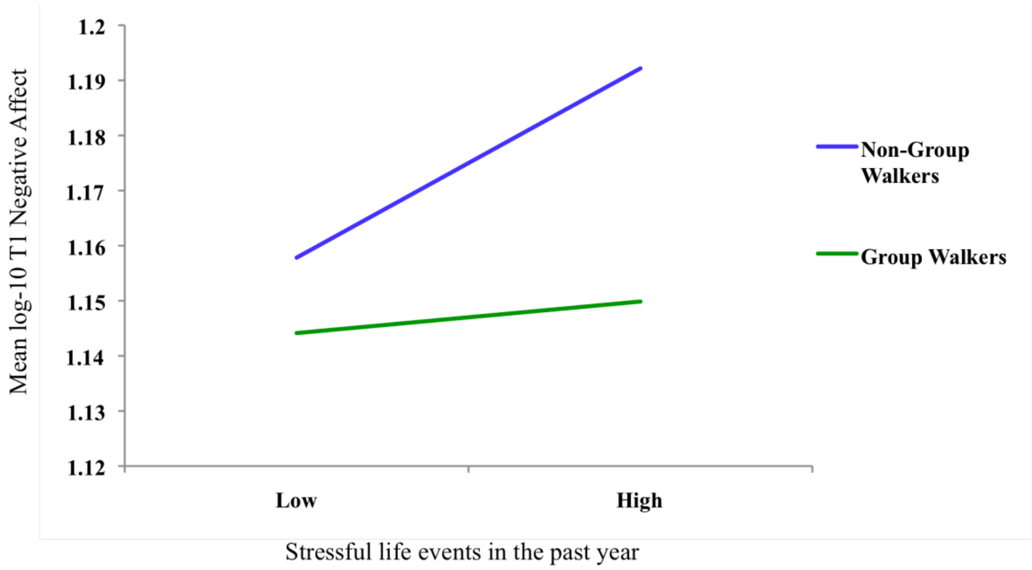


Table 8.4 shows that outdoor group walk participation ($B = 0.000$, $p = .92$) was a nonsignificant predictor of T2 negative affect. Recent stressful life events was a significant predictor of T2 negative affect ($B = 0.036$, $p = .002$), supporting Hypothesis 2. There was no evidence of an interaction ($B = -0.003$, $p = .79$); Hypothesis 3 was not supported.

Group walk as a moderator of stressful life events on depression

The results of the stressful life events moderation analyses for T1 and T2 depression are presented in Table 8.5. Hypothesis 1 was supported; outdoor group walk participation had a significant negative association on T1 log-transformed depression ($B = -0.027$, $p < .001$); Hypothesis 2 was also supported; stressful life events in the past year was significantly positively associated with log-transformed T1 depression ($B = 0.137$, $p < .001$). The interaction term, however, was nonsignificant ($B = -0.045$, $p = .13$).

For T2 depression, outdoor group walk participation was a significant predictor ($B = -0.014$, $p = .02$), supporting Hypothesis 1. T2 log-10 stressful life events was not a significant predictor of T2 depression ($B = 0.05$, $p = .09$), nor was the interaction term ($B = 0.029$, $p = .32$), indicating that Hypotheses 2 and 3 were not supported.

Table 8.5. Final step for moderation analyses between stressful life events and group walk participation on T1 and T2 depression.

Variable	Step 4 *B*	SE	*p*	Adj R^2 †	Δ R^2
	DV: T1 Depression^				
Constant	0.816	0.008	< .001		
Disability	0.050	0.023	.03		
Health Condition	0.034	0.017	.04		
T1 Perceived Stress	0.029	0.001	< .001		
T1 Resiliency	-0.005	0.001	< .001		
T1 Social Support	-0.007	0.001	< .001		
IMD	-0.009	0.009	.31	.449***	
Group Walk	-0.027	0.007	< .001	.454***	.005***
T1 Stressful life events^	0.137	0.031	< .001	.459***	.006***
Group walk * T1 Stressful life events^	-0.045	0.030	.13	.460***	.001
	DV: T2 Depression^				
Constant	0.780	0.014	< .001		
Education	0.021	0.009	.02		
GP referral to WfH	0.070	0.021	.001		
T1 Depression^	0.340	0.019	< .001		
T2 Physical Activity	-0.010	0.003	< .001		
T2 Perceived Stress	0.024	0.001	< .001		
IMD	-0.006	0.008	.41	.581***	
Group Walk	-0.014	0.006	.02	.582***	.001*
T2 Stressful life events^	0.051	0.030	.09	.583***	.001*
Group walk * T2 stressful life events^	0.029	0.029	.32	.583***	.000

Note. Matched *as treated* sample; analysis weighted by propensity score weight. All continuous variables were centred. *B* = Unstandardised regression coefficient. Disability: 0 = No 1 = Yes. Health Condition: 0 = No health condition 1= One or more health conditions. Education: 0 = No qualifications, 1 = lower, upper or post- Secondary education, 2 = Tertiary education. GP referral to WfH: 0 = No GP referral, 1 = Yes, referred by GP to WfH. Group Walk: -1 = *matched* Non-Group Walkers, 1 = *matched* Group Walkers. Higher scores indicate greater: perceived stress, resiliency, social support, physical activity, depression and stressful life events. Higher IMD scores indicate less deprivation. †Adjusted R^2 and Δ R^2 for each step of the model are presented adjacent to the last variable entered at each step. ^ = log-transformed variable. * $p < .05$. *** $p < .001$.

8.3.3 Social Deprivation

The results of the moderated multiple regressions for social deprivation are presented below. For simplicity, only the coefficients for the final step of the model are shown for each regression. The Adjusted R^2 and R^2 change values for each step of the model are presented adjacent to the last variable entered at that step. Moderated multiple regression results from both T1 and T2 outcome variables are presented in the same table. Unstandardised regression coefficients (*B*) are reported, as recommended in the literature (Baron & Kenny, 1986; Tabachnick & Fidell, 2013, p. 159).

Group walk as a moderator of IMD on mental well-being

The results of the social deprivation moderation hypotheses for T1 and T2 mental well-being are presented in Table 8.6. Outdoor group walk participation was significantly positively associated with T1 mental well-being ($B = 0.35$, $p = .02$), supporting Hypothesis 4. IMD tertile was a not a significant predictor of T1 mental well-being ($B = -0.27$, $p = .20$), nor was the interaction term ($B = 0.09$, p = .66), indicating that both Hypotheses 4 and 5 were not supported for T1 mental well-being.

Outdoor group walk participation was a nonsignificant predictor of T2 mental well-being ($B = 0.14$, $p = .31$). IMD was not a significant predictor of T2 mental well-being ($B = 0.20$, $p = .30$), nor was the interaction term ($B = -0.08$, $p = .68$). Hypotheses 4, 5 and 6 were not supported for T2 mental well-being.

Table 8.6. Final step for moderation analyses between IMD tertile and group walk participation on T1 and T2 mental well-being

	Step 4				
Variable	***B***	**SE**	***p***	**R^2 †**	**ΔR^2**
	DV: T1 Mental Well-being				
Constant	50.94	0.42	< .001		
Age	0.93	0.38	.02		
Marital Status	0.82	0.28	.003		
T1 Perceived Stress	-0.65	0.03	< .001		
T1 Resiliency	0.36	0.03	< .001		
T1 Social Support	0.27	0.02	< .001		
T1 Connectedness to nature	0.13	0.02	< .001		
T1 Stressful life events^	-1.03	0.55	.06	.632***	
Group Walk	0.35	0.14	.02	.633***	.001*
IMD tertile	-0.27	0.21	.20	.633***	.000
Group walk * IMD tertile	0.09	0.20	.66	.633***	.000
	DV: T2 Mental Well-being				
Constant	51.82	0.23	< .001		
Sex	-0.80	0.26	.002		
Marital Status	1.03	0.27	< .001		
T1 Mental Well-being	0.30	0.02	< .001		
T2 Physical Activity	0.27	0.07	< .001		
T2 Perceived Stress	-0.42	0.03	< .001		
T2 Resiliency	0.22	0.03	< .001		
T2 Social Support	0.07	0.02	.001		
T2 Connectedness to nature	0.06	0.02	< .001		
T2 Stressful life events^	1.46	0.61	.02	.627***	
Group Walk	0.14	0.14	.31	.627***	.000
IMD	0.20	0.19	.30	.627***	.000
Group walk * IMD	-0.08	0.19	.68	.626***	.000

Note. Matched *as treated* sample; analysis weighted by propensity score weight. All continuous variables were centred. *B* = Unstandardised regression coefficient. Age: 0 is 18-54 years old, 1 = 55 years or older. Sex: 0 = Woman, 1 =Man. Marital status: 0 = unpartnered (single, widowed, divorced), 1 = partnered (cohabitating, married, civil partnered). Group Walk: -1 = *matched* Non-Group Walkers, 1 = *matched* Group Walkers. Higher scores indicate greater: perceived stress, resiliency, social support, connection to nature, physical activity and mental well-being. Higher IMD scores indicate less deprivation. †Adjusted R^2 and ΔR^2 for each step of the model are presented adjacent to the last variable entered at each step. ^ = log-transformed variable. * $p < .05$. *** $p < .001$.

<u>Group walk as a moderator of IMD on positive affect</u>

The results of the social deprivation moderator hypotheses for T1 and T2 positive affect are presented in Table 8.7. Outdoor group walk participation ($B = 0.24$, $p = .12$) and IMD ($B = 0.04$, $p = .88$) were not significant predictors of T1 positive affect, over and above the covariates. The interaction term was also nonsignificant ($B = 0.21$, $p = .33$). Hypotheses 4, 5 and 6 were not supported for T1 positive affect.

Outdoor group walk participation was significantly positively associated on T2 positive affect (*B* = 0.59, $p < .001$), over and above the covariates; Hypothesis 4 was supported. IMD tertile was a not a significant predictor of T2 positive affect (*B* = -0.05, $p = .79$), nor was the interaction term (*B* = -.19, $p = .31$). Hypotheses 5 and 6 were not supported for T2 positive affect.

Table 8.7. Final step for moderation analyses between IMD tertile and group walk participation on T1 and T2 positive affect.

	Step 4				
Variable	***B***	**SE**	***p***	**Adj R^2 †**	**Δ R^2**
	DV: T1 Positive Affect				
Constant	32.83	0.41	< .001		
Marital Status	0.64	0.30	.03		
Education	0.55	0.22	.01		
T1 Frequency non-group walks	0.22	0.08	.003		
T1 Perceived Stress	-0.34	0.03	< .001		
T1 Resiliency	0.36	0.03	< .001		
T1 Social Support	0.18	0.02	< .001		
T1 Connectedness to nature	0.15	0.02	< .001		
T1 Stressful life events^	-0.53	0.59	.37	.425***	
Group Walk	0.24	0.16	.12	.426***	.001
IMD	0.04	0.22	.88	.425***	.000
Group walk * IMD	0.21	0.22	.33	.425***	.000
	DV: T2 Positive Affect				
Constant	33.16	0.22	< .001		
Marital Status	0.78	0.26	.002		
T1 Positive affect	0.39	0.02	< .001		
T2 Physical Activity	0.46	0.06	< .001		
T2 Perceived Stress	-0.29	0.02	< .001		
T2 Resiliency	0.19	0.03	< .001		
T2 Social Support	0.05	0.02	.02		
T2 Connectedness to nature	0.07	0.02	< .001		
T2 Stressful life events^	0.35	0.60	.56	.582***	
Group Walk	0.59	0.13	< .001	.587***	.005***
IMD	-0.05	0.19	.79	.587***	.000
Group walk * IMD	0.19	0.19	.31	.587***	.000

Note. Matched *as treated* sample; analysis weighted by propensity score weight. All continuous variables were centred. *B* = Unstandardised regression coefficient. Marital status: 0 = unpartnered (single, widowed, divorced), 1 = partnered (cohabitating, married, civil partnered). Education: 0 = No qualifications, 1 = lower, upper or post-secondary education, 2 = Tertiary education. Group Walk: -1 = *matched* Non-Group Walkers, 1 = *matched* Group Walkers. Higher scores indicate greater: frequency of non-group walks, perceived stress, resiliency, social support, connection to nature, physical activity, positive affect and stressful life events. Higher IMD scores indicate less deprivation. †Adjusted R^2 and Δ R^2 for each step of the model are presented adjacent to the last variable entered at each step. ^ = log-transformed variable. * $p < .05$. *** $p < .001$.

Group walk as a moderator of IMD on negative affect

The results of the social deprivation moderator hypotheses for T1 and T2 negative affect are presented in Table 8.8. There was a significant negative association of outdoor group walk participation on T1 log-transformed negative affect (B = -0.014, p < .001), supporting Hypothesis 4. Hypothesis 5 was also supported; IMD tertile was a significant predictor of Time 1 log-transformed negative affect (B = -0.012, p = .001), indicating a decrease of .012 in log-transformed negative affect as deprivation decreases by one tertile. The interaction term was marginally significant (B = 0.007, p = .054), partially supporting Hypothesis 6.

Table 8.8. Final step for moderation analyses of IMD tertile and group walk participation on T1 and T2 negative affect

Variable	Step 4 *B*	SE	*p*	Adj R^2 †	Δ R^2
DV: T1 Negative Affect^					
Constant	1.161	0.006	< .001		
Education	0.009	0.004	.02		
T1 Perceived Stress	0.013	0.000	< .001		
T1 Resiliency	-0.001	0.000	.002		
T1 Social Support	-0.001	0.000	.02		
T1 Stressful life events	0.028	0.010	.007	.475***	
Group Walk	-0.014	0.003	< .001	.483***	.008***
IMD	-0.012	0.004	.001	.484***	.002**
Group walk * IMD	0.007	0.004	.054	.485***	.001
DV: T2 Negative Affect^					
Constant	1.145	0.006	< .001		
Marital status	-0.009	0.004	.04		
Education	0.009	0.003	.01		
T1 Negative Affect^	0.320	0.019	< .001		
T2 Perceived Stress	0.011	0.000	< .001		
T2 Stressful life events	0.034	0.010	.001	.607***	
Group Walk	0.000	0.002	.93	.607***	.000
IMD	-0.006	0.003	.10	.607***	.001
Group walk * IMD	0.002	0.003	.54	.607***	.000

Note. Matched *as treated* sample; analysis weighted by propensity score weight. All continuous variables were centred. B = Unstandardised regression coefficient. Education: 0 = No qualifications, 1 = lower, upper or post- Secondary education, 2 = Tertiary education. Marital status: 0 = unpartnered (single, widowed, divorced), 1 = partnered (cohabitating, married, civil partnered). Group Walk: -1 = *matched* Non-Group Walkers, 1 = *matched* Group Walkers. Higher scores indicate greater: perceived stress, resiliency, social support, negative affect and stressful life events. Higher IMD scores indicate less deprivation. †Adjusted R^2 and Δ R^2 for each step of the model are presented adjacent to the last variable entered at each step. ^ = log-transformed variable. * p < .05. *** p < .001.

Figure 8.7 illustrates the marginally significant interaction. Non-Group Walkers demonstrated a social gradient in negative affect, in that as one moves up the social ladder to live in a less deprived area, the less negative affect they experience. Group Walkers on the other hand did not show as steep a social gradient in negative affect, indicating less change in negative affect as social deprivation decreases. In order to discern which matched *as treated* group significantly differed from zero, simple slopes analysis of the effect of IMD on T1 log-transformed negative affect were conducted (Aiken & West, 1991). For Non-Group Walkers, IMD was a significant predictor of T1 negative affect (B = -0.02, p = .01), after controlling for significant covariates, ΔR^2 = .006, F_{inc} (1,443) = 6.35, p = .01. For Group Walkers, IMD was a nonsignificant predictor of T1 negative affect (B = -0.006, p = .16), after controlling for significant covariates, ΔR^2 = .001, F_{inc} (1,1193) = 1.95, p = .16. The social gradient in negative affect was attenuated for Group Walkers - negative affect scores were similar irrespective of social deprivation level. The findings indicate positive adaptation, or resilience, for Group Walkers.

Figure 8.7. Moderation of IMD on T2 log-10 negative affect by group walk participation.

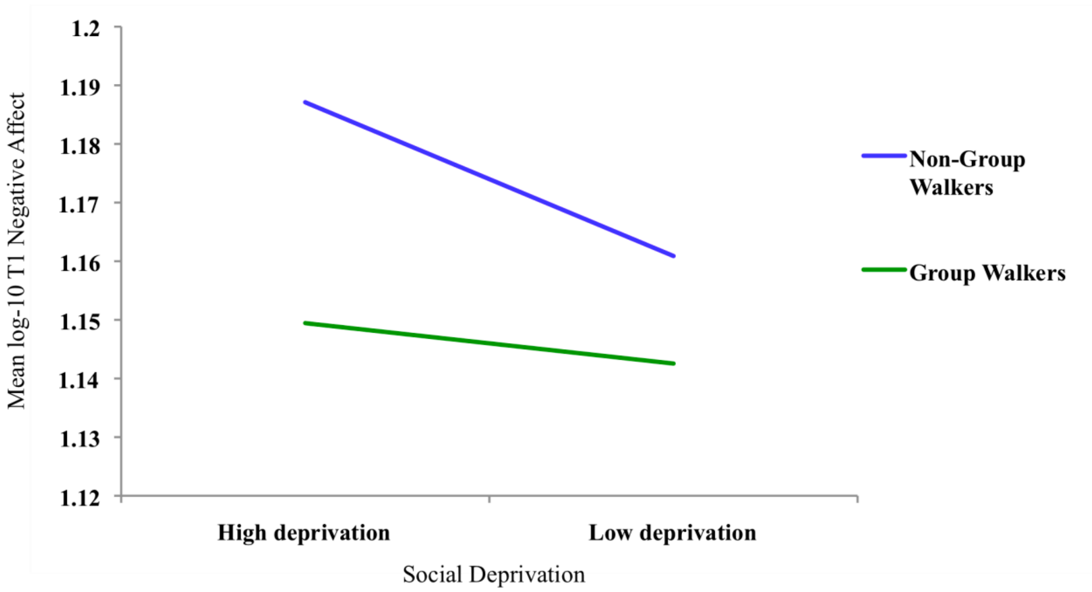


Table 8.8 shows that outdoor group walk participation (*B* = 0.000, *p* = .93), and IMD tertile (*B* = -0.006, *p* = .10) were nonsignificant predictors of T2 log-10 negative affect, after controlling for covariates. The interaction term was also not significant (*B* = 0.002, *p* = .54). Hypotheses 4, 5 and 6 were not supported for T2 negative affect.

Group walk as a moderator of IMD on depression

Table 8.9 presents the results of the social deprivation moderator analyses for T1 and T2 depression. Hypothesis 4 was supported; outdoor group walk participation was significantly negatively associated with T1 log-transformed depression (*B* = -0.027, *p* < .001). IMD was a not a significant predictor of T1 log-transformed depression (*B* = -0.014, *p* =.17), nor was the interaction term (*B* = 0.011, *p* = .29). Hypotheses 5 and 6 were not supported for T1 depression.

Hypothesis 4 was also supported for T2 depression. Outdoor group walk participation was a significant predictor of T2 log-transformed depression (*B* = -0.014, *p* = .02), indicating group walk participation was associated with a reduction in T2 depression. IMD was a not a significant predictor of T2 log-transformed depression (*B* = -0.002, *p* =.81), nor was the interaction term (*B* = -0.010, *p* = .23), indicating that both Hypotheses 5 and 6 were unsupported for T2 depression.

Table 8.9. Final step for moderation analyses between IMD tertile and group walk participation on T1 and T2 depression

Variable	*B*	SE	*p*	Adj R^2 †	Δ R^2
	Step 4				
	DV: T1 Depression^				
Constant	0.816	0.008	< .001		
Disability	0.049	0.023	.03		
Health condition	0.035	0.017	.04		
T1 Perceived Stress	0.029	0.001	< .001		
T1 Resiliency	-0.005	0.001	.001		
T1 Social Support	-0.007	0.001	< .001		
T1 Stressful life events	0.116	0.027	< .001	.455***	
Group Walk	-0.027	0.007	< .001	.459***	.005***
IMD	-0.014	0.010	.17	.459***	.000
Group walk * IMD	0.011	0.010	.29	.459***	.000
	DV: T2 Depression^				
Constant	0.780	0.014	< .001		
Education	0.021	0.009	0.01		
GP recommendation	0.069	0.021	0.001		
T1 Depression	0.341	0.019	< .001		
T2 Physical activity	-0.010	0.003	< .001		
T2 Perceived Stress	0.024	0.001	< .001		
T2 Stressful life events	0.064	0.027	.02	.582***	
Group Walk	-0.014	0.006	.02	.583***	.001*
IMD	-0.002	0.009	.81	.583***	.000
Group walk * IMD	-0.010	0.008	.23	.583***	.000

Note. Matched *as treated* sample; analysis weighted by propensity score weight. All continuous variables were centred. *B* = Unstandardised regression coefficient. Disability: 0 = No 1 = Yes. Health Condition: 0 = No health condition 1= One or more health conditions. Education: 0 = No qualifications, 1 = lower, upper or post-secondary education, 2 = Tertiary education. GP referral to WfH: 0 = No GP referral, 1 = Yes, referred by GP to WfH. Group Walk: -1 = *matched* Non-Group Walkers, 1 = *matched* Group Walkers. Higher scores indicate greater: perceived stress, resiliency, social support, physical activity, depression and stressful life events. Higher IMD scores indicate less deprivation. †Adjusted R^2 and Δ R^2 for each step of the model are presented adjacent to the last variable entered at each step. ^ = log-transformed variable. * $p < .05$. *** $p < .001$.

8.4 Discussion

This analysis investigated Objective 3 for this thesis - whether outdoor group walks would facilitate resilience by moderating the negative effects of stressful life events and social deprivation on mental and emotional well-being. Hypotheses 1 and 4 were supported: Group Walkers were associated with greater T1 mental well-being and T2 positive affect, and less T1 negative affect and T1 and T2 depression, compared to Non-Group Walkers. Hypothesis 2 was also supported: more stressful life events were associated with an increase in T1 and T2 negative affect and T1 depression. Contrary to expectations and the correlations, a greater number of recent stressful life events experienced was associated with an increase in T2 mental well-being. Hypothesis 3 that group walk participation would moderate the effect of stressful life events on well-being was supported with a small interaction effect for T1 negative affect only. Participating in an outdoor walking group attenuated the negative effect of stressful life events in the past year on T1 negative affect. Stressful life events in the past year were not a significant predictor of T1 negative affect for Group Walkers, but were a significant predictor for Non-Group Walkers. Group Walkers showed evidence of resilience by having similar scores of T1 negative affect irrespective of the number of stressful life events experienced.

The effect of IMD on well-being (Hypothesis 5) was supported for T1 negative affect only; a classic social gradient was shown where living in an area of greater social deprivation was associated with greater negative affect. Hypothesis 6 that group walk participation would moderate the effect of social deprivation on well-being was marginally supported with a small interaction effect for T1 negative affect. Participating in an outdoor group walk (marginally) attenuated the negative effect of social deprivation on T1 negative affect. Social deprivation was a significant predictor for Non-Group Walkers only, who showed a social gradient in negative affect by level of social deprivation. In contrast, Group Walkers showed evidence of resilience to social deprivation by having similar scores of T1 negative affect irrespective of the level of deprivation.

The finding that outdoor group walks moderated the effects of stressful life events and (marginally) IMD on T1 negative affect is in line with the psycho-evolutionary model (Ulrich, 1983). This theory posits interacting with green spaces reduces negative affect (Ulrich, 1983; Ulrich et al., 1991). In Chapter 2, the psycho-evolutionary model was hypothesised to relate to the resilience process as a mechanism for recovery from the after-effects of stress. The after-effects from experiencing stress are impairments to psychological functioning and physiological health (Bell et al., 2001, p. 123). Recovery from after-effects of stress appears to mirror the definition of resilience as the recovery of well-being following exposure to adversity or risk (Bonanno, 2004; Mancini & Bonanno, 2010; Ryff et al., 1998). The psycho-evolutionary model argues that recovery from the after-effects of stress can be facilitated by spending time in the natural environment (Ulrich et al., 1991). Ulrich (1983; 1991) states that a natural environment may provide a psycho-physiological ‘breather’ from stress by holding one’s interest to block out stressful thoughts and reduce physiological stress responses. Individuals who have experienced adversity and attend an outdoor walking group may have had reduced levels of negative affect because they had recovered from the after-effects of adversity due to walking in the natural environment.

8.4.1 Explanations for lack of significant results

There are several possible explanations for why the results of most of the analyses did not support the moderation hypotheses. The first of which relates to the frequency of outdoor group walks in the matched *as treated* Group Walker sample; perhaps the group walks were not frequent enough to buffer the effects of stressful life events on well-being. The average attendance for WfH walks for matched *as treated* Group Walkers was 2-3 times per month at both Time 1 and Time 2. Previous studies that found a buffering effect from direct interactions with the natural environment on stressful life events all had more frequent interactions with nature than 2-3 times per month. For example, Armstrong and Edwards (2003; 2004) had participants attend an outdoor walking group three times per week. Cimprich and Ronis (2003) had participants spend 120 minutes per week interacting with nature. Stuart (2005) found a dose-response relationship wherein the number of hours spent gardening per week (6 or more) were related to greater well-being benefits. Ottosson and Grahn (2008) found individuals who ‘often’ spent time contemplating nature and wildlife were less affected by adversity. The authors (Ottosson & Grahn, 2008) conclude “access to nature in everyday life seems to have a buffering effect on people’s mental state...If people in crisis have *many* nature experiences, they tend to experience an improved state of health” (emphasis added) (p. 66). Future research could re-examine the between group analyses in this chapter with a sub-sample of frequently attending Group Walkers[51]. About sixty per cent of matched *as treated* Group Walkers attended a WfH walk once per week or more at both T1 (65%, n = 777) and T2 (60%, n = 728). Alternatively, future research could analyse Group Walkers only to assess the frequency of outdoor group walk attendance as a categorical moderator (e.g. 0 = less than once per week, 1 = at least once a week or more) between adversity and well-being.

[51] A new propensity matched *as treated* sample may need to be required for this analysis.

Second, it is possible that daily hassles would have been a more appropriate assessment of life stressor for Hypothesis 3. Daily stressors are “the routine challenges of day-to-day living, such as the everyday concerns at work, caring for other people, and commuting...[as well as] unexpected occurrences, such as arguments with children, unexpected work deadlines....that disrupt daily life” (Almeida, 2005, p. 64). Whilst less traumatic than stressful life events, daily stressors can accumulate and effect psychological functioning (Almeida, 2005; Bell et al., 2001, p. 118). Compared to stressful life events, daily stressors are better predictors of ill health (Schwarzer & Schultz, 2003). Daily stress has been used as a measure of adversity in adult resilience research (Almeida, Wethington, & Kessler, 2002; Almeida, 2005; Ong et al., 2006; Stawski, Sliwinksi, Almeida, & Smyth, 2008), and nature and health studies (Bodin & Hartig, 2003; Hawkins, 2012; Korpela, Ylén, Tyrväinen, & Silvennoinen, 2008). However, Hawkins (2012) found that time spent outdoors did not moderate the effect of daily hassles on perceived stress. Future research could usefully investigate the relationship between daily hassles and group walk participation.

A related measurement issue is the choice of social deprivation variable. Previous moderation analyses of green space on health used separate deprivation domains of IMD (Mitchell & Popham, 2007; Mitchell & Popham, 2008) instead of overall IMD, which is a weighed combination of seven deprivation domains (Department for Communities and Local Government, 2011). Re-running the analysis with separate deprivation domains is warranted before disregarding the hypothesis that outdoor group walks moderate the effect of social deprivation on well-being.

A fourth explanation for the lack of significant moderating effects may be due to the decision to analyse both adversity variables separately. While both adversity variables were analysed separately because of the exploratory nature of this study and previous research, future research could usefully investigate the cumulative impact of stressful life events and social deprivation together. Residents of deprived neighbourhoods are more likely to experience more frequent stressful life events and chronic stressors than those in less deprived areas (Matthews, Gallo, & Taylor, 2010; Zimmerman & Brenner, 2010). Resources to cope with these stressors are limited in deprived areas (Matthews et al., 2010; Zimmerman & Brenner, 2010), making it more likely that stressors are appraised as stressful and result in negative emotional states (Cohen et al., 1997). The accumulation or duration of stressors can result in poor coping responses, and mental and physical ill health (Matthews et al., 2010; Zimmerman & Brenner, 2010).

A fifth explanation for the failure for a moderation effect could be because the moderation variable, outdoor group walk participation, was related to the outcome variables (see Table 8.1). Baron and Kenny (1986) state that the moderator variable should be unrelated to both the predictor and outcome variable. However, as all correlations between outdoor group walk participation and well-being were less than r = .30, this may not have been a major limitation on the moderation analyses (Hawkins, 2012).

A final explanation for the lack of significant moderation results here is that not all Group Walkers were walking in natural environments. At Time 1, it is unknown how many matched *as treated* Group Walkers walked in urban environments, as this information was not available. At Time 2, six percent (n = 72) of the 1,200 matched *as treated* Group Walkers walked in an urban environment (e.g. streets, shopping centre, plaza). For these participants, the theories of restorative environments and their relation to the resilience process as a protective factor are inappropriate.

8.4.2 Conclusions

The chapter addressed the aim of the thesis by investigating whether outdoor group walks could be a potential public health intervention for positive mental and emotional well-being by fostering resilience. The analyses reported in this chapter investigated whether participating in an outdoor walking group would moderate the negative effects of adversity on mental and emotional well-being. Significant moderation was found for negative affect only - and only at the start of the study. Non-Group Walkers were more affected by greater stressful life events in the past year and social deprivation than Group Walkers. Thus, Group Walkers demonstrated resilience for stressful life events in the past year and social deprivation on negative affect.

The next chapter will further investigate the aim of the thesis by exploring whether the type of environment for a group walk has any effect on mental and emotional well-being. In other words, do all outdoor group walks – irrespective of the environment type

– contribute to public health and well-being, or just group walks in certain types of natural environments? Using a single exemplars approach (Hartig, 2011), the mental and emotional well-being of *as treated* Group Walkers who frequently walked in an urban environment was compared to the mental and emotional well-being of *as treated* Group Walkers who frequently walked in a specific type of natural environment.

Chapter 9 The well-being benefits from group walks in different types of environments

The aim of this chapter was to explore whether the type of environment for a group walk influences mental and emotional well-being. Using a single exemplars approach (Hartig, 2011), this chapter investigates the difference in well-being between Group Walkers who walked in an urban environment to Group Walkers who walked in specific types of natural environments. This chapter addresses Objective 4:

> Explore whether different types of natural environments for a group walk are associated with positive mental and emotional well-being, compared to group walks in the urban environment.

There are four sections to this chapter. The first section briefly reviews the literature on the well-being benefits from different types of natural environments. The second section details the method for the analysis, followed by a presentation of the results in section three. The final section provides a summary and conclusion.

9.1 Introduction

9.1.1 Walking in different types of natural environments

Walking in natural environments has been found to provide additional benefits to emotional well-being compared to walking indoors (Bowler et al., 2010; Thompson Coon et al., 2011) or in an urban environment (Bowler et al., 2010). However, studies of walking and well-being have, to date, investigated a limited set of natural environments. Parks and university campuses are the most common types of natural environments in walking studies (Bowler et al., 2010; Thompson Coon et al., 2011). Furthermore, none of the walking studies in the systematic reviews of Bowler et al. (2010) and Thompson Coon et al. (2011) examined more than one type of natural environment. Further research has been called for in order to investigate the contribution of different types of natural environments on well-being (Bowler et al., 2010; Croucher et al., 2007; Jorgensen & Gobster, 2010; Lee & Maheswaran, 2011; Mitchell, 2013; Thompson Coon et al., 2011; Velarde et al., 2007).

Several recent studies have specifically considered this issue. Three studies focused on the impact of physical exercise in different natural environments on mental and emotional well-being. Pretty et al. (2005) found running indoors whilst viewing scenes of either a pleasant urban or rural environment had a greater effect on self-esteem over and above the effect of exercise alone. Walking alone in a maintained forest had a greater increase on positive affect and greater decrease in negative affect than walking alone in a wild, unmaintained forest (Martens et al., 2011). Mitchell (2013) found exercising in parks and woodland environments was associated with decreased risk of mental ill health, and exercising in parks and outdoor sports fields was associated with greater mental well-being, when compared to not exercising in these respective environment settings. One secondary data analysis study investigated impact of the both broad and specific types of environments on recalled restoration (White, Pahl, Ashbullby, Herbert, & Depledge, 2013). Compared to rural green space (i.e. the countryside), urban green space was associated with significantly less restoration, but coastal environments were associated with greater restoration (White et al., 2013). With regard to specific environment types, beach, coastal, forest/woodland, hill/mountain and farmland environments were all significantly positively associated with restoration, compared to the countryside environments (White et al., 2013). Two epidemiological-type studies have found positive associations between different types of natural environments and physical and mental health. Perceived health was positively associated with the amount of farmland, woodland or grassland around one's home (Maas et al., 2006). Mental health was positively associated with the amount of farmland near one's home (de Vries et al., 2003).

Aquatic environments have also been shown to have a greater effect on health and well-being than other natural environments. A 'blue' gradient in health and mental health has been found, in which self-reported health (Wheeler, White, Stahl-Timmins, & Depledge, 2012) and mental health (Wheeler et al., 2012; White, Alcock, Wheeler, & Depledge, 2013) increased the closer an individual lived to the sea, over and above the effects of green environments. Exercising near waterside environments demonstrated greater improvements in self-esteem and mood compared to exercising in urban green space, farmland and woodland environments (Barton & Pretty, 2010). Beach and river environments are experienced with high levels of mental well-being and low levels of negative feelings (Hinds & Sparks, 2011).

The perceived degree of naturalness or level of biodiversity of the natural environment has also been found to contribute to well-being (Dallimer et al., 2012; Fuller, Irvine, Devine-Wright, Warren, & Gaston, 2007; Jorgensen & Gobster, 2010). Hinds and Sparks (2011) found 'more natural environments' (e.g. mountain, forest, woodland, valley) were associated with greater mental well-being, than 'less natural environments' (e.g. parks, gardens, farmland fields). Mental well-being was positively associated with the actual number of plant species and habitat types in urban green space (Fuller et al., 2007) and perceived number of plant, bird and butterfly species in riparian green space (Dallimer et al., 2012).

9.2 Method

A cross-sectional design was used to investigate the influence of the walk environment for a group walk on mental and emotional well-being. Data on environment type for a WfH group walk was collected at the T2 questionnaire only. Following recommendations from Bowler et al. (2010), the analysis considers whether there is an "added benefit" (p. 2) from a specific type of natural environment by comparing the well-being of Group Walkers who walked in an urban environment to the well-being of Group Walkers who walked in different types of natural environments. This is called the "single exemplars approach" (Hartig, 2011, p. 52). Any differences between the two groups may then be attributable to the environment.

9.2.1 Participants

A subsample of 708 frequent Group Walkers were analysed for this study out of the total *as treated* Group Walkers sample (n = 1,258). Frequent Group Walkers are individuals who had attended a WfH walking group at least once a week during the previous 13 weeks. Further eligibility criteria were that participants had to have completed T2 questionnaire and have no missing data. The sub-sample was largely female (62%), aged 55 years or older (92%), university educated (46%), married, civil partnered or cohabiting (72%) and lived in the least deprived areas of England (51%).

9.2.2 Measures

The measures used in this chapter were outlined in Chapter 3. The outcome variables in these analyses were T2 mental well-being, positive affect, negative affect and depression and perceived stress. Perceived stress was included as an outcome variable in this chapter due to its importance as a mediator in the relationship between group walks and well-being (see Chapter 7), and nature and health (Groenewegen et al., 2012; Health Council of the Netherlands and Dutch Advisory Council for Research on Spatial Planning, Nature and the Environment, 2004). Covariates of the outcome variable were included in each analysis. The predictor variable was the type of walk environment. The following section will describe these new data.

<u>Walk environment type</u>

The most common type of environment in which the participant walked with a WfH group during the 13-week study period was assessed with the question: “What is the main type of environment you walk in with this [WfH] group?”. Participants selected one response from a list of 10 categories. Response options were drawn from the WfH Walk Route Assessment questionnaire (Walking for Health, 2011), which itself matched the environment types outlined in the English Planning Policy Guidance (PPG) 17 (Department for Communities and Local Government, 2002) (p. 13-14). For this study, the ‘cemeteries, disused churchyards and other burial grounds’ category was excluded and a ‘coastal environments’ category (Wheeler et al., 2012; White et al., 2010; White et al., 2013) was included into the list of walk environment types.

Response distribution across the ten provided environment type categories was unequal: natural and semi-natural places (24.8%); green corridor (26.8%); farmland (13.3%); parks and gardens (6.8%); urban public space (5.8%); coastal (6.1%); amenity green space (2.3%); allotments, community gardens, urban farms (0.4%), outdoor sports facilities (0.1%) or an ‘other’ write-in category (10%). For analysis purposes, four of the categories were combined following PPG 17 definitions of environment types into a new walk environment category entitled “Urban green space” (see Table 1). Coastal and urban public space environments were considered empirically and theoretically important (Bowler et al., 2010; Wheeler et al., 2012) and were left intact. Write-in responses were analyzed and recoded into an existing environment type category, where appropriate. Forty write-in responses that described a combination of two or more environment types (e.g. "a combination of all above"; "a mixture of urban public space and green corridor"; "the walks cover farmland, green corridor and coastal") were coded into a new category entitled 'Mixture'. Table 1 provides details for the frequency with which each environment type was selected following recategorization of original responses for the subsample.

Table 9.1. The number of frequently attending Group Walkers as a function of the main type of environment walked in which walked with their WfH group (*n* = 708).

Walk environment type	Example provided in questionnaire	Frequency	
		n	**%**
Natural and semi-natural places	Country park, nature reserve	216	30.5%
Green corridor	River path, cycleways, bridleways	190	26.8%
Farmland	*No example given*	102	14.4%
Urban green space[a]	Public gardens, formal parks, amenity green space, allotments, community gardens, urban farms, outdoor sports pitches	71	10.0%
Coastal	Seaside, estuary	45	6.4%
Urban public space	Streets, shopping centres, plaza	44	6.2%
Mixture[b]	"A combination of all of the above"	40	5.6%

[a] = New category analyzed by the authors combines four original categories: parks and gardens; allotments, community gardens and urban farms; amenity green space; and outdoor sports pitches.
[b] = New category analyzed by the authors; category contains 'other' write-in responses from participants that described two or more different environment types. Example not provided in the questionnaire, but a participant response to the 'other' write in category.

9.2.3 Statistical analyses

Differences on socio-demographics, walking behaviour, physical activity and recent stressful life events between participants across the seven walk environment types were examined using chi-square and one-way ANOVA with Bonferroni *post-hoc* tests[52].

Regression analyses investigated the contribution of each walk environment type to mental well-being, depression, perceived stress, and positive and negative affect, holding significant covariates constant. Separate regression analyses were run for each outcome variable. Dummy variables were created for each walk environment type. The reference group was 'urban public space'. This analysis enabled the comparison of the

[52] Bonferroni corrected α-level (.05/7) = .007

change in the outcome variable as a participant changes from WfH group walks in urban public space to WfH group walks in a more 'natural' environment.

First, backwards stepwise regression was used to identify a subset of non-environment related predictor variables that significantly predicted each outcome variable (Step 1). Predictor variables entered into the backwards stepwise regression included: sex, age, ethnicity, marital status, education, deprivation, frequency of WfH group walks and non-group walks in green space, log-transformed duration of WfH walks, duration of non-group walks, frequency of physical activity in the past week and log-transformed recent stressful life events. Residual plots from the regression models were analysed to determine how closely these followed a normal distribution. Where residuals showed large deviations from normality, transformations were applied to the outcome variables; a log transformation was conducted for both negative affect and depression (Tabachnick & Fidell, 2013).

Second, hierarchical multiple regression was conducted to examine the relationship between environment type for a WfH walk and mental and emotional well-being while holding constant identified significant predictors from the backwards stepwise regression. Significance levels for all regression analyses were set at $p < .05$. The following procedure was followed for entry of variables for all analyses:

1. Covariates identified as significant predictors were entered in the first block (Step 1).
2. WfH walk environment type dummy variables were entered in the second block (Step 2).

9.3 Results

9.3.1 Predictor variables by environment type

Characteristics for participant groups across the seven walk environment types are provided in Tables 9.2 and 9.3. Table 9.2 details the socio-demographic characteristics. Groups differed significantly on ethnicity (χ^2 (6) = 14.40, p = .03), age (χ^2 (6) = 33.70, p < .001) and deprivation (χ^2 (12) = 27.37, p = .01). More participants of a non-white ethnicity attended WfH walks in urban green space (11.3%) than any other type of environment. One quarter (25%) of frequent WfH walkers in urban public space were aged 18-54, more than any other environment type. More participants from the most deprived areas of England would frequently attend WfH walks in urban green space (21.1%) than any other environment. Over half (55.6%) of all frequent group walkers in a coastal environment lived in moderately deprived areas of England. Approximately 60% of WfH walkers in green corridor environments lived in the least deprived areas in England.

Table 9.3 provides details on additional characteristics of interest. Groups significantly differed on duration of WfH walks (F (6, 701) = 13.74, $p < .001$) and frequency of non-group walks in green space (F (6, 701) = 3.23, $p = .004$). Bonferroni *post-hoc* tests indicated that WfH walks in urban green space and urban public space were of significantly less duration compared to WfH walks in natural environments, green corridor, and farmland ($p < .007$ for all); additionally, WfH walks in urban public space were of significantly less duration than WfH walks in coastal and mixture environments ($p < .007$ for all). Bonferroni *post-hoc* tests indicated a significant difference on the frequency of non-group walks between group walkers in green corridor and urban green space (mean difference = 0.81, 95% CI = .20, 1.42, $p < .007$). Group walkers in green corridor environments took the most non-group walks (M = 4.13) whilst group walkers in urban green space took the fewest (M = 3.32).

Table 9.2. Socio-demographic characteristics of frequently attending group walkers as a function of the main type of environment in which they walked with the group in the past 13 weeks (*n* = 708).

	Walk Environment Type						
Variable	**Urban public space (*n* =44)**	**Natural & Semi-natural (*n* = 216)**	**Green corridor (*n* = 190)**	**Farmland (*n* = 102)**	**Urban green space (*n* = 71)**	**Coastal (*n* = 45)**	**Mixture (*n* = 40)**
Female							
% (*n*)	56.8 (25)	66.2 (143)	60.5 (115)	50.0 (51)	64.8 (46)	64.4 (29)	70.0 (28)
Aged 55+ ***							
% (*n*)	**75.0 (33)**	92.6 (200)	92.1 (175)	99.0 (101)	81.7 (58)	95.6 (43)	95.0 (38)
White ethnicity*							
% (*n*)	97.7 (43)	95.4 (206)	97.9 (186)	98.0 (100)	**88.7 (63)**	97.8 (44)	97.5 (39)
Married, civil partnered, cohabitating							
% (n)	70.5 (31)	66.7 (144)	75.8 (144)	82.4 (84)	64.8 (46)	68.9 (31)	67.5 (27)
Education % (n)							
No educations	9.1 (4)	8.8 (19)	9.5 (18)	5.9 (6)	5.6 (4)	6.7 (3)	7.5 (3)
Secondary education	45.5 (20)	49.1 (106)	43.7 (83)	39.2 (40)	45.1 (32)	57.8 (26)	50.0 (20)
Tertiary education	45.5 (20)	42.1 (91)	46.8 (89)	54.9 (56)	49.3 (35)	35.6 (16)	42.5 (17)
Deprivation % (n)**							
Most deprived	13.6 (6)	11.6 (25)	11.6 (22)	6.9 (7)	**21.1 (15)**	13.3 (6)	10.0 (4)
Moderate deprived	34.1 (15)	35.2 (76)	29.5 (56)	39.2 (40)	43.7 (31)	**55.6 (25)**	47.5 (19)
Least deprived	51.3 (23)	53.2 (115)	**58.9 (112)**	53.9 (55)	35.2 (25)	31.1 (14)	42.5 (17)

Note. All analyses were Pearson Chi-square. Bold text indicates category that differs from the rest.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 9.3. Frequency and duration of WfH group and non-group walks, physical activity, and number of recent stressful life events of frequently attending WfH group walkers as a function of the main type of environment in which they walked with the group in the past 13 weeks (*n* = 708).

	Walk Environment Type						
Variable	**Urban public space (*n* =44)**	**Natural & Semi-natural (*n* = 216)**	**Green corridor (*n* = 190)**	**Farmland (*n* = 102)**	**Urban green space (*n* = 71)**	**Coastal (*n* = 45)**	**Mixture (*n* = 40)**
WfH walk at least once a week % (*n*)	77.3 (34)	70.4 (152)	71.1 (135)	75.5 (77)	64.8 (46)	75.6 (34)	60.0 (24)
Duration of a WfH walk (in minutes) M (SD)^***	**61 (32)**	96 (45)	94 (40)	100 (41)	**74 (45)**	88 (41)	83 (38)
Frequency of non-group walks M (SD)**	3.52 (1.47)	3.90 (1.47)	**4.13 (1.33)**	3.84 (1.40)	**3.32 (1.54)**	3.96 (1.68)	3.98 (1.44)
Duration of non-group walks (in minutes) M (SD)	89 (57)	93 (56)	95 (50)	91 (52)	79 (59)	88 (54)	103 (57)
Physical Activity (days) M (SD)	3.57 (1.55)	3.50 (1.73)	3.66 (1.73)	3.51 (1.72)	3.69 (1.85)	4.00 (1.73)	3.78 (1.83)
Recent stressful life events^ M (SD)	0.52 (.85)	0.52 (0.85)	0.62 (.85)	0.61 (.96)	0.79 (1.01)	0.73 (0.92)	0.58 (0.84)

Note: All analyses were one-way ANOVA Bonferroni *post-hoc* tests. Bold text indicates group difference.
Higher scores indicate greater: duration of WfH walks (range 15 - 195 minutes); frequency of non-group walks (1 = never; 7 = daily); duration of non-group walks in green space (range 0 - 195 minutes); greater physical activity (0 = 0 days; 7 = 7 days); and number of stressful life events experienced in the past 13 weeks (range 0 - 11). ^ = log-transformed variable for ANOVA analyses. Non-transformed means and standard deviations presented here. ** p < .01. *** p <.001.

9.3.2 Well-being outcomes

Table 9.4 shows the means and standard deviations of mental and emotional well-being of Group Walkers who frequently attended a WfH walk in each type of environment. The mean scores for urban public space Group Walkers are presented in the first row.

Table 9.4. Mean and standard deviation of Group Walkers' mental and emotional well-being as a function of walk environment type (*n* = 708).

	Mental Well-being		**Positive Affect**		**Negative Affect**		**Depression**		**Perceived Stress**		
Environment type	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*n*
Urban public space	51.61	7.62	34.14	7.37	15.57	5.75	8.09	7.37	13.23	5.91	44
Natural and semi-natural	53.17	7.30	34.80	7.45	14.06	4.33	6.06	5.26	11.17	6.12	216
Green corridor	54.23	7.16	35.99	6.31	13.65	4.09	5.68	5.02	9.93	5.55	190
Farmland	54.64	6.83	36.34	6.04	12.68	3.30	5.60	5.95	9.57	5.66	102
Urban green space	52.68	9.63	34.97	7.96	15.54	6.04	7.93	7.48	12.56	7.74	71
Coastal	52.42	6.86	34.49	6.93	15.42	4.99	5.96	4.02	12.16	5.94	45
Mixture	53.10	6.41	35.58	6.55	14.70	5.11	7.48	6.31	12.63	6.30	40

Note. Non-transformed means and standard deviations presented here. Higher scores indicate greater: mental well-being (range 14 - 70), depression (range 0 - 50), perceived stress (range 0 - 40), positive affect (range 10 - 50) and negative affect (range 10 - 50).

<u>Mental well-being and environment type</u>

Marital status and physical activity accounted for 3.2% of the variance of mental well-being in the initial model and remained significantly positively associated with mental well-being in the final model (β = .13, $p < .001$; β = .11, $p = .003$, respectively; see Table 9.5). The final model remained significant although the addition of walk environment type accounted for a nonsignificant increase of the variance explained ($\Delta R^2 = .011$, $p = .247$). Of the 6 walk environment predictors, participants who frequently attended WfH group walks in farmland environments (β = .13, $p = .04$) were significantly associated with greater mental well-being in comparison with participants who frequently attended WfH group walks in urban public spaces. The effect of WfH group walks in green corridor environments was marginally significant (β = .15, $p = .05$).

Table 9.5. Hierarchical regression analyses for variables predicting mental well-being of frequent group walkers attending at least once a week or more (*n* = 708).

	Mental Well-being						
Variables	***B***	***SE B***	**β**	***p***	***F***	***df***	***p***
Step 1					11.574	2, 705	< .001
Constant	50.12	0.77		< .001			
Marital Status	2.34	0.61	.14	< .001			
Physical Activity	0.46	0.16	.11	.004			
Step 2					3.890	8, 699	< .001
Constant	48.39	1.31		< .001			
Marital Status	2.18	0.62	.13	< .001			
Physical Activity	0.47	0.16	.11	.003			
Natural & Semi-Natural	1.67	1.21	.10	.17			
Green corridor	2.46	1.22	.15	.05			
Farmland	2.79	1.32	.13	.04			
Urban Green Space	1.13	1.40	.05	.42			
Coastal	0.64	1.55	.02	.68			
Mixture of 2 or more	1.45	1.60	.05	.36			

Note. Step 1: $R^2 = .032$, Adj $R^2 = .029$, $p < .001$. Step 2: $R^2 = .043$, Adj $R^2 = .032$, $p < .001$; $\Delta R^2 = .011$ ($p = .247$). *B* = regression coefficient, β = standardised regression coefficient. Marital Status: Reference category was single, divorced, widowed. Physical Activity: 0 = 0 days; 7 = 7 days. Environment type: Reference category was Urban Public Space.

Positive affect and environment type

Table 9.6 provides results for positive affect. In Step 1, marital status, physical activity and duration of non-group walks in green space accounted for a significant 5.6% of the variance of positive affect. The final model with all predictors was significant. In Step 2, marital status ($\beta = .08$, $p = .03$), physical activity ($\beta = .17$, $p < .001$) and duration of non-group walks in green space ($\beta = .11$, $p = .004$) were significantly positively associated with positive affect. Environment type accounted for a nonsignificant increase of the explained variance ($\Delta R^2 = .008$, $p = .403$); there were no significant differences between the effect of WfH group walks in urban public space and WfH group walks in any type of natural environment on positive affect.

Table 9.6. Hierarchical regression analyses for variables predicting positive affect for frequent group walkers attending at least once a week (*n* = 708).

	Positive Affect						
Variables	***B***	***SE B***	**β**	***p***	***F***	***df***	***p***
Step 1					13.874	3, 704	< .001
Constant	30.62	0.78		< .001			
Marital Status	1.43	0.57	.09	.01			
Physical Activity	0.67	0.15	.17	< .001			
Duration of non-group walks	0.01	0.01	.11	.003			
Step 2					5.315	9, 698	< .001
Constant	29.60	1.25		< .001			
Marital Status	1.28	0.57	.08	.03			
Physical Activity	0.68	0.15	.17	< .001			
Duration of non-group walks	0.01	0.01	.11	.004			
Natural & Semi-Natural	0.70	1.12	.05	.53			
Green corridor	1.65	1.13	.10	.15			
Farmland	2.06	1.22	.10	.09			
Urban Green Space	0.96	1.30	.04	.46			
Coastal	0.09	1.43	.003	.95			
Mixture of 2 or more	1.14	1.48	.03	.44			

Note. Step 1: $R^2 = .056$, Adj $R^2 = .052$ $p < .001$. Step 2: $R^2 = .064$, Adj $R^2 = .052$, $p < .001$; $\Delta R^2 = .008$ ($p = .403$). B = regression coefficient, β = standardised regression coefficient. Marital Status: Reference category was single, divorced, widowed. Physical Activity: 0 = 0 days, 7 = 7 days. Duration of non-group walks in green space (in minutes) range was 0 minutes to 195 minutes (3 hours 15 minutes). Environment type: Reference category was Urban Public Space.

Negative affect and environment type

In the initial model, a significant 8.5% of the variance in log-transformed negative affect was explained by age, marital status, physical activity and recent stressful life events (see Table 9.7). The significant negative association for age, marital status and physical activity and the significant positive association of recent stressful life events remained in the final model. With all predictors in the equation, walk environment type accounted for a significant increase of the variance explained by the model ($R^2 = .113$, Adjusted $R^2 = .100$, $p < .001$; $\Delta R^2 = .027$, $p = .002$). Of the 6 walk environment types, participants who frequently attended WfH group walks in green corridor environments ($\beta = -.16$, $p = .03$) and in farmland ($\beta = -.19$, $p = .002$) were significantly associated with less negative affect in comparison with participants who frequently attended WfH group walks in urban public space.

Table 9.7. Hierarchical regression analyses for variable predicting log-transformed negative affect for frequent group walkers attending at least once a week (*n* = 708).

	Negative Affect^						
Variables	***B***	***SE B***	**β**	***p***	***F***	***df***	***p***
Step 1					16.398	4, 703	< .001
Constant	1.21	0.02		< .001			
Age	-0.05	0.02	-.12	.002			
Marital Status	-0.03	0.01	-.12	.001			
Physical Activity	-0.01	0.003	-.11	.002			
Recent stressful life events^	0.13	0.02	.21	< .001			
Step 2					8.857	10, 697	< .001
Constant	1.23	0.02		< .001			
Age	-0.04	0.02	-.09	.01			
Marital Status	-0.03	0.01	-.11	.003			
Physical Activity	-0.01	0.00	-.12	.001			
Recent stressful life events^	0.13	0.02	.21	< .001			
Natural & Semi-Natural	-0.03	0.02	-.12	.10			
Green corridor	-0.04	0.02	-.16	.03			
Farmland	-0.07	0.02	-.19	.002			
Urban Green Space	-0.01	0.02	-.02	.66			
Coastal	0.01	0.03	.01	.84			
Mixture of 2 or more	-0.01	0.03	-.02	.63			

Note: Step 1: R^2 = .085, Adj R^2 = .080, *p* < .001. Step 2: R^2 = .113, Adj R^2 = .100, *p* < .001; ΔR^2 = .027 (*p* = .002). *B* = regression coefficient, β = standardised regression coefficient. Age: Reference category was 18-54 years of age. Marital Status: Reference category was single, divorced, widowed. Physical Activity: 0 = 0 days, 7 = 7 days. Recent stressful life events range was 0 - 11 stressful events. Environment type: Reference category was Urban Public Space. ^ = log-transformed variable.

Depression and environment type

In the initial model, age, marital status, physical activity, recent stressful life events and duration of WfH walks accounted for a significant 9.5% of the variance of log-transformed depression (Table 9.8). The final model with all predictors was also significant. In Step 2, marital status (β = -.12, *p* = .002) and physical activity (β = -.16, *p* < .001) were significantly negatively associated and recent stressful life events (β = .19, *p* < .001) was significantly positively associated with depression. A marginal significant association was found between age (β = -.07) and duration of WfH group walks (β = -.08) with a reduction in depression (p = .05). Environment type accounted for a nonsignificant increase of the variance explained by the model ($\Delta R^2 = .007$, p = .499); there were no significant differences between WfH group walks in urban public space and WfH group walks in any type of natural environment on log-transformed depression.

Table 9.8. Hierarchical regression analyses for variables predicting log-transformed depression of frequent group walkers attending at least once a week (*n* = 708).

	Depression^						
Variables	***B***	***SE B***	**β**	***p***	***F***	***df***	***p***
Step 1					14.699	5, 702	< .001
Constant	1.27	0.12		< .001			
Age	-0.09	0.04	-.08	.02			
Marital Status	-0.09	0.03	-.12	.001			
Physical Activity	-0.03	0.01	-.16	< .001			
Recent stressful life events^	0.30	0.06	.19	< .001			
Duration of WfH walks^	-0.17	0.06	-.10	.01			
Step 2					7.162	11, 696	< .001
Constant	1.24	0.13		< .001			
Age	-0.08	0.04	-.07	.05			
Marital Status	-0.08	0.03	-.12	.002			
Physical Activity	-0.03	0.01	-.16	< .001			
Recent stressful life events^	0.30	0.06	.19	< .001			
Duration of WfH walks^	-0.13	0.06	-.08	.05			
Natural & Semi-Natural	-0.07	0.05	-.10	.18			
Green corridor	-0.08	0.05	-.12	.11			
Farmland	-0.09	0.06	-.10	.12			
Urban Green Space	-0.03	0.06	-.03	.65			
Coastal	-0.05	0.07	-.04	.41			
Mixture of 2 or more	-0.01	0.07	-.01	.89			

Note: Step 1: $R^2 = .095$, Adj $R^2 = .088$, $p < .001$. Step 2: $R^2 = .102$, Adj $R^2 = .087$, $p < .001$; $\Delta R^2 = .007$ (p = .499). *B* = regression coefficient, β = standardised regression coefficient. Age: Reference category was 18-54 years of age. Marital Status: Reference category was single, divorced, widowed. Physical Activity: 0 = 0 days; 7 = 7 days. Recent stressful life events range was 0 - 11 stressful events. Duration of WfH walks, in minutes, range was 15 minutes to 195 minutes (3 hours 15 minutes) (original, untransformed variable range). Environment type: Reference category was Urban Public Space. ^ = log-transformed variable.

Perceived stress and environment type

Age, marital status, recent stressful life events and frequency of non-group walks in green space accounted for a significant 8.8% of the variance of perceived stress in the initial model (Table 7). In the final model age, marital status and frequency of non-group walks in green space were significantly negatively associated with perceived stress and recent stressful life events was significantly positively associated with perceived stress. Walk environment type was an additional explanatory variable accounting for a significant increase of the variance explained by the model (R^2 = .112, Adj R^2 = .099, p < .001; ΔR^2 = .025, p = .004). Of the six environment types, participants who frequently attended WfH group walks in green corridor (β = -.20, p = .005) and farmland environments (β = -.17, p = .006) were associated with significantly less perceived stress in comparison with participants who frequently attended WfH walks in urban public space.

Table 9.9. Hierarchical regression analyses for variables predicting perceived stress of frequent group walkers attending at least once a week (*n* = 708).

	Perceived Stress						
Variables	***B***	***SE B***	**β**	***p***	***F***	***df***	***p***
Step 1					16.881	4, 703	< .001
Constant	14.91	1.04		< .001			
Age	-2.73	0.80	-.12	.001			
Marital Status	-1.41	0.49	-.10	.004			
Recent stressful life events^	7.02	1.11	.23	< .001			
Frequency non-group walks	-0.38	0.15	-.09	.014			
Step 2					8.807	10, 697	< .001
Constant	15.96	1.26		< .001			
Age	-2.35	0.81	-.11	.004			
Marital Status	-1.19	0.49	-.09	.02			
Recent stressful life events^	7.03	1.11	.23	< .001			
Frequency of non-group walks	-0.32	0.15	-.08	.04			
Natural & Semi-Natural	-1.57	0.98	-.12	.11			
Green corridor	-2.81	0.99	-.20	.005			
Farmland	-2.96	1.08	-.17	.006			
Urban Green Space	-1.05	1.13	-.05	.35			
Coastal	-0.83	1.26	-.03	.51			
Mixture of 2 or more	-0.11	1.29	-.004	.93			

Note: Step 1: R^2 = .088, Adj R^2 = .082, $p < .001$. Step 2: R^2 = .112, Adj R^2 = .099, $p < .001$; ΔR^2 = .025 (p = .004). B = regression coefficient, β = standardised regression coefficient. Age: Reference category was 18-54 years of age. Marital Status: Reference category was single, divorced, widowed. Recent stressful life events range was 0 - 11 stressful events. Frequency of non-group walks: 1 = never; 7 = daily. Environment type: Reference category was Urban Public Space. ^ = log-transformed variable.

9.4 Discussion

The focus of the study was to answer Objective 4, whether the type of environment for a group walk had an 'added benefit' on mental and emotional well-being. Participants who attended a WfH group walk at least once a week during the 13-week study period completed an online questionnaire about their mental well-being, positive affect, negative affect, depression, perceived stress, and other covariates. Using hierarchical regression and controlling for significant covariates (e.g. age, physical activity), environment type was found to be a nonsignificant predictor for mental well-being, depression and positive affect. Environmental type did, however, significantly improve the prediction of perceived stress and negative affect.

9.4.1 Differences in well-being between group walks in specific types of environments

The impact of specific types of natural environments on mental and emotional well-being was also investigated. For depression and positive affect there was no difference between group walks in any type of natural environment compared to group walks in the urban environment. For mental well-being, perceived stress and negative affect there was a significant difference between group walks in farmland and those taken in the urban environment; group walks in farmland were significantly associated with less perceived stress and negative affect and with greater mental well-being. The results for farmland environments are supported by de Vries et al. (2003), who found a positive association between the amount of farmland near the home and mental health. Group walks in green corridor environments were also significantly associated with less perceived stress and negative affect, and (marginally) associated with greater mental well-being, when compared to group walks in the urban environment. The results for green corridor environments (NB: the 'green corridor' category includes 'river path') are consistent with previous studies in which waterside environments show higher levels of mental (Hinds & Sparks, 2011) and emotional well-being (Barton & Pretty, 2010; Hinds & Sparks, 2011) than other types of environments. No significant effect was found for group walks in natural and semi-natural places, urban green space, coastal and mixed environments on well-being, when compared to group walks in the urban environment.

These nonsignificant results are supported by previous research. White et al. (2013) found no difference in recalled restoration from visits in urban environments or the countryside. Pretty et al. (2007) found that emotional well-being and self-esteem were the same irrespective of the type of environment for a green exercise activity. The results presented here and from previous literature suggest that positive benefits to well-being from participating in an outdoor walking group can be obtained in any type of environment.

9.4.2 Theories of restorative environments

The significant findings for perceived stress and negative affect support the Attention Restoration Theory (ART) (R. Kaplan & Kaplan, 1989) and the psycho-evolutionary framework (Ulrich et al., 1991), respectively. ART posits that the directed attention is responsible for executive cognitive functioning (Berman et al., 2008; S. Kaplan, 1995; Ottosson & Grahn, 2008). This is supported by previous research which found greater improvements in cognitive functioning following a walk in a natural environment, compared to a walk in an urban environment (Berman et al., 2008; Berman et al., 2012; Hartig et al., 1991; Hartig et al., 2003). Chapter 2 hypothesised that restoration of directed attention from interacting with the natural environment reduces perceived stress by facilitating cognitive coping strategies.

The question remains why only farmland and green corridor environments had a significant difference in perceived stress, compared to the urban environment? Waterside environments are hypothesized by the psycho-evolutionary model to elicit greater affective reactions (e.g. liking) (Ulrich, 1983, p. 105). ART states that a restorative experience requires four factors of a person-environment experience: being away, fascination, extent and compatibility (Hartig & Evans, 1993; R. Kaplan & Kaplan, 1989; S. Kaplan, 1995):

- Being away – physical or mental distance from situations or behaviours that tax directed attention;
- Fascination – stimuli in the environment must be stimulating enough to evoke involuntary attention and the opportunity for reflection (e.g. snowfall, clouds, sunsets, waterfalls, fire, leaves moving in the breeze);
- Extent – an environment must be rich and coherent enough to represent a "sense of being in a whole other world" (R. Kaplan & Kaplan, 1989, p. 184)
- Compatibility – the person-environment fit; the environment must match the goals and the motivations of the individual.

It may be possible that a group walk in farmland or green corridor environments have an abundance of these four factors. Marselle (2004) found that a green corridor environment (i.e. river path) was rated as highly restorative by containing the four factors of ART. Other studies (Beil & Hanes, 2013; Bodin & Hartig, 2003; Hartig, Kaiser, & Bowler, 1997) investigating the perceived restorative qualities of a natural environment have not, to date, investigated farmland or green corridor environments[53].

The psycho-evolutionary model posits that interacting with nature decreases negative emotion and physiological stress and increases positive emotion. The findings in this chapter mirror previous research that found a reduction in negative affect following walks in the natural environment (Hartig et al., 1991; Hartig et al., 2003; Hine et al., 2011; Park et al., 2011; Peacock et al., 2007), compared to walks in the urban environment. However, the findings reported in this chapter for positive affect did not support the psycho-evolutionary framework (Ulrich et al., 1991) and previous research (Baker et al., 2008; Focht, 2009; Hartig et al., 1991; Hartig et al., 2003; Mayer et al., 2009). The social environment of the group walk and the other significant predictors of positive affect may explain this lack of change in positive affect by type of environment.

The lack of differentiation between environment types may be related to the fact that these are group walks , *i.e.*, walking with others may have increased the experience of the urban environment or contracted the experience of the natural environments. Previous research suggests that feelings of restoration from natural environments may be diminished when walking with others. For example, the effects of mental restoration from a nature setting are greater when alone than with others - but only if the person feels safe (Staats & Hartig, 2004). Johannsson et al. (Johansson et al., 2011) found that feelings of revitalization were greater when walking alone in a park compared to walking in a park with a friend. Conversely, feelings of revitalization were greater when walking in an urban environment with a friend compared to walking alone in an urban environment (Johansson et al., 2011). White et al. (2013) found that visiting an environment with other adults was associated with significantly less restoration compared to being alone in the environment. Walking with others may change how one interacts with the natural environment, which could influence the mental and emotional well-being benefits from walking outdoors (Duvall, 2010a; Duvall, 2010b). It is possible that interactions with the natural environment when on a WfH walk are incidental to the walking activity or social interaction. Indeed, qualitative research of

[53] These studies have investigated the perceived restorativeness of natural or semi-natural, or urban green space natural environments.

WfH group walks suggests that group walkers are more concerned with brisk walking or talking with others than the environment (e.g. Hynds & Allibone, 2009, p. 10-11).

9.4.3 Dose response

The results show an interesting dose-response relationship between outdoor walk behaviour and several aspects of well-being. Depression, positive affect and perceived stress demonstrated dose-responses for duration and frequency of walking. Depression showed a (marginally significant) inverse relationship with duration of a group walk, in that depression decreased as a group walk increased by 15 minutes. Positive affect significantly improved as the duration of non-group walks in green space increased by an additional 15 minutes. Perceived stress decreased significantly as the frequency of non-group walks in green space increased by one walk. Barton and Pretty (Barton & Pretty, 2010) similarly found improvements in self-esteem and mood after a short duration of exercise (i.e. 5 minutes) in the natural environment. Although, other observational studies have found no effect of outdoor exercise duration on well-being (Mackay & Neill, 2010; Pretty et al., 2007). Hamer et al. (2009) found that higher frequency of walking (once a week or more) was independently associated with a lower risk of mental ill health. The research into frequency or duration of walks outdoors and well-being has been described as unclear by Thompson Coon et al. (2011), as the majority of studies on walking in nature and well-being are experimental cross-over designs with a single bout of exercise for a short, defined period of time (Thompson Coon et al., 2011). Results from this chapter illustrate the influence frequent walks in green space of variable duration may have on multiple indicators of well-being. Specifically, these results suggest that small changes in walk behaviour – such as one extra walk in green space per week or walking for an additional 15 minutes – could have a positive influence on emotion and stress.

9.4.4 Physical exercise and well-being

Physical exercise was found to have an effect on mental well-being, depression and positive and negative affect. However, these results also suggest an 'added benefit' to mental well-being and negative affect from group walks in farmland environments that is above and beyond the effect of physical activity. The impact of physical activity on mental and emotional well-being is well documented (e.g. Biddle & Mutrie, 2008).

Previous results have found that walking *per se* was associated with improvements in well-being, irrespective of the type of environment or the social condition for walking (Johansson et al., 2011; Plante et al., 2007). Johansson et al. (2011) found that walking increased positive affect, irrespective of whether it occurred in a park or in urban environment. Mood improved irrespective of whether one was walking alone or with a friend in either a university campus or indoors (Plante et al., 2007). Pretty et al. (2007) found that all types of physical activity outdoors – irrespective of the environment, duration or intensity – increased self-esteem and mood. Barton and Pretty (2010) found no significant differences in self-esteem and mood between exercise in urban space, countryside and woodland environments, suggesting physical activity outdoors was the main cause for change in these measures. Issacs et al. (2007) found participating in a led outdoor group walk did not significant reduce scores of depression and anxiety when compared to indoor leisure-centre exercise intervention. Our results, and those of previous literature, highlight the need to control for other physical activity when analysing the unique contribution of the type of environment for a walk to well-being.

9.4.5 Stressful life events and well-being

Recently experienced stressful life events were significantly associated with the negative aspects of well-being – depression, perceived stress and negative affect. The negative relationship between stressful life events and well-being is well known (Cohen, 2000; Radloff, 1977). However, this study found a significant effect of the type of environment for a walking group on perceived stress and negative affect, over and above the effect of recent stressful life events. Specifically, frequent group walks in green corridor and farmland environments were associated with a reduction in perceived stress and negative affect. These results suggest that frequent group walks in these specific environments may be a protective factor against the negative effects of stressful life events on perceived stress and negative affect.

9.4.6 Strengths and limitations of the analysis

The strengths of the analysis include its relatively large sample of adults from the general population of England. The large sample size enabled comparisons between seven different walk environment types as well as the statistical control of physical activity and other significant predictors of well-being. This study measured various indicators of well-being and their relationship to outdoor walking, thus contributing to the investigation of the effect of natural environments on multiple dimensions of well-being.

This analysis does have a number of limitations. Firstly, care has to be taken in generalizing beyond the sample. The subsample was restricted to participants who frequently attended a walking group once a week or more. Frequently attending WfH walkers represent a minority of individuals who participate in the WfH program (Coleman et al., 2011). Moreover, the subsample was mostly female, aged 55 or older, married and living in the least deprived areas of England. As such, the subsample is unrepresentative of the adult general population living in England. Furthermore, participants in the study were a self-selected sample of motivated, computer literate individuals who had the time to complete two lengthy questionnaires. Secondly, the use of standardised measures meant that well-being was assessed over a time frame 'in the last two weeks'. The analyses sought to relate attending group walks in a certain environment at least twice over the time period to well-being experienced in that same period. There are, however, other events, occurrences or behaviours a participant may/may not have experienced or undertaken on a daily basis that could affect well-being (e.g., physical activity, deprivation of living environment, marital status, stressful life events). The analysis accounted for a few of these potential confounding variables on well-being by including them in the hierarchical regression model. Thirdly, although confounding variables were controlled for, other unmeasured explanatory variables could account for the group differences, such as region of England, intensity of group walks in each environment (Barton & Pretty, 2010), the social aspect of a walking group (Johansson et al., 2011) or personal drivers for participating in outdoors walking groups. Indeed the low overall predictive power of the final model highlights the need to examine additional explanatory variables. Lastly, the observational, cross-sectional design of this study limits conclusions about causality.

9.4.7 Future research

Future studies could isolate the effects of walking, the social environment and the physical environment. To isolate the effects of walking and the physical environment, an experimental study could randomly assign individuals to a walking group in different types of environments or a wait-list control group. To isolate the effects of the social and physical environments on walks, future studies could compare walking in specific types of environments alone or with a group. Future research could also investigate whether certain types of environments facilitate social well-being better than others. However, such studies would necessitate quite a large sample size in order to have the power to perform the between group comparisons presented here. Future studies may want to consider participant perceptions of the quality of the different types of environments.

9.4.8 Conclusions

Much has been written about the mental or emotional benefits from interaction with nature (Croucher et al., 2007; Irvine & Warber, 2002; Keniger, Gaston, Irvine, & Fuller, 2013; Pretty et al., 2011). Recent systematic reviews have concluded that there are emotional well-being benefits from engaging in physical activity in natural environments when compared to indoor or urban environments (Bowler et al., 2010; Thompson Coon et al., 2011). The majority of studies of walking and well-being investigate a participant walking alone in one type of natural environment compared to walking alone in the urban environment or indoors. Results from this study contribute to this research area by showing an effect that walking in a group in different types of natural environments can have on mental and emotional well-being, when compared to group walks in the urban environment. The benefits of outdoor group walks suggest the importance of such programs for improving mental and emotional well-being and increasing physical health through physical activity.

Chapter 10 Discussion and Conclusions

This chapter contains five sections. The first section provides an overview of the study. The second section is a summary of the study's findings and how they relate to each objective. Implications for theory, research, policy, and practitioners are discussed in the third section. Limitations of the study are considered in the fourth section. The chapter ends with recommendations for further research.

10.1 Overview of the study

The aim of this thesis was to evaluate outdoor group walks as a potential public health intervention for positive mental and emotional well-being. Four objectives to meet this aim were to:

1. Evaluate if individuals who take part in outdoor group walks have better mental and emotional well-being than individuals who do not take part in outdoor group walks.
2. Explore the mechanisms that contribute to the relationship between outdoor group walk participation and positive mental and emotional well-being.
3. Investigate whether outdoor group walks facilitate resilience by moderating the effects of adversity on mental and emotional well-being.
4. Explore whether different types of natural environments for a group walk are associated with positive mental and emotional well-being, compared to group walks in the urban environment.

A nonexperimental, longitudinal panel design was developed to explore the mental and emotional well-being from participating in an outdoor walking group (see Section 3.1). The Walking for Health (WfH) programme, a national group walking programme in England, formed the case study from which data on the well-being effects from outdoor group walk participation were drawn (see Section 2.3.1). Two groups of individuals were assessed in this study: adults who were already participating in WfH group walks (Group Walkers); and a comparison group of adults who were not involved in any walking group (Non-Group Walkers). Data were collected from participants using two online questionnaires, which were administered at the start of the study (Time 1) and thirteen weeks later (Time 2).

Due to the nonexperimental research design, participants significantly differed on demographic and pre-existing health variables at the start of the study (see Chapter 4). Such differences between the two groups have important implications for any assumptions of a causal relationship between outdoor group walk participation and well-being – as any group differences on well-being could be attributed to the demographic and health differences in the sample as well as WfH participation. Propensity score matching was used to improve causal assumptions of the effect of outdoor group walk participation on well-being (see Chapter 5). The outcome of the propensity score matching was that a subset of Group Walkers and Non-Group Walkers had no significant group differences on demographic and pre-existing health variables (see Section 5.3.3). This propensity score matched sample – labelled the matched *as treated* sample – was used to investigate the benefits of group walk participation on mental and emotional well-being, the findings of which are summarised below.

10.2 Summary of findings

The following summarises the findings reported in this thesis for each of the four study objectives, and compares them with results from previous studies.

10.2.1 Benefits of participating in outdoor group walks

The first objective of this study evaluated the positive mental and emotional well-being benefits from participating in outdoor group walks. The quantitative methodology enabled comparisons between Group Walkers and Non-Group Walkers on valid, reliable measures of well-being. Between group analyses on mental and emotional well-being sought to answer the first objective of this study (see Sections 6.2.3 and 6.2.4). The hypothesis was that Group Walkers would have more positive mental and emotional well-being than Non-Group Walkers.

Table 10.1, a reproduction of Table 6.12, summarises the between group differences of Group Walkers and Non-Group Walkers on mental and emotional well-being at Time 1 (T1) and Time 2 (T2). Results from the independent samples *t*-tests support the hypothesis; Group Walkers had better mental well-being and positive affect, and less negative affect and depression than Non-Group Walkers. Additional constructs that could also explain the difference in well-being between the two groups (i.e. social support, perceived stress, resiliency and connectedness to nature) were also tested. There was no difference between groups for social support, resiliency or connection to nature. However, there was a significant difference between groups on levels of perceived stress; Group Walkers experienced less perceived stress than Non-Group Walkers.

In order to control for the effects of perceived stress and other covariates on mental and emotional well-being, hierarchical regression analyses were conducted to discern the independent effect of outdoor group walk participation on mental and emotional well-being. The results were almost identical to those from the independent samples *t*-test: Group Walkers had better mental and emotional well-being compared to Non-Group Walkers, over and above the effects of other variables (see Table 10.1). The results suggest that participating in outdoor group walks contributes to positive mental and emotional well-being.

Table 10.1 Reproduced Table 6.12 - summarised results of between group analyses.

	Mental well-being		**Positive Affect**		**Negative Affect**		**Depression**	
Variable	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**	**T1**	**T2**
Independent samples *t*-tests								
Group Walk Participation	↑+	↑+	→	↑+	↑+	↑+	↑+	↑+
Hierarchical regression analyses								
Group Walk Participation	↑+	→	→	↑+	↑+	→	↑+	↑+

Note. Group Walk Participation: 0 = matched *as treated* Non-Group Walkers, 1 = matched *as treated* Group Walkers.
↑+ a statistically significant difference was reported; the direction was beneficial.
→ no statistically significant differences were reported.

The above results mirror those from previous studies which found beneficial improvements in depression (Armstrong & Edwards, 2003; Armstrong & Edwards, 2004; Gusi et al., 2008; Roe & Aspinall, 2011), perceived stress (Roe & Aspinall, 2011) and emotional well-being (Hine et al., 2011; Mayer et al., 2009; Nisbet & Zelenski, 2011; Peacock et al., 2007) from participating in a walking group. The research on group walking, to date, has not examined mental well-being as an outcome variable (see Section 2.3.2), thus the results presented in this thesis are novel. Other group walk studies support the nonsignificant results presented in this thesis for social support (Armstrong & Edwards, 2003; Armstrong & Edwards, 2004) and connectedness to nature (Hine et al., 2011). Existing research on the relationship between outdoor group walks and resiliency measures is limited and the nonsignificant result presented here may be the first to examine resiliency and outdoor group walks.

10.2.2 Mechanisms of the relationship between group walks and positive well-being

Mediation analyses were conducted in order to understand 'how' or 'why' (Hoyle & Robinson, 2004) participating in an outdoor walking group positively influenced mental and emotional well-being (see Chapter 7). Based on previous literature on potential mechanisms of nature and health (Health Council of the Netherlands and Dutch Advisory Council for Research on Spatial Planning, Nature and the Environment, 2004; Mayer et al., 2009; Ward Thompson & Aspinall, 2011), the study investigated five potential mediators: perceived stress reduction, physical activity, social support, connectedness to nature, and resiliency. As physical activity was only measured in the second questionnaire, frequency of non-group walks was used as a proxy in the first questionnaire. Preliminary analyses indicated that the latter three variables did not meet the criteria for a mediator, because group walk participation had no effect on these three variables (see Section 7.2.2). Thus, the mediation analyses were conducted with frequency of non-group walks in green space, physical activity, and perceived stress as mediators.

Table 10.2, reproduced from Table 7.19, summarises the outcomes from the mediation analyses. Frequency of non-group walks was a mediator of Time 1 positive affect only. The mediation can be interpreted thusly: outdoor group walk participation was associated with an increase in the frequency of non-group walks, which in turn positively influenced positive affect. Physical activity mediated the relationship between outdoor group walk participation and Time 2 mental well-being, positive affect and depression. The results for physical activity as a mediator are interpreted thusly: participating in outdoor group walks was associated with an increase in physical activity, which in turn was associated with an increase in mental well-being and positive affect and a reduction in depression. Perceived stress also mediated the relationship between outdoor group walk participation and mental well-being, positive affect and depression at both Time 1 and Time 2, and Time 1 negative affect. The results for perceived stress as a mediator are interpreted thusly: outdoor group walk participation was associated with a reduction in perceived stress, which in turn was associated with a decrease in mental well-being and positive affect, and an increase in negative affect and depression.

Of the three mediators, perceived stress was the most important, explaining a greater proportion of the total effect between group walk participation and mental and emotional well-being than the other two mediators (see Table 10.2).

Table 10.2. Reproduced Table 7.19 - Summarised results of all mediation analyses.

Mediator variable	**Mental Well-being**	**Positive Affect**	**Negative Affect**	**Depression**
	Time 1			
Frequency of non-group walks	*ns*		*ns*	*ns*
Type of mediation		Indirect		
Proportion of the total effect mediated		12.6%		
Perceived stress				
Type of mediation	Partial	Complete	Partial	Partial
Proportion of the total effect mediated	62.5%	55.7%	44%	47.5%
	Time 2			
Physical activity			*ns*	
Type of mediation	Indirect	Partial		Partial
Proportion of the total effect mediated	29.6%	13.7%		12.8%
Perceived stress			*ns*	
Type of mediation	Complete	Partial		Partial
Proportion of the total effect mediated	72.1%	32.9%		49.4%

ns = variable is not a mediator of the group walk-well-being relationship.

Comparison and reflection

The results for perceived stress as a mediator are consistent with research by Groenewegen et al. (2012) which found perceived stress reduction completely mediated the relationship between the quantity of streetscape greenery and mental health, and partially mediated the relationship between quality of streetscape green space and mental health. The same authors (Groenewegen et al., 2012) also found perceived stress reduction to be the most important mediator, accounting for 40% of the total effect of quantity of streetscape greenery and mental health.

The findings of physical activity as a mediator also mirror the literature. Previous studies found walking to be a partial mediator of the relationship between amount of green space and mental health (Groenewegen et al., 2012; Sugiyama et al., 2008). Groenewegen et al. (2012) report that green exercise (i.e. walking or cycling) accounted for 10% of the total effect of quantity of streetscape greenery and mental health.

A question remains, what influenced perceived stress reduction? The literature has identified three mechanisms that may explain the reduction in perceived stress from outdoor group walks: engagement in physical activity (Aldana et al., 1996; Schnohr et al., 2005); perceived social support from others (Cohen, 2004); and interaction with the natural environment (Hawkins, 2012; Roe & Aspinall, 2011; Stigsdotter et al., 2010; Ward Thompson et al., 2012). Physical activity cannot explain the reduction in perceived stress, because frequency of non-group walks in green space and physical activity were controlled for in the perceived stress mediation analyses; thus, the reduction in perceived stress occurred independently of these variables. Social support may be a cause, although there was no effect of outdoor group walk participation on levels of social support. By deduction, interaction with nature may be a probable mechanism to explain the reduction in perceived stress from participating in an outdoor group walk. The majority of Group Walkers (94%) walked in natural environments in the 13-week ‘intervention period’ between the two questionnaires.

10.2.3 Facilitating resilience through outdoor group walks

The third objective sought to understand whether group walk participation could foster resilience by moderating the effects of adversity on mental and emotional well-being. Moderation is useful for answering questions of “when” (Hayes, 2012, p. 1). Chapter 8 addressed the question, would the size of the effect of adversity on well-being depend on whether one participates in an outdoor walking group?

The first hypothesis was that group walk participation would buffer or attenuate the negative effect of stressful life events on mental and emotional well-being (see Section 8.1.4). This hypothesis was supported for Time 1 negative affect with a small interaction effect. Group walk participation attenuated the effect of stressful life events in the past year on negative affect at the start of the study. Non-Group Walkers’ negative affect was positively associated with the number of stressful life events in the past year – those who experienced more stressful events also expressed more negative affect. Conversely, Group Walkers demonstrated resilience to stressful life events by having similar scores of negative affect irrespective of the number of stressful events experienced. Thus, Group Walkers were more resilient to stressful life events in the past year on negative affect than Non-Group Walkers.

The second hypotheses was that outdoor group walk participation would buffer or attenuate the negative effect of social deprivation on mental and emotional well-being (see Section 8.1.4). This hypothesis was marginally supported for Time 1 negative affect only with a small interaction effect. Group walk participation attenuated the effect of social deprivation on negative affect at the start of the study. Non-Group Walkers demonstrated a classic social gradient in negative affect where greater deprivation was associated with greater negative affect. Conversely, Group Walkers were resilient to the negative effects of social deprivation on negative affect; levels of negative affect were more or less stable across levels of deprivation.

<u>Comparison and reflection</u>

Comparisons with previous literature were not possible. Previous studies of nature as a buffer from stressful life events or social deprivation did not investigate negative affect as an outcome variable[54]. In resilience research, outcome variables for stressful life events studies are generally perceived stress (Cohen, 2000) or mental ill health (Fredrickson et al., 2003; Jordanova et al., 2007; Kessler, 1997; Shevlin et al., 2007). Negative affect is used as an outcome variable in resilience studies analysing the impact of daily stressors (Almeida et al., 2002; Montpetit, Bergeman, Deboeck, Tiberio, & Boker, 2010; Ong et al., 2006; Singer et al., 1998; Stawski et al., 2008). The present results mirror previous literature on interacting with natural environments, which report a reduction in negative affect after a solo walk (Bowler et al., 2010; Hartig et al., 1991;

[54] Outcome measures in studies of nature as a protective factor from stressful life events or social deprivation were perceived physical (de Vries, Verheij, Groenewegen, & Spreeuwenberg, 2003, Lechtzin et al., 2010, Maas et al., 2009, Mitchell & Popham, 2007, Mitchell & Popham, 2008, van den Berg, Maas, Verheij, & Groenewegen, 2010) or mental health (de Vries et al., 2003, Ottosson & Grahn, 2008, van den Berg et al., 2010), directed attention (Cimprich & Ronis, 2003, Kuo, 2001, Ottosson & Grahn, 2008), or perceived (Corraliza & Collado, 2011) or physiological stress (Ward Thompson et al., 2012).

Hartig et al., 2003; Pretty et al., 2007), or group walk (Peacock et al., 2007; Roe & Aspinall, 2011), in a natural environment

10.2.4 The effects of different types of environments for a group walk on well-being

The fourth objective sought to identify the types of natural environment for a group walk that are associated with positive mental and emotional well-being. A subsample of frequent Group Walkers were selected for these analyses. The well-being of frequent Group Walkers who walked in different types of natural environments was compared to the well-being of frequent Group Walkers who walked in an urban environment (i.e. streets, shopping centre, plaza) (see Chapter 9). Frequent group walks in farmland were associated with greater mental well-being, and less perceived stress and negative affect, compared to frequent group walks in the urban environment. Frequent group walks in green corridor environments were associated with less perceived stress and negative affect, and (marginally) greater mental well-being, compared to frequent group walks in the urban environment. In all, the results suggest that the positive benefits to well-being from participating in an outdoor walking group can be obtained in any type of environment, but may be enhanced further when walking in farmland or a green corridor environments.

Comparison and reflection

The results are consistent with previous research. The results for farmland environments are supported by de Vries et al. (2003) who found a positive association between the amount of farmland near the home and mental health. The results for green corridor environments (NB: the ‘green corridor’ category includes ‘river path’) are consistent with previous studies in which waterside environments show higher levels of mental (Hinds & Sparks, 2011) and emotional well-being (Barton & Pretty, 2010; Hinds & Sparks, 2011) and self-esteem (Barton & Pretty, 2010) than other types of environments.

The nonsignificant differences between different types of environments and measures of well-being were also supported by previous researchers. Pretty et al. (2007) found that emotional well-being and self-esteem were the same irrespective of the type of environment for a green exercise activity. White et al. (2013) found no difference in recalled restoration from visits in urban environments, when compared to the countryside.

10.2.5 Summary of findings

Participants of Walking for Health, a national group walking programme in England, enhanced their mental well-being and positive affect, and reduced their negative affect, depression and perceived stress compared to individuals who did not take part in the Walking for Health programme. The positive improvement in mental and emotional well-being were confirmed when statistically controlling for demographics and other predictors of well-being. Group walking had no effect on social well-being, connectedness to nature or resiliency.

Participation in an outdoor walking group effects positive mental and emotional well-being through increased physical activity, and decreased perceived stress. The decrease in perceived stress was independent of the effect of physical activity or social support. This suggests that outdoor group walks may reduce perceived stress through interaction with the natural environment.

Outdoor group walks foster resilience from stressful life events in the past year and social deprivation on negative affect only. Individuals who took part in outdoor group walks demonstrated resilience against adversity on negative affect, whilst those not involved in an outdoor walking group were more effected by adversity. No evidence of resilience from outdoor group walk participation was found for mental well-being, positive affect or depression.

Group walks in farmland and green corridor environments may further boost mental well-being, and reduce negative affect and perceived stress. The type of environment for a group walk had no effect on positive affect or depression. The results suggest that positive well-being from outdoor walking groups may be obtained irrespective of the type of environment, but that a further increase may occur in farmland and green corridor environments.

10.3 Implications

10.3.1 Theoretical

In Chapter 2 integrated frameworks for understanding the mental and emotional well-being benefits from participating in outdoor group walks were described. Ways in which the Attention Restoration Theory (ART) and the psycho-evolutionary model might relate to the theories of coping and resilience were suggested. The purpose of these integrated frameworks was to illustrate how group walks in natural environments could contribute to positive well-being. The following will discuss what the data in this thesis say about these integrated approaches.

<u>Coping and restorative environments</u>

Figure 10.1, reproduced from Figure 2.4, shows the proposed integration of the transactional model of stress (Lazarus & Folkman, 1984) and ART. Data from this thesis suggest that the integrated approach of ART and the transactional model of stress presented in Figure 10.1 could be possible. Chapter 7 showed that perceived stress reduction mediated the relationship between outdoor group walk participation and mental and emotional well-being. How does an outdoor group walk reduce perceived stress? Restoration of directed attention from the natural environment could explain the reduction in perceived stress from outdoor group walk participation. Data from the thesis show that the reduction in perceived stress was over and above the effects of physical activity or non-group walks in green space, and was not related to social support (see Chapter 7). However, no measures of directed attention were collected in the study, and as such the proposed integrated framework in Figure 10.1 was not tested in this thesis. Further efforts to understand this integrated framework would need to collect data on directed attention, and conduct a mediation analysis with directed attention as a mediator between outdoor group walks and perceived stress.

Figure 10.1. Reproduced Figure 2.4 - Integration of the transactional model of stress (Lazarus & Folkman, 1984) and ART (Kaplan, 1995).

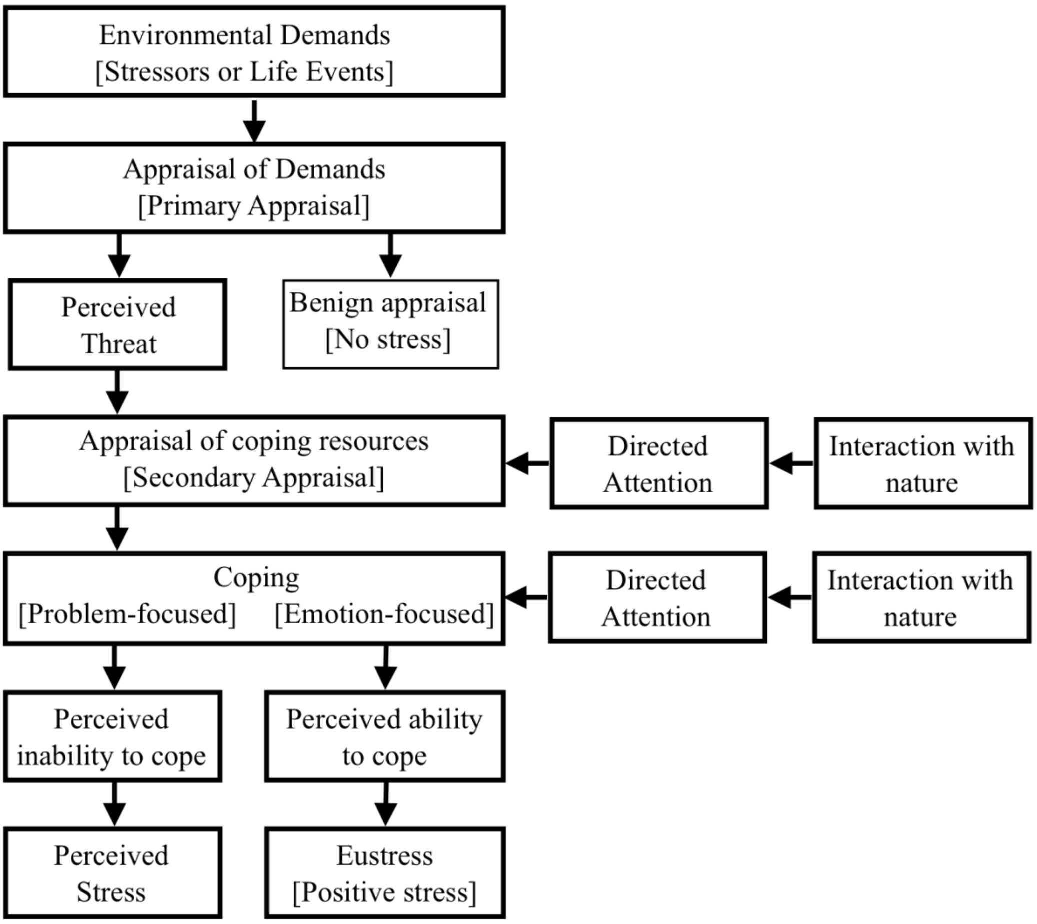
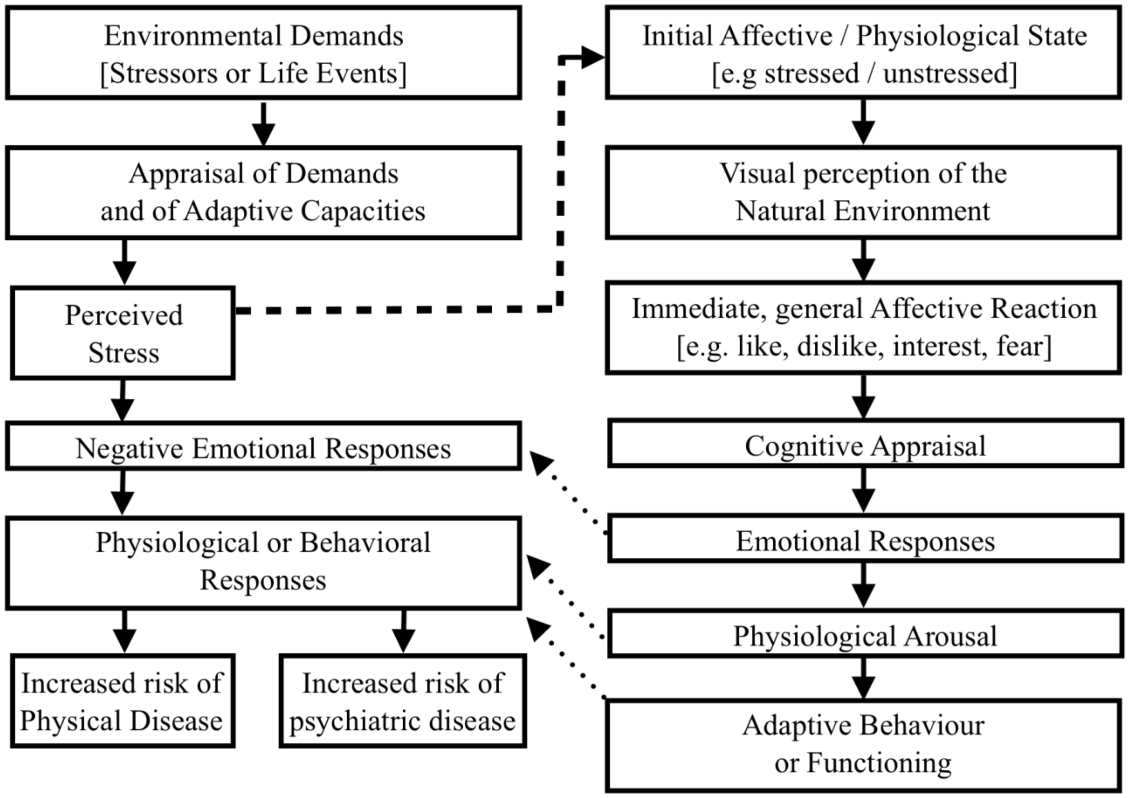


Figure 10.2, reproduced from Figure 2.5, shows the proposed integration of the psycho-evolutionary model with the unified model of stress (Cohen et al., 1997). Data in this thesis provide some support for the integrated framework. The between group analyses in Chapter 6 found that individuals who participated in outdoor group walks had a shift toward more positive emotional states; Group Walkers had significantly reduced T1 negative affect and increased T2 positive affect compared to Non-Group Walkers. Further efforts to understand this integrated framework would need to collect data on perceived stress and emotional, physiological and behavioural stress responses before and after an outdoor group walk. Do stressed individuals who participate in an outdoor walking group show a reduction in levels of emotional, physiological or behaviour stress responses?

Figure 10.2. Reproduced Figure 2.5 - Integration of the unified model of stress (Cohen et al., 1997) (left) and the psycho-evolutionary model (right).



<u>Resilience and restorative environments</u>

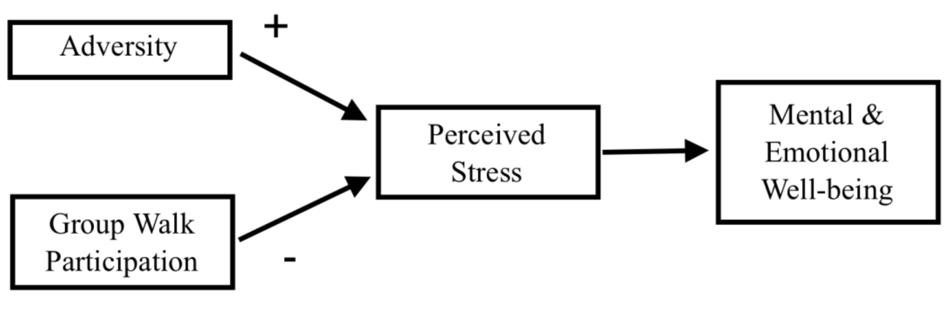
Data were not collected in this thesis to comment on the proposed integration of ART to the theory of resilience. Future research to test this relationship would need to collect data on directed attention, the perceived restorativeness of the natural environment, the ability to think clearly to cope with adversity, as well as evidence of post-adversity growth through higher order ART experiences of thinking through life matters and self-reflection.

Data from this thesis provide some support for the proposed integration of the psycho-evolutionary model to resilience. Chapter 8 showed that participating in an outdoor walking group fostered resilience by attenuating the effect of adversity on negative affect. Both stressful life events in the past year and social deprivation effected negative affect in a positive direction: greater adversity was related to greater negative affect. But the strength of that relationship depended on whether one participated in an outdoor walking group. Greater stressful life events or social deprivation were associated with greater levels of negative affect for Non-Group Walkers, but not for Group Walkers. Group Walkers who experienced many stressful life events in the past year or lived in a deprived environment demonstrated resilience through a reduction in negative affect, which could have been facilitated by attending group walks in the natural environment.

A new model for outdoor group walks and resilience

The results in this thesis suggest that a new model for understanding group walks and resilience is required. Results in Chapter 7 found outdoor group walks indirectly affected mental and emotional well-being through a reduction in perceived stress, whilst Chapter 8 results suggest that outdoor group walks may not interact with adversity to influence mental well-being, depression and positive affect. Based on these findings, an indirect model of resilience in which group walk participation indirectly facilitates resilience by reducing perceived stress may be a better fit for the data (see Figure 10.3). This indirect model of resilience posits that adversity undermines positive well-being by increasing perceived stress, but that outdoor group walk participation can enhance positive well-being, and attenuate the negative effects of adversity, by reducing perceived stress. This model is supported by previous research which has shown that adversity is associated with an increase in perceived stress (Cohen et al., 1983; Cohen & Janicki-Deverts, 2012), and that perceived stress is a mediator between adversity and well-being (Cohen et al., 1997).

Figure 10.3. Indirect model of resilience where the effects of adversity and outdoor group walks on well-being are mediated by perceived stress.



Masten (2001) states that resilience processes can have an indirect effect as well as a moderating effect on well-being. Indirect models of resilience describe an intervention to alter the level of an asset or risk on an individual's well-being (Masten, 2001, p. 230). In the indirect model proposed in Figure 10.3, outdoor group walking could an intervention to alter the level of perceived stress and its impact on well-being. For individuals experiencing adversity, participating in an outdoor walking group may reduce their perceived stress and improve their well-being.

The proposed indirect model of resilience posits directed attention is the mechanism responsible for perceived stress reduction from group walks in the natural environment. Emotional and physiological benefits from group walks in the natural environment posited by the psycho-evolutionary model have a direct influence on well-being, and as such would be represented in Figure 10.3 as an arrow from 'group walk participation' to 'mental and emotional well-being'. Further research is necessary to test this indirect model of resilience.

10.3.2 Research

<u>Propensity score matching</u>

The use of propensity score matching (PSM) is not widely used in psychological research (Harder et al., 2010; Thoemmes, 2012). This thesis may be one of the first to use PSM in nature-health research.

It has been noted that the methodological robustness of nature-health intervention studies could be improved (Brown et al., 2011). Randomised controlled trials (RCTs) provide evidence of the highest quality in health research (Brown et al., 2011); they are considered the "gold standard" (Hine et al., 2011, p. 20). One of the ways in which RCTs achieve this 'gold standard' is through random assignment of participants to conditions, which means confounding covariates are randomly distributed between the groups – ensuring the only difference between the two experimental groups is the treatment condition. However, researchers have argued that RCTs may not be appropriate for nature-health evaluations for the following reasons (Hine et al., 2011, p. 20; Peacock et al., 2007, p. 41):

- The application of a comparative method and control sample are difficult in nature-health studies as there is no discrete 'treatment' group;

- Randomised sampling cannot be applied because there are no identifiable population of ‘patients’ from which to select;
- Nature-health research is not amenable to a placebo;
- Outcomes investigated in nature-health studies are not discrete or easily measured.

The absence of RCTs in nature-health research thus “places greater emphasis on the need to develop and use appropriate and robust alternative methods and approaches” (Brown et al., 2011, p. 25). One such robust and alternative approach could be PSM, which allows researchers to conduct a nonexperimental, comparative study but statistically process the sample to “replicate a randomized experiment” (Stuart & Rubin, 2007, p. 3). The benefits of PSM for nature-health research would be improved internal validity and ability to make causal statements about the impact of the natural environment on health and well-being. It does this by statistically balancing the samples on measured confounding variables. The improvement of causal assumptions is important for understanding and evaluating nature and health interventions (Brown et al., 2011).

PSM does not require a large sample. The most common total sample size for PSM is about 200 participants (Stuart, 2011) and PSM has been effectively used on small samples. For example, Beard et al. (2012) , in an assessment of the effect of nicotine replacement therapy as a smoking cessation intervention, conducted PSM on two samples. The first sample comprised 61 ‘treatment’ participants using nicotine replacement therapy and 468 ‘control’ participants who were not; a PSM sample, using 1:1 nearest neighbour matching without replacement, contained a total of 116 participants with 58 participants in each group. The second sample comprised 25 ‘treatment’ participants who were using the nicotine replacement therapy and 206 ‘control’ participants who were not; the total PSM sample, using 1:1 nearest neighbour matching without replacement, was 40 with 20 participants in each group.

Loss of participants in PSM does not reduce power to detect effects, as long as not too many participants are lost (Ho et al., 2007). This is because power increases when the two groups are more similar or balanced (Harder et al., 2010, p. 245), as the similarity reduces both variance and bias (Ho et al., 2007, p. 214). If there are more ‘control’ participants than 'treatment' participants, as was the case with Beard et al. (2012), then only the control group decreases in size, and power may not reduce very much (Ho et al., 2007).

The drawbacks to PSM are loss of participants, generalisibility, and 'hidden bias' which could still effect internal validity. Loss of participants in PSM through missing data and 'pruning' may mean that important cases with interesting data are lost. Ho et al. (2007) recommend examining the cases that were removed from the matched sample to determine their importance. However, the authors (Ho et al., 2007, p. 232) warn that if critical cases are removed from the matched sample it may be because there were no appropriate matches for them, and as such may not be part of the intended population (Tabachnick & Fidell, 2013). The loss of participants can be mitigated by selecting a different technique to match participants, such as 1:1 matching with replacement or matching one to many 1:*k.* One can use whatever matching approach necessary as long as the balance between the groups on measured covariates has been obtained (see Chapter 5) (Harder et al., 2010, p. 245).

Generalisibility to the population is another limitation of PSM. Due to loss of participants "the researcher must carefully consider the potential implications of such a decision and be clear to whom the estimated effects apply" (Harder et al., 2010, p. 245). The final limitation of PSM is 'hidden bias'. PSM can only match samples based on observed (measured) covariates; it cannot match samples on unmeasured covariates. If an important pre-treatment covariate was omitted from the PSM, then the sample could be unmatched for this variable. RCTs, in contrast, are assumed to have randomly distributed both measured and unmeasured covariates between groups (Harder et al., 2010; Stuart, 2010). Unlike a RCT, unmeasured covariates in a PSM sample cannot be assumed to be evenly distributed between groups. Thus, unmeasured covariates are a "potential hidden bias" (Harder et al., 2010, p. 244). For this reason, the PSM literature recommends including as many observed covariates as possible in order to obtain covariate balance (Stuart, 2010; Thoemmes, 2012). This limitation is not however restricted to PSM only. The inability to balance unmeasured covariates is a major limitation of quasi- and nonexperimental studies in general, and there is no statistical method (PSM or regression) that can correct for unmeasured covariates (Harder et al., 2010, p. 244).

Better understanding of measures

Multiple dimensions of well-being are described in the WHO (1946) definition of health, investigated in the field of positive psychology (Gallagher, 2009; Keyes, 2002), and advocated for in nature and health research (Irvine & Warber, 2002; Irvine et al., 2013; Newton, 2007). The study presented here measured multiple dimensions of well-being based on positive psychology research (Gallagher, 2009; Keyes, 2002): mental, emotional and social well-being. Results from the study provide a useful insight into the measures used and their appropriateness in nature-health research.

Mental well-being is under-investigated in group walking studies (see Section 2.3.2) and in nature and health research more specifically (Newton, 2007). The mental well-being measure used in this study, the Warwick Edinburgh Mental Well-being Scale (WEMWBS) (Tennant et al., 2007), was suitable for assessing the mental well-being of individuals from the general UK population who did or did not take part in an outdoor walking group. The Major Depressive Inventory (MDI) scale (Olsen et al., 2004) was used as the measure of depression used in this study. This was the first time the MDI had been used in nature-health research. This study concludes that nature-health researchers have another measure of depression they can use for their investigations.

Emotional well-being is the most extensively measured psychological outcome in group walk studies specifically (see Section 2.3.2), and in nature and health studies generally (Bowler et al., 2010; Brown et al., 2011; Thompson Coon et al., 2011). The Positive and Negative Affect Schedule (PANAS) (Watson et al., 1988) was used to measure emotional well-being in this thesis. The PANAS was appropriate for the investigation of emotional well-being of individuals who do and do not take part in outdoor group walks in the UK.

Social well-being is also under researched in group walk studies (see Section 2.3.2) and nature-health studies (Bowler et al., 2010; Brown et al., 2011; Thompson Coon et al., 2011). The study presented here used perceived emotional social support as its measure of social well-being. It was hypothesised, based on qualitative research of group walks (Dawson et al., 2006; Hynds & Allibone, 2009; South et al., 2013), that any differences in social support between Group Walkers and Non-Group Walkers would be due to the walking group. However, there was no difference between the two groups on social support. Why the discrepancy between the qualitative and quantitative results for social well-being outcomes from group walks? A possible suggestion is that the measure of social well-being used (Cohen et al., 1985) may have been inappropriate to assess the social well-being from participating in WfH group walks. The social well-being measure used was developed to assess social support as a moderator (Cohen et al., 1985). It was not developed as a tool to investigate the social well-being from small group participation. Other measures used by other group walk studies include social cohesion of small groups (Kwak et al., 2005, p. 24) or social support for exercise (Fitzsimons et al., 2008). These measures were not used in this study because of their inappropriateness for the Non-Group Walkers. The best measures of social well-being from outdoor group walk participation would be one that was based in qualitative data (Irvine et al., 2013).

10.3.3 Policy

WfH may help the UK Government achieve the first objective of its mental health strategy 'No Health Without Mental Health': "more people … will have better wellbeing and good mental health. Fewer people will have mental health problems" (HM Government, 2011, p. 6). To achieve this, the Government needs to improve the mental well-being of the general population, and increase resilience to adversity through public health interventions (HM Government, 2011, p. 19-20). National group walking programmes such as WfH could be a population public health intervention to improve mental and emotional well-being. Population public health models propose a small increase in average mental or emotional well-being across the population could result in a large decrease in the percentage of individuals with mental illness (Foresight Mental Capital and Wellbeing Project, 2008; Friedli, 2009; Huppert, 2008). Results from this thesis suggest that WfH may be a public health intervention to generate and maintain mental well-being and foster resilience of the general population aged 55 and over in England.

The UK Government should further put into policy the use of natural environments for population public health. At present, the UK Government acknowledges that "access to green spaces is associated with better mental health" (HM Government, 2011, p. 19) in its mental health strategy. But in health policy documents, there is only one reference to the use of outdoor environments as a wider determinant of health (Department of Health, 2012b). The results of this thesis add to the growing evidence base that contact with nature can enhance multiple dimensions of well-being. This growing evidence base suggests that interaction with natural environments be incorporated within public health strategies (Maller et al., 2005). Maller et al. (2005) argue that "nature can be seen … as an under-utilized public resource in terms of human health and well-being, with the use of parks and natural areas offering a potential gold mine for population health promotion" (p. 52). Thus, the Government should suggest that Health and Well-being boards collaborate with environmental psychologists and Local Nature Partnerships to utilise the local natural environment as a public health intervention.

10.3.4 Implications for Practitioners

<u>Walking for Health</u>

This study evaluated the WfH national group walk programme. As WfH is the largest group walk intervention in England (Fitches, 2011), there is the potential of WfH to be a population public health promotion intervention for physical, mental, emotional and social well-being. However, to date, only one other study has quantitatively evaluated the impact of WfH on emotional well-being (Pretty et al., 2007), a study whose limitations have been noted (Bird, 2007; Newton, 2007). This thesis may be one of the first to quantitatively investigate the mental, emotional, and social well-being benefits from WfH participation.

An implication for WfH from the findings in this thesis are the insights into the mental, emotional and social well-being benefits from participation in the programme. The results are positive: individuals who participate in WfH group walks had more positive mental and emotional well-being and less perceived stress than individuals who did not take part in group walks. There was, however, no relationship between social well-being and WfH participation. Individuals who participated in WfH had the same levels of social well-being as individuals who did not take part in WfH. The positive results of WfH participation could be used to make the case for support for funding WfH walk schemes and facilitate recruitment to and promotion of WfH group walks.

The WfH management could evaluate the mental, emotional and social well-being benefits from WfH participation, as has been done with physical activity (Dawson et al., 2006; Phillips et al., 2012). Questions about well-being could be included into the Outdoor Health Questionnaire (OHQ) - a one-page questionnaire given to all new individuals who join a WfH group walk. This would enable a holistic understanding of the benefits from WfH participation.

This study demonstrates that evaluations of national group walk programmes need not be “light touch” (Brown et al., 2011, p. 24). In their review of 40 green exercise intervention studies in the UK, Brown et al. (2011) found that the research designs were not rigorous enough to make causal conclusions about the effect of the intervention on health, and suggest why this could be:

> “Another factor affecting the choice of method was the funders’ requests that the evaluation be ‘light touch’ so as not to impose overly on the participants … One [evaluation] selected tools to minimise their impact – but this had implications for the thoroughness and effectiveness of the evaluation overall (Reynolds, 2005). The evaluator has to balance participants’ experience carefully with method choice to meet the interventions aims alongside their evaluation aims.” (p. 24).

This research study presented here asked a lot of its participants. However, the study did not appear to impose overly on participants. Those who did not want to take part in the study were able to opt out, and those who did take part were found to be highly motivated and passionate. The expected response rate from WfH management at the start of the study was 4% (F. Taylor, personal communication, 20 January 2011). However, this study managed to obtain a 21% response rate from Group Walkers and a 10% response rate from lapsed or ‘inactive’ WfH walkers. As such, this study suggests evaluations of group walk programmes can be methodologically rigorous to meet evaluation aims – without overly imposing programme participants.

Health practitioner

The findings add support for the use of group walking programs for ‘green prescriptions’. A ‘green prescription’ is an outdoor physical activity prescription from a health care practitioner (Jepson, Robertson, & Cameron, 2010) and are issued the United States (Institute at the Golden Gate, 2010), New Zealand (New Zealand Ministry of Health, 2010), and Scotland (Jepson et al., 2010). The results presented in this thesis show that Group Walkers have better mental and emotional well-being than Non-Group Walkers (Chapter 6) and that Group Walkers who frequently attended a walking group at least once a week were also frequently participating in other physical activity, which further contributed to positive well-being (Chapter 9). Furthermore, the benefits to mental and emotional well-being from participating in an outdoor group walk could be used by health practitioners to encourage people to take up walking in order to reduce physical inactivity and its concomitant health problems (Walking for Health, 2013e).

Local nature partnerships

In England, there exist Local Nature Partnerships (LNP) – associations of local government departments, organisations and businesses who raise awareness of the benefits and services of the natural environment (Department of Health, 2012a). It is through the Local Nature Partnerships that the health benefits of nature can be advocated to Health and Wellbeing Boards (DEFRA, 2011, p.46). The implications of this study for these Partnerships are further evidence of the well-being benefits of natural environments. A LNP could raise these data with a Health and Wellbeing board to advocate the use of green spaces as a public health intervention for mental and emotional well-being. LNPs may use these data to advocate Local Councils for the conservation of green spaces on health and well-being grounds. Moreover, the results from Chapter 9 show that better well-being may occur from group walks in farmland and green corridor environments. The well-being benefit of group walks in certain types of natural environments could be used by LNP members to advocate and promote use of these specific environments.

10.4 Limitations

Limitations with this research study are largely associated with the nonexperimental research design. In order to take advantage of the large WfH population and to conduct as full an evaluation of the WfH programme as possible, several compromises were made which meant random assignment to conditions and random sampling of participants were not possible. However, the lack of random allocation meant the two groups differed on various demographic and pre-existing health variables (see Chapter 4), which can confound any causal conclusions about the effect of outdoor group walk participation. This is a problem for a study that wants to make causal assumptions on the effect of group walk participation on well-being. To remedy this, propensity score matching was applied to the sample, the outcome of which was similarity between the two samples on demographics, pre-existing health and stressful life events in the past year (see Chapter 5). Unlike random allocation where measured and unmeasured variables are assumed to be randomly distributed between participants (Stuart, 2010), propensity score matching cannot guarantee similarity in the samples on unmeasured variables. This is a "potential hidden bias" (Harder et al., 2010, p. 244). An example of an unmeasured covariate is physical activity prior to starting WfH.

Another limitation is the lack of treatment manipulation. The decision of the author to evaluate current outdoor group walkers enabled the research to take advantage of the very large WfH population – at the cost of obtaining a pretest measure of well-being prior to starting the WfH programme. Thus, the study was unable to determine the 'true' effect outdoor group walk participation has on well-being. The longitudinal design helped to mitigate this threat by demonstrating the change in well-being that could occur if one continues (or not) to walk in a group during the 13-week study period.

To remedy the lack of a pretest, a retrospective pretest was included in the Time 1 online questionnaire to discern change in mental and emotional well-being. However, the retrospective pretest has many validity threats, such as recall bias (Sprangers, Van Dam et al.. 1999; Kreulen, Stommel et al.. 2002), demand characteristics[55] (Kreulen, Stommel et al.. 2002; Lamb 2005), anchoring on current well-being (Aneshensel, Estrada, Hansell, & Clark, 1987) or response shift bias (Pratt et al., 2000; Sprangers et al., 1999). Recall bias and demand characteristics were attempted to be controlled by reminding participants of specific time frames and not communicating with them of the specific objectives of the research study[56].

The time frame for Group Walkers' participation and the assessments of well-being may not overlap. Assessments of well-being, based on valid and reliable measures, were made by asking participants about how they felt in the previous fortnight. However, the eligibility criteria for Group Walkers did not require them to have participated in a WfH

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[55] Demand characteristics is a threat to validity. It occurs when participants are influenced by the purpose of the research and give responses to conform to the research purpose (Lamb, 2005).
[56] Study participants were informed that the purpose of the study was to evaluate the "personal well-being of people who do and do not take part in WfH".

group walk in the previous fortnight. Because the study wanted to evaluate the WfH national walking programme and its impact on well-being, recruitment of WfH participants was kept as realistic as possible. Thus, eligibility criteria at the start of the study, based on previous WfH research (Phillips et al., 2011), required Group Walkers to have taken part in at least one WfH walk in the 6 months prior to the first questionnaire. Eligibility criteria for Group Walkers at the second questionnaire was to attend at least one WfH walk in the previous 13-weeks. This means that a Group Walker participant may not have attended an outdoor group walk in the 2-week assessment period of well-being, indicating that their well-being response could have nothing whatsoever to do with group walking. However, these Group Walkers were in the minority. At the start of the study 85.4% (n = 1,025) of the 1,200 matched *as treated* Group Walkers had taken part in a WfH group walk twice a month or more. At the second questionnaire, 83.5% (n = 1,002) matched *as treated* Group Walkers had taken part in a WfH group walk twice a month or more.

As this study was an evaluation of WfH as a programme, this meant that no restrictions were placed on the Group Walkers sample by the location or type of environment in which they were walking. Consequently, this meant not all Group Walkers were walking in the natural environment. In the 13-week 'intervention period' between the two online questionnaires, 6% (n = 72) of the 1,200 matched as treated Group Walkers had walked in urban public space (i.e. streets, shopping centre, plaza).

The loss of participants over time is also a limitation of the study. The greater the attrition rate of participants from the study, the less claims can be made about the wider population. Whilst strategies were put in place to mitigate participant attrition (i.e. financial incentive to complete both online questionnaires, piloting of online questionnaires, use of reminder and advance notice emails), 35% of Group Walkers and 33% of Non-Group Walkers dropped out of the study from Time 1 to Time 2.

Selection bias is another limitation (Howitt & Cramer, 2008). The kind of person who volunteered to take part in this research study may not be representative of the larger WfH population. Due to the data collection method, participants in the study were a self-selected sample of motivated, computer literate individuals who had the time to complete two lengthy online questionnaires. As such, the sample might not be representative of the general population in England.

Finally, the questionnaires missed measuring some potential covariates. Specifically, the first questionnaire did not measure physical activity, and neither questionnaire contained items relating to current health or medical conditions, disability or loss of physical functioning due to age/health. As both physical activity (Biddle & Mutrie, 2008) and health status (Deacon et al., 2010; Olsen et al., 2004; Tennant et al., 2007; Watson, 1988) can effect well-being, the analysis would have benefited from measurement of and controlling for these variables.

10.5 Further Research

Build on exploratory study – It is recommended that any future evaluations of the multiple dimensions of well-being from WfH participation include pretest-posttest measures. Pretest measures about mental, emotional, and social well-being could be introduced into the WfH Outdoor Health Questionnaire (OHQ), a short two-page questionnaire that all WfH participants complete on their first WfH walk.

ART as a mediator – Further research could investigate whether directed attention mediates the relationship between outdoor group walks and perceived stress reduction.

ART and post-adversity growth – An intervention study could investigate whether interactions with nature foster post-adversity growth. Such a study would test the hypothesis presented in section 2.2.4 about ART and resilience. This study could assign a group of participants who have recently experienced adversity to a natural environment intervention. Outcome measures could be mental fatigue, mental and emotional well-being, the perceived restorativeness of the natural environment, and evidence of higher order ART experiences of thinking through life matters and self-reflection, as well as post-adversity growth. The results could contribute to psycho-therapeutic interventions for resilience (e.g. Fava & Tomba, 2009).

Indirect model of resilience – Future research could test the indirect model of resilience presented in Figure 10.3. Can outdoor walking groups be an resilience intervention for individuals experiencing adversity? Do individuals who are experiencing adversity and participate in an outdoor walking group show evidence of resilience through reduced perceived stress and greater positive well-being, compared to individuals experiencing adversity who did not attend outdoor group walks?

Level of interaction with nature and its consequences on well-being – Previous researchers suggest that the level of interaction with nature can effect well-being outcomes (Duvall, 2010a; Duvall, 2010b). Walking with others may moderate the beneficial effects of natural environments on well-being (Johansson et al., 2011; Staats & Hartig, 2004; Staats, van Gemerden, & Hartig, 2010). Further research in this area of group walks is needed, replicating the experimental research design of Johansson et al (2011) or Plante (2007).

More data on the type of environments for a group walk – Future research could analyse the characteristics of the walk (e.g. intensity, duration, frequency) and the physical environment (e.g. biodiversity, perceived restorativeness) and how they relate to the change in well-being from participating in a single WfH walk.

Secondary data analysis of the data collected in this thesis – The research study collected a substantial amount of data, not all of which could be analysed in this thesis. Further research could conduct within groups **a**nalyses on Non-Group Walkers who started, and Group Walkers who stopped, participating in WfH from the first to the second questionnaire. Would these Non-Group Walkers show a significant increase in well-being following their sudden participation in WfH? Would these Group Walkers show a significant reduction in well-being after they stopped participating in WfH group walks? These participants can show a 'true' pretest-posttest.

A simple replication of this study could be conducted with the 'intention to treat' sample (see Chapter 3) of participants who did not meet the eligibility criteria. Would the same outcomes occur in a 'less pure' sample?

Positive affect could be investigated as a mediator explaining the effects of group walks on mental well-being, depression and negative affect. Positive affect may be "another important mechanism underlying the effects of green space on well-being" (Irvine et al., 2013, p. 431).

Further research on resilience is also possible with the current dataset. First, future analyses could replicate the resilience analyses presented in Chapter 8, but comparing

Non-Group Walkers to frequent Group Walkers, or frequent Group Walkers to non-frequent Group Walkers. Second, specific domains of social deprivation (e.g. income deprivation) could be investigated as an adversity variable in moderation analyses of group walk participation (e.g. Mitchell & Popham, 2007; Mitchell & Popham, 2008). Third, positive affect (Fredrickson et al., 2003; Ong et al., 2006; Tugade & Fredrickson, 2004), social support (Bisconti, Bergeman, & Boker, 2006; Montpetit et al., 2010; Netuveli, Wiggins, Montgomery, Hildon, & Blane, 2008), and resiliency (Crawford, 2012; Montpetit et al., 2010; Ong et al., 2006; Wingo et al., 2010) have been identified as moderators of the relationship between adversity and well-being in resilience research. Further analyses could investigate these variables are moderators of the relationship between stressful life events or social deprivation and well-being.

Data on the frequency and duration of WfH and non-WfH walks in green space were collected that could enable a dose-response analysis. Previous researchers have found a positive dose-response relationship between frequency or duration of outdoor group walks, or green exercise, and emotional well-being outcomes (Barton & Pretty, 2010; Hamer et al., 2009). Such an analyses may be able to contribute to the research area of green prescriptions (Institute at the Golden Gate, 2010; Jepson et al., 2010; New Zealand Ministry of Health, 2010).

10.6 Conclusion

The UK Government wants more people to have better well-being and good mental health (HM Government, 2011, p. 6), which entail public health interventions to improve the mental well-being of the general population, and increase resilience to adversity (HM Government, 2011, p. 19-20). National group walking programmes could be a population public health intervention to improve mental and emotional well-being, but to date have not been evaluated as such. The aim of this thesis was to evaluate outdoor group walks as a potential public health intervention for positive mental and emotional well-being. Four objectives investigated the aim, specifically whether outdoor group walks do contribute to positive mental and emotional well-being, the mechanisms through which this occurs, if outdoor group walks contribute to public health by fostering resilience from adversity, and the types of environments for an outdoor group walk that contribute to positive well-being.

This study suggests that outdoor group walks can be a potential public health intervention for positive mental and emotional well-being. Participants of a national group walking programme in England had better mental well-being and positive affect, and less negative affect, depression and perceived stress, than individuals who did not take part in outdoor group walks. The mechanisms through which outdoor group walks contributed to positive well-being were increased physical activity and decreased perceived stress. There was a little evidence that outdoor group walks foster resilience from adversity for negative affect only. The positive well-being from participating in outdoor walking groups can be obtained in any type of environment, but that an additional increase may occur in farmland and green corridor environments.

Given the projected increase in mental ill health (World Federation for Mental Health, 2012), outdoor group walk programmes would be a potentially important contribution to public health with benefits to mental health and well-being.

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Appendices

Appendix A List of walking or physical exercise intervention studies

Author	Duration of intervention (in weeks)
(Blumenthal, Williams, Needles, & Wallace, 1982)	10
(Bachmann et al., 1985)	13
(MacMahon & Gross, 1987)	20
(Martinsen, Hoffart, & Solberg, 1989)	8
(Sexton, Mære, & Dahl, 1989)	8
(Weber & Wertheim, 1989)	12
(Cramer, Nieman, & Lee, 1991)	10
(Kramer, 1996)	12
(Bream, 1997)	16
(A. H. Taylor, Doust, & Webborn, 1998)	10
(McAuley et al., 2000)	26
(K. Williams, Gill, Butki, & Kim, 2001)	8
(Coutts, Weatherby, & Davie, 2001)	12
(Aşçı, 2003)	10
(Armstrong & Edwards, 2003)	12
(Murtie, Wright, Wilosn, & Gunnyeon, 2004)	4
(Armstrong & Edwards, 2004)	12
(Lancer, 2005)	6
(Killey & Watt, 2006)	1
(Priest, 2007)	10
(Mead et al., 2007)	12
(Nguyen, 2008)	2
(Baker et al., 2008)	12
(Diaz & Motta, 2008)	15
(C. Williams & Tappen, 2008)	16
(Shyu et al., 2008)	52
(Legrand & Mille, 2009)	4
(Barton et al., 2012)	6
(Robichaud, 2009)	6
(Etnier et al., 2009)	18
(Duvall, 2010a)	2
(Dell Pruett, 2010)	10
(MacKay-Lyons et al., 2010)	12
(Wilbur et al., 2009)	24
(Van Citters et al., 2010)	39

Appendix B Pre-recruitment communications to Walking for Health participants

Well-being and Walking for Health study
Info for Regional Teams

What is the purpose of the study?

The study is exploring the wellbeing of people who take part in Walking for Health led walks.

Who's conducting the study?

The study is being carried out by Melissa Marselle, a PhD student from De Montfort University's Institute of Energy and Sustainable Development (IESD) in Leicester. The study is supervised by Katherine Irvine PhD from the IESD, and Sara Warber MD, of the University of Michigan's Department of Family Medicine (USA). The research is funded by De Montfort University and supported by Natural England.

What does it involve?

The study will consist of two questionnaires about walkers' wellbeing. Individuals in the study will be asked to complete an online questionnaire at two different times. Walkers will be contacted via e-mail. We will ask a subset of participants to complete a paper questionnaire for each Walking for Health led walk they attend within a specific time frame.

Data collection will take place in autumn 2011.

Further details about the research will be circulated in March 2011.

Who does it involve?

Walkers who meet the following criteria will be contacted:

1. Aged 18 years and above
2. Have given their consent to be contacted for evaluation purposes (Q21 on OHQ/database, see below)
3. Have gone on at least one Walking for Health walk in the past 6 months, and
4. Have an email address.

Walkers will be contacted in **July 2011**. Please ensure walkers' database entry to Q21on the OHQ correctly reflects their wishes, as it defaults to "no" if not filled out. If necessary, please update walkers' email addresses by the end of June. Thank you.

Q21.	Are you happy to be contacted to help us evaluate health walks? ☐ Yes ☐ No

What will happen to the data?

The data collected will be linked to participants' OHQ and walk history data held on the WfH database. This will be analysed in order to understand if there is a relationship between the number and duration of Walking for Health led walks attended and wellbeing.

All data will be handled in compliance with the Data Protection Act 1998. The research project will meet De Montfort University's Human Research Ethics review guidelines. No names and other personal details of participants will appear in any material (written, oral or otherwise) arising from the research.

If you have any questions regarding this study, please contact Melissa Marselle or Dr Katherine Irvine (details below).

How will the results be used and shared?

The results of this research will add to Natural England's evidence base about Walking for Health. Research findings will be shared with the public through newspaper articles, academic papers and conference presentations. The results will also contribute to our understanding of the effects of walking on wellbeing, as well as Ms. Marselle's PhD thesis.

How will you let people know about the study?

A number of communication channels will be used to publicise the study. Natural England's intranet will carry an article about the study and WfH written by Fiona Eadie. The March Newsletter and the WfH website will both feature the study. Walkers, through their scheme co-ordinator, will be contacted by regional advisers to alert them to the study.

CONTACT DETAILS

If you have any questions about this project please feel free to discuss them with the PhD researcher involved, Melissa Marselle, on 0116 255 1551 extension 6847, or email mmarselle@dmu.ac.uk. You may also contact the research supervisor, Dr Katherine Irvine, on 0116 207 8711 or email kirvine@dmu.ac.uk.

Learn more about the research team by visiting
www.iesd.dmu.ac.uk/staff/students/melissa_marselle.php for Melissa Marselle
www.iesd.dmu.ac.uk/staff/katherine_irvine.php for Katherine Irvine, PhD
www.med.umich.edu/umim/faculty/warber.htm for Sara Warber, MD

Well-being and Walking for Health study
Info for WfH Walkers

What is the purpose of the study?

The study is exploring the personal well-being of people who take part in Natural England's Walking for Health (WfH) programme.

Who is conducting the study?

The study is being carried out by Melissa Marselle, a PhD student from De Montfort University. The study is supervised by Katherine Irvine PhD, from De Montfort University, and Sara Warber MD, from the University of Michigan (USA). The research is funded by De Montfort University and supported by Natural England.

What does it involve?

The study will consist of two online questionnaires about walkers' well-being. The first online questionnaire will be emailed to walkers in August. The second questionnaire will be emailed 12 weeks later. **Walkers who complete both questionnaires will be entered into a prize draw to win £150 worth of High Street Gift Vouchers**. The email in August will come from Melissa Marselle (mmarselle@dmu.ack) with the subject title *"Your invitation to the De Montfort University Well-being and Walking for Health study"*. Within the email will be a link to the online questionnaire.

Who can take part?

Only those individuals who meet the following criteria will be invited to take part in the study:

5. Indicated on their Outdoor Health Questionnaire (recorded on the WfH Database) that he or she is happy to be contacted for evaluation purposes
6. Aged 18 years and above
7. Have gone on at least one Walking for Health walk in the past 6 months, and
8. Gave their email address on their Outdoor Health Questionnaire.

What will happen to the data?

Questionnaire responses will be linked to participants' Outdoor Health Questionnaire and walk history data held on the Walking for Health database. This will be analysed in order to understand if there is a relationship between walker's well-being and the number and duration of Walking for Health walks they attend.

All data will be handled in compliance with the Data Protection Act 1998. The research project meets De Montfort University's Human Research Ethics guidelines. No names or other personal details of participants will appear in any material (written, oral or otherwise) arising from the research.

How will the results be used and shared?

The results of this research will add to Natural England's evidence base about Walking for Health, as well as Ms. Marselle's PhD thesis. Research findings will be shared with the public through newspaper articles, academic papers and conference presentations.

CONTACT DETAILS

If you have any questions about this project please feel free to discuss them with the PhD researcher, Melissa Marselle, on 0116 255 1551 extension 6847, or email mmarselle@dmu.ac.uk. You may also contact the research supervisor, Dr Katherine Irvine, on 0116 207 8711 or email kirvine@dmu.ac.uk.

Learn more about the research team by visiting the following websites:
www.iesd.dmu.ac.uk/staff/students/melissa_marselle.php for Melissa Marselle
www.iesd.dmu.ac.uk/staff/katherine_irvine.php for Katherine Irvine, PhD
www.med.umich.edu/umim/faculty/warber.htm for Sara Warber, MD

New research aims to explore the well-being of walkers

Published: 6th July 2011

Natural England is supporting an exciting new piece of research into the well-being of people who take part in Walking for Health.

The study aims to explore the link between attendance on health walks and personal well-being. It is being carried out by PhD student **Melissa Marselle**, with funding from De Montfort University in Leicester.

An invitation to take part will be emailed in August to walkers (aged 18 or over) who said they are happy to be contacted for evaluation purposes when they completed their Outdoor Health Questionnaire, and who have taken part in a walk in the last six months, as recorded on the WfH Database.

What does the study involve?

Those taking part in the study will be asked to complete two online questionnaires: the first in August, and the second 12 weeks later. Individuals who complete both questionnaires have the chance to win **£150 of high street gift vouchers.** Participation is entirely voluntary, and all data will be confidential and anonymous.

The findings will contribute to valuable new evidence about the value of health walks, and will be shared with the public via newspaper articles, academic papers, and a summary on the WfH website.

We hope you will be able to support this very worthwhile new study. To find out more you can **read our FAQs on the Wellbeing and Walking for Health study** or contact Melissa Marselle on **0116 255 1551** ext. **6847** or **mmarselle@dmu.ac.uk**.

You can also **print a copy of the FAQs** to hand out to walkers on your scheme.

Appendix C Time 1 Questionnaire

Group Walkers' T1 questionnaire

Informed Consent

De Montfort University Well-being and Walking for Health Study

What is the purpose of the study?
The purpose of the study is to learn about the personal well-being of people who do and do not take part in Natural England's Walking for Health programme.

Why am I invited to take part?
You have been asked to take part because you have gone on at least one Natural England Walking for Health walk in the past 6 months, and completed an Outdoor Health Questionnaire on which you ticked a box to say you were happy to be contacted for evaluation purposes. Participation is open to individuals who are aged 18 years or older.

Who is conducting the study?
The study is being carried out by Melissa Marselle, a PhD student at De Montfort University. The study is supervised by Katherine Irvine PhD from De Montfort University, and Sara Warber MD from the University of Michigan (USA). The research is funded by De Montfort University and is supported by Natural England.

What does it involve?
The study involves completing two online questionnaires: now and in 12 weeks time. You are asked to complete the first questionnaire now. The second questionnaire will be emailed to you 12 weeks later. Completing the questionnaire should take about 30 minutes of your time.

If you choose to participate, your Outdoor Health Questionnaire responses and walk history held in Natural England's Walking for Health database will be made available to us. The purpose of this is to understand if there is a relationship between well-being and the number and duration of Walking for Health walks attended.

At the end of this questionnaire, you will be asked if you are willing to recruit someone to take part in the control group of this study. This person should not be taking part in the Walking for Health programme, and should be your same gender, within 10 years of your age and live near you.

Is there an incentive for participating?
Yes. Individuals who complete both online questionnaires will be entered into a prize draw for the chance to win **£150 worth of High Street Gift Vouchers**. Your participation in the study will add to Natural England's evidence base about the Walking for Health programme.

How will the results be used?
The data will be used in: Ms Marselle's PhD thesis; a summary report to Natural England; academic papers; and conference presentations.

Is this confidential?
All data collected and processed in this study will be handled in compliance with the Data Protection Act 1998. All data will be kept confidential. This means that only the PhD student, her two supervisors and Tim Fitches, Evaluation Specialist for Natural England Walking for Health, will know you have participated in the study. All data collected will be stored in a secure location. This study has been approved by De Montfort University's Human Research Ethics committee.

Is my participation anonymous?
Yes. All data will be anonymised. No names or other personal details will appear in any material (written, oral or otherwise) arising from this study.

Are there any risks?
Risks of the study are minimal. The questionnaire will ask you about your feelings and beliefs. You may experience some discomfort answering some of the questions. You may choose not to answer any questions that make you feel uncomfortable.

How can I withdraw from this study?
Your participation in this study is voluntary. You may decide to drop out from this study at any time. To do so, stop answering the questions and close your Internet browser. If you choose to withdraw from the study after you have completed the questionnaire, please contact Ms Marselle (details below).

If you prefer not to be contacted for any future evaluation of Natural England's Walking for Health programme, please email tim.fitches@naturalengland.org.uk.

CONTACT DETAILS

If you have any questions about this study please feel free to discuss them with the PhD student, Melissa Marselle, on 0116 255 1551 extension 6847 or email mmarselle@dmu.ac.uk.

You may also contact the Research Supervisor, Dr Katherine Irvine on 0116 207 8711 or email kirvine@dmu.ac.uk.

If you have any general questions about your rights as a participant, or wish to make a complaint, you can contact De Montfort University's Ethics Administrator Professor Bernd Stahl, on 0116 207 8252, or email bstahl@dmu.ac.uk.

PLEASE PRINT OR SAVE A COPY OF THIS PAGE (Information sheet for WfH walkers) FOR YOUR RECORDS

By clicking the "I agree to take part in this study" button below, you confirm that you are 18 years of age or older, and voluntarily agree to take part in this research study.

If you do not wish to participate, click the "I do not wish to take part in this study" button below.

I agree to take part in this study	I do not wish to take part in this study
○	○

No consent End of survey

Thank you very much for your time.

If you have any questions about this research project, please feel free to contact Melissa Marselle, PhD student at De Montfort University at 0116 255 1551 extension 6847 or mmarselle@dmu.ac.uk

Introduction

Thank you for deciding to take this questionnaire.

Completing the questionnaire should take about 30 minutes of your time. You can stop the questionnaire and come back to it at any time by using the link in the invitation email.

The deadline for completing the questionnaire is **August 15th**.

Because the questionnaire is about your thoughts and feelings, it is suggested that you complete it in a quiet setting, if possible.

Thank you again for your help with this study.

About Walking for Health behaviour

Page 1 of 14

When did you first start walking in one of Natural England's Walking for Health schemes? Please select the month and the year from the drop down lists below.

Month

Year

What was the date of your last walk with one of Natural England's Walking for Health schemes? Please select the month and the year from the drop down lists below.

Month

Year

On average, how frequently do you take part in one of Natural England's Walking for Health schemes?

- Daily
- 4-6 Times a Week
- 2-3 Times a Week
- Once a Week
- 2-3 Times a Month
- Once a Month
- Several Times a Year
- Once a Year
- Never

On average, how frequently do you walk or hike in green space (such as a local park, natural area, national park, countryside) <u>outside of your local Natural England Walking for Health scheme</u>?

- Daily
- 4-6 Times a Week
- 2-3 Times a Week
- Once a Week
- 2-3 Times a Month
- Once a Month
- Several Times a Year
- Once a Year or Less
- Never

Retrospective questions

Page 2 of 14

The questions below ask you to reflect on any changes you may have experienced since you first took part in a Natural England Walking for Health scheme. Please reflect back on your experience **<u>before taking part in Walking for Health</u>** and compare this to your experience **<u>now</u>**.

Move the slider along the line to describe your experience at the two different time points. The slider turns blue when it has been moved.

	Anxious	Relaxed
<u>Before you started</u>		

Walking for Health, how relaxed or anxious did you feel?	
How do you feel **now**?	

	Negative mood	Positive mood
Before you started Walking for Health, how was your mood?		
How is your mood **now**?		

	Not thinking clearly	Thinking clearly
Before you started Walking for Health, to what extent were you able to think clearly?		
To what extent are you able to think clearly **now**?		

	Not depressed	Severely depressed
Before you started Walking for Health, to what extent did you feel depressed?		

To what extent do you feel depressed **now**?	

Nature Connectedness

Page 3 of 14

Please answer each statement in terms of the way you generally think and feel about the natural world.

Use the scale to the right to indicate how much you agree with each statement.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I often feel a sense of oneness with the natural world around me	○	○	○	○	○
I think of the natural world as a community to which I belong	○	○	○	○	○
I recognise and appreciate the intelligence of other living organisms	○	○	○	○	○
I often feel disconnected from nature	○	○	○	○	○
When I think of my life, I imagine myself to be part of a larger cyclical process of living	○	○	○	○	○
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I often feel a kinship with animals and plants	○	○	○	○	○
I feel as though I belong to the Earth as equally as it belongs to me	○	○	○	○	○
I have a deep understanding of how my actions affect the natural world	○	○	○	○	○
I often feel part of the web of life	○	○	○	○	○
I feel that all inhabitants of Earth - human and nonhuman - share a common 'life force'	○	○	○	○	○
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Like a tree can be part of a forest, I feel embedded within the broader natural world	○	○	○	○	○
When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature	○	○	○	○	○
I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees	○	○	○	○	○
My personal welfare is independent of the welfare of the natural world	○	○	○	○	○

Social support

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Below are a list of statements about friends and family, which may or may not be true for you.

Please choose an answer to indicate your response as it applies to you.

Select "definitely true" if you are sure it is true about you, and "probably true" if you think it is true but are not absolutely certain.

Likewise, select "definitely false" if you are sure the statement is false and "probably false" if you think it is false but are not absolutely certain.

	Definitely True	Probably True	Probably False	Definitely False
There are several people that I trust to help solve my problems	○	○	○	○
There is no one I feel comfortable talking to about intimate personal problems	○	○	○	○
There really is no one who can give me an honest view of how I'm handling my problems	○	○	○	○
I feel that there is no one I can share my most private worries and fears with	○	○	○	○
There is someone I can turn to for advice about handling problems with my family	○	○	○	○
When I need suggestions on how to deal with a personal problem, I know someone I can turn to	○	○	○	○
There is someone I could turn to for advice about changing my job or volunteer focus	○	○	○	○
There really is no one I can trust to give me good financial advice	○	○	○	○
If a family crisis arose, it would be difficult to find someone who could give me good advice about how to handle it	○	○	○	○
There is at least one person I know whose advice I really trust	○	○	○	○

Stressful life experiences

Page 5 of 14

Below are a list of problems or events. For each, please indicate if you have experienced any of the problems or events in the **past 12 months**.

	Yes	No
A serious illness, injury or an assault to yourself	○	○
A serious illness, injury or assault to a close relative	○	○
Death of a parent, spouse, partner, child, brother or sister of yours	○	○
Death of a close family friend or other relative, like an aunt, cousin or grandparent	○	○
Separation due to marital difficulties, divorce or break down of a steady relationship	○	○
Serious problem with a close friend, neighbour or relative	○	○
Being made redundant or sacked from your job	○	○
Looking for work without success for more than 1 month	○	○
Major financial crisis, such as losing the equivalent of 3 months income	○	○
Problem with the police involving a court appearance	○	○
Something you valued being lost or stolen	○	○

Conner-Davidson Resilience Scale 10

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Please indicate how much you agree with each of the following statements as they apply to you

Please indicate how much you agree with each of the following statements as they apply to you.

Use the drop down menu to the right to answer each statement.

	Not true at all	Rarely True	Sometimes True	Often True	True nearly all the time
I am able to adapt when changes occur					
I can deal with whatever comes my way					
I try to see the humorous side of things when I am faced with problems					
Having to cope with stress can make me stronger					
I tend to bounce back after illness, injury, or other hardships					
I believe I can achieve my goals, even if there are obstacles					
Under pressure, I stay focused and think clearly					
I am not easily discouraged by failure					
I think of myself as a strong person when dealing with life's challenges and difficulties					
I am able to handle unpleasant or painful feelings like sadness, fear and anger					

Perceived Stress Scale

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You are halfway there. Great job!

The questions below ask about your feelings and thoughts in the past month. Ple*ase indicate how often you felt or thought a certain way.*

In the past month, how often have you.....

	Never	Almost Never	Sometimes	Fairly Often	Very Often
.... been upset because of something that happened unexpectedly?					
.... felt that you were unable to control the important things in your life?					
.... felt nervous and 'stressed'?					
.... felt confident about your ability to handle your personal problems?					
.... felt that things were going your way?					
.... found that you could not cope with all the things you had to do?					
.... been able to control irritations in your life?					
.... felt that you were on top of things?					
.... been angered because of things that were outside of your control?					
.... felt difficulties were piling up so high that you could not overcome them?					

WEMWBS

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Please choose an answer that best describes your experience over the **past two weeks**.

	None of the time	Rarely	Some of the time	Often	All of the time
I've been feeling optimistic about the future	○	○	○	○	○
I've been feeling useful	○	○	○	○	○
I've been feeling relaxed	○	○	○	○	○
I've been feeling interested in other people	○	○	○	○	○
I've had energy to spare	○	○	○	○	○
I've been dealing with problems well	○	○	○	○	○
I've been thinking clearly	○	○	○	○	○
I've been feeling good about myself	○	○	○	○	○
I've been feeling close to other people	○	○	○	○	○
I've been feeling confident	○	○	○	○	○
I've been able to make up my own mind about things	○	○	○	○	○
I've been feeling loved	○	○	○	○	○
I've been interested in new things	○	○	○	○	○
I've been feeling cheerful	○	○	○	○	○

Major Depression Inventory

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The following questions ask about how you have been feeling over the **past two weeks**.

Using the scale to the right, please select a response that is closest to how you have been feeling.

	At no time	Some of the time	Slightly less than half of the time	Slightly more than half of the time	Most of the time	All the time
Have you felt sad or low in spirits?	○	○	○	○	○	○
Have you lost interest in your daily activities?	○	○	○	○	○	○
Have you felt lacking in energy or strength?	○	○	○	○	○	○
Have you felt less self-confident?	○	○	○	○	○	○
Have you had a bad conscience or feelings of guilt?	○	○	○	○	○	○
Have you felt that life wasn't worth living?	○	○	○	○	○	○
Have you had difficulty in concentrating, e.g. when reading the newspaper or watching television?	○	○	○	○	○	○
Have you felt very restless?	○	○	○	○	○	○

Have you felt slowed down or subdued?	○	○	○	○	○	○
Have you had trouble sleeping at night?	○	○	○	○	○	○
Have you suffered from reduced appetite?	○	○	○	○	○	○
Have you suffered from increased appetite?	○	○	○	○	○	○

20 item PANAS

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You are almost done!

Below are a number of words that describe different feelings and emotions. Please indicate to what extent you have felt this emotion during the **past two weeks?**

Read each word and then select a response that reflects how you have been feeling.

	Very slightly or Not at all	A little	Moderately	Quite a bit	Extremely
Interested	○	○	○	○	○
Distressed	○	○	○	○	○
Excited	○	○	○	○	○
Upset	○	○	○	○	○
Strong	○	○	○	○	○
Guilty	○	○	○	○	○
Scared	○	○	○	○	○
	Very slightly or Not at all	A little	Moderately	Quite a bit	Extremely
Hostile	○	○	○	○	○
Enthusiastic	○	○	○	○	○
Proud	○	○	○	○	○
Irritable	○	○	○	○	○
Alert	○	○	○	○	○
Ashamed	○	○	○	○	○
Inspired	○	○	○	○	○
	Very slightly or Not at all	A little	Moderately	Quite a bit	Extremely
Nervous	○	○	○	○	○
Determined	○	○	○	○	○
Attentive	○	○	○	○	○
Jittery	○	○	○	○	○
Active	○	○	○	○	○
Afraid	○	○	○	○	○

Demographic information

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The following questions are about you.
Your answers are for analysis purposes only. No names or other personal details about yourself will appear in any material arising from the research.

What is your age?

What is your postcode?

What is your current status?

- Single, never married or in a civil partnership
- Living with partner / Cohabiting as a couple
- Married
- Civil partnership
- Separated
- Divorced
- Widowed

What is your highest qualification?

Please choose an answer that closely resembles your highest qualification.
If your qualification is not listed, please choose an answer that contains its nearest equivalent.

- No qualifications
- 1 - 4 O levels/CSEs/GCSEs (any grades), Entry Level, Foundation Diploma, NVQ Level 1, Foundation GNVQ
- 5+ O levels (passes)/CSEs (grade 1) /GCSEs (grades A* - C), School Certificate, 1 A level/ 2-3 AS levels/ VCEs, Higher Diploma, NVQ Level 2, Intermediate GNVQ
- 2+ A levels/VCEs, 4+ AS levels, Higher School Certificate, Progression/Advanced Diploma, NVQ Level 3, Advanced GNVQ
- Degree (for example BA, BSc), Higher degree (for example MA, PhD, PGCE), NVQ Level 4 - 5, HNC, HND, RSA Higher Diploma, BTEC Higher Level, Professional qualifications

Recruitment

Page 12 of 14

I would like to give this survey to individuals who do **not** participate in one of Natural England's Walking for Health schemes. These individuals will form a control group for the study. The well-being of people participating in Walking for Health can be compared to the well-being of those who do not.

Would you be willing to help me recruit someone who does **not participate in Walking for Health** to take this survey? This person should be **your same gender, within 10 years of your age, and live near you**.

Individuals who form the control group will have the chance to win £150 worth of High Street Gift Vouchers from a separate prize draw.

'Yes'
If you know someone that meets the above requirements, and are willing to recruit him or her, please tick 'Yes' below. Melissa will send you an invitation email that you can forward to your friend's email address. For ethical reasons, I cannot ask you for your friend's email.

'No'
If you do not know someone that meets the above requirements, or do not wish to recruit such a person, please tick 'No' below.

- Yes
- No

Thank you for your willingness to help us recruit a group of people who do not participate in Walking for Health.

Melissa Marselle will send you an invitation email shortly. You can then forward this invitation email to your friend's email address.

Your friend can choose whether or not they want to take part in the survey.

Study 2 recruitment

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This is the last question!

Would you like to help the study further by completing a short paper questionnaire for every Natural England Walking for Health led walk you attend from 22 August to 14 November 2011?

The questionnaire is 2 sides of a sheet of A4 and asks about your feelings and experience of the outdoor walk. The paper questionnaire should take about 10 minutes of your time to complete.

To compensate you for your time, an additional prize draw for the chance to win **£100 of High Street Gift Vouchers** is available to those who complete a paper questionnaire for every Natural England Walking for Health walk they attend between 22 August and 14 November 2011.

- Yes
- No

Thank you very much for your willingness to help the study further.

May I have your postal address in order to send you a Participant Pack containing a set of questionnaires and pre-addressed stamped return envelopes?

You already gave your postcode above, so you don't have to re-enter it again now.

Address

Address 2

City

County

NATURAL WALKING

dmu.ac.uk
DE MONTFORT UNIVERSITY

Snowball sampled Non-Group Walkers' T1 questionnaire

The T1 online questionnaire for snowball sampled Non-Group Walkers was very similar to the T1 questionnaire for Group Walkers, above. However, there were three differences. First, in the informed consent the 'Why am I invited to take part?' text stated:

You have been asked to take part because you were referred by a friend and do not participate in one of Natural England's Walking for Health schemes. You do not have to be an active walker to take part, in fact, we welcome you to the study. However, you must be aged 18 or over to participate.

Second, there were questions about whether the participant was a member of a walking group. The following question was asked on page 1:

Do you attend an outdoor walking group (such as the Ramblers Association, Feet First, or a local walking group)?

- Yes
- No

If the participant was a member of a walking group, they were asked to answer the following questions about his or her walking group behaviour on page 1b of the T1 questionnaire:

What is the name of the outdoor walking group you attend?

- Ramblers Association
- Natural England Walking for Health
- Walk4Life
- Other (please write in the name of your outdoor walking group below):

When did you first start walking with this outdoor walking group?
Please select the month and the year from the drop down lists below.

- Month
- Year

What was the date of your last walk with this outdoor walking group?

Please select the month and the year from the drop down lists below.

- Month
- Year

On average, how frequently do you take part in this outdoor walking group?

- Daily
- 4-6 Times a Week
- 2-3 Times a Week
- Once a Week
- 2-3 Times a Month
- Once a Month
- Several Times a Year
- Once a Year or Less
- Never

Thirdly, at the end of the T1 questionnaire, Snowball Sampled Non-Group Walkers were asked to enter their first name, surname and email address in order to complete the T2 questionnaire and be eligible for the prize draw. This occurred on final page of the T1 questionnaire for Snowball sampled Non-Group Walkers:

Congratulations, you have finished the first survey! You are halfway to being entered into the prize draw for a chance to win **£150 of High Street Gift vouchers**.

The prize draw is only available to individuals who complete both online surveys - now and in 12 weeks time.

I would like to send you the second online survey in 12 weeks time. To do this, I need your email address.

Please enter your name and email address below so that I may send you the second survey.

Your email address will not be used for anything unrelated to this research project - that would be unethical.

Inactive Non-Group Walkers' T1 questionnaire

The T1 online questionnaire for Inactive Non-Group Walkers was very similar to the T1 questionnaire for Group Walkers, above. However, there were a three differences. First, in the informed consent the 'Why am I invited to take part?' text stated:

You have been asked to take part in this study because you have taken part in at least one a *Walking for Health* health walk, but have not taken part in a health walk since mid-January this year, and completed an Outdoor Health Questionnaire on which you ticked a box to say you were happy to be contacted for evaluation purposes.

Second, Inactive Non-Group Walkers had a validation question immediately after he or she gave informed consent and were informed about the study. The purpose of the validation question was to ensure only individuals who had not taken part in a group walk comprised the Non-Group Walkers group. The text for the validation question was:

For this survey we are particularly interested in people who have **not** taken part in a Walking for Health health walk since 14 January 2011.

So before we begin, can you please clarify whether **you have taken part in a Walking for Health health walk since 14th January 2011?**

Health walks are characterised by being free organised group walks led by trained Walk Leaders.

	I have **not** taken part in a health walk since 14 January 2011
	I have taken part in a health walk since 14 January 2011- and it was a Walking for Health health walk
	I have taken part in a health walk since 14 January 2011 - and it was not a Walking for Health health walk
	I have taken part in a health walk since 14 January 2011 - but I don't know if it was a Walking for Health health walk or not

If you remember the name of the health walk group, can you please write it in the space below.
If you do not recall the name of the health walk group, you can leave this blank.

Third, Inactive Non-Group Walkers T1 questionnaire contained questions about whether the participant was a member of an outdoor walking groups and if so, their outdoor group walk behaviour. These items were identical to those used in the Snowball sampled Non-Group Walkers' T1 questionnaire.

Appendix D Time 2 Questionnaire

Group Walkers' T2 questionnaire

De Montfort University Well-being and Walking for Health Study

Thank you again for your help in August with the first survey of this study. This is the second, and final, survey of this study.

Questions in this survey are about your health walk involvement and personal well-being since 15th August 2011. You are welcome to take part in the study regardless of the number of health walks you may or may not have attended since August.

It is estimated the survey will take about 20-25 minutes of your time to complete.

Your responses are saved automatically. If you need to take a break, you can come back to the survey at any time by using the web link in the email from Melissa Marselle.

The deadline for completing the survey is 1st December 2011.

We really hope you consider taking part in this second survey. Thank you.

In the last seven days, on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate?

In addition to Walking for Health health walks, this may include sport, exercise, and brisk walking or cycling for recreation or to get to and from places, but should not include housework or physical activity that is part of your job.
Please put an 'X' in one box to the left to indicate your answer.

	0 days
	1 day
	2 days
	3 days
	4 days
	5 days
	6 days
	7 days

When did you last attend a Walking for Health health walk?
Please write the month in the space below.

Month	

Since 15 August 2011, on average how frequently did you attend a Walking for Health health walk?
Please put an 'X' in one box to the left to indicate your answer.

	Daily
	4-6 Times a Week
	2-3 Times a Week
	Once a Week
	2-3 Times a Month
	Once a Month
	Several Times a Year
	Once a Year
	Never

Thinking of all the Walking for Health health walks you have done since 15 August 2011, on average how much time would you spend walking?
Please put an 'X' in one box to the left to indicate your answer.

	0 minutes
	15 minutes
	30 minutes
	45 minutes
	1 hour
	1 hour 15 minutes
	1 hour 30 minutes
	1 hour 45 minutes
	2 hours
	2 hours 15 minutes
	2 hours 30 minutes
	2 hours 45 minutes
	3 hours
	Greater than 3 hours

Since 15 August 2011, on average how frequently did you walk or hike in green space - outside of Walking for Health health walks?
Green space can be a park, natural area, national park, or countryside.
Please put an 'X' in one box to the left to indicate your answer.

	Daily
	4-6 Times a Week
	2-3 Times a Week
	Once a Week
	2-3 Times a Month
	Once a Month
	Several Times a Year
	Once a Year
	Never

Thinking about all the walks in green space you have done outside of Walking for Health since 15 August 2011, on average how much time would you spend walking?
Please put an 'X' in one box to the left to indicate your answer.

	0 minutes
	15 minutes
	30 minutes
	45 minutes
	1 hour
	1 hour 15 minutes
	1 hour 30 minutes
	1 hour 45 minutes
	2 hours
	2 hours 15 minutes
	2 hours 30 minutes
	2 hours 45 minutes
	3 hours
	Greater than 3 hours

What is the name of your main Walking for Health group you have walked with since 15 August?
If you do not know the name of your main Walking for Health group, could you please write where you walk with this group - such as a town (Torquay) or natural area (Attenborough Nature Reserve).

Please write the name of main Walking for Health group below.

____

What is the main type of environment you walk in with this group?
*Please put an 'X' in **one** box to the left to indicate your answer.*

	Natural and Semi-natural places (e.g. Country Park, Nature Reserve)
	Parks and Gardens (e.g. public gardens, formal parks)
	Green corridor (e.g. river path, cycleways, bridleways)
	Urban public space (e.g. streets, shopping centre, plaza)
	Outdoor sports facilities (e.g. school playing field, football pitch)
	Amenity green space (e.g. informal recreation ground, village greens)
	Allotments, Community gardens, Urban farms
	Farmland
	Coastal (e.g. seaside, estuary)
	Other (Please write in below):

Below are statements about feelings and thoughts. Please choose an answer that best describes your experience over the past two weeks.
Please chose a response for each statement by placing an 'X' in the appropriate box.

	None of the time	Rarely	Some of the time	Often	All of the time
I've been feeling optimistic about the future					
I've been feeling useful					
I've been feeling relaxed					
I've been feeling interested in other people					
I've had energy to spare					
I've been dealing with problems well					
I've been thinking clearly					
I've been feeling good about myself					
I've been feeling close to other people					
I've been feeling confident					
I've been able to make up my own mind about things					
I've been feeling loved					
I've been interested in new things					
I've been feeling cheerful					

The following questions ask about how you have been feeling over the past two weeks.

Using the scale to the right, please chose a response that is closest to how you have been feeling by placing an 'X' in the box.

	At no time	Some of the time	Slightly less than half of the time	Slightly more than half of the time	Most of the time	All the time
Have you felt sad or low in spirits?						
Have you lost interest in your daily activities?						
Have you felt lacking in energy or strength?						
Have you felt less self-confident?						
Have you had a bad conscience or feelings of guilt?						
Have you felt that life wasn't worth living?						
Have you had difficulty in concentrating, e.g. when reading the newspaper or watching television?						
Have you felt very restless?						
Have you felt slowed down or subdued?						
Have you had trouble sleeping at night?						
Have you suffered from reduced appetite?						
Have you suffered from increased appetite?						

Below are a number of words that describe different feelings and emotions. Please indicate to what extent you have felt this emotion during the past two weeks?
Read each word and then select a response that reflects how you have been feeling.

	Very slightly or Not at all	A little	Moderately	Quite a bit	Extremely
Interested					
Distressed					
Excited					
Upset					
Strong					
Guilty					
Scared					
Hostile					
Enthusiastic					
Proud					
Irritable					
Alert					
Ashamed					
Inspired					
Nervous					
Determined					
Attentive					
Jittery					
Active					
Afraid					

Below are a list of problems or events. For each, please indicate if you have experienced any of the problems or events in the since 15 August.

For each, please put an X *in the appropriate box.*

	Yes	No
A serious illness, injury or an assault to yourself		
A serious illness, injury or assault to a close relative		
Death of a parent, spouse, partner, child, brother or sister of yours		
Death of a close family friend or other relative, like an aunt, cousin or grandparent		
Separation due to marital difficulties, divorce or break down of a steady relationship		
Serious problem with a close friend, neighbour or relative		
Being made redundant or sacked from your job		
Looking for work without success for more than 1 month		
Major financial crisis, such as losing the equivalent of 3 months income		
Problem with the police involving a court appearance		
Something you valued being lost or stolen		

The questions below ask about your feelings and thoughts in the past month. Please indicate how often you felt or thought a certain way.

In the past month, how often have you.....

	Never	Almost Never	Sometimes	Fairly Often	Very Often
.... been upset because of something that happened unexpectedly?					
.... felt that you were unable to control the important things in your life?					
.... felt nervous and 'stressed'?					
.... felt confident about your ability to handle your personal problems?					
.... felt that things were going your way?					
.... found that you could not cope with all the things you had to do?					
.... been able to control irritations in your life?					
.... felt that you were on top of things?					
.... been angered because of things that were outside of your control?					
.... felt difficulties were piling up so high that you could not overcome them?					

Please indicate how much you agree with each of the following statements as they apply to you.

Please place an 'X' in the box to the right to answer each statement.

	Not true at all	Rarely True	Sometimes True	Often True	True nearly all the time
I am able to adapt when changes occur					
I can deal with whatever comes my way					
I try to see the humorous side of things when I am faced with problems					
Having to cope with stress can make me stronger					
I tend to bounce back after illness, injury, or other hardships					
I believe I can achieve my goals, even if there are obstacles					
Under pressure, I stay focused and think clearly					
I am not easily discouraged by failure					
I think of myself as a strong person when dealing with life's challenges and difficulties					
I am able to handle unpleasant or painful feelings like sadness, fear and anger					

Below are a list of statements about friends and family, which may or may not be true for you.
Please put an 'X' in the box to indicate your response as it applies to you.
Select "definitely true" if you are sure it is true about you, and "probably true" if you think it is true but are not absolutely certain.
Likewise, select "definitely false" if you are sure the statement is false and "probably false" if you think it is false but are not absolutely certain.

	Definitely True	Probably True	Probably False	Definitely False
There are several people that I trust to help solve my problems				
There is no one I feel comfortable talking to about intimate personal problems				
There really is no one who can give me an honest view of how I'm handling my problems				
I feel that there is no one I can share my most private worries and fears with				
There is someone I can turn to for advice about handling problems with my family				
When I need suggestions on how to deal with a personal problem, I know someone I can turn to				
There is someone I could turn to for advice about changing my job or volunteer focus				
There really is no one I can trust to give me good financial advice				
If a family crisis arose, it would be difficult to find someone who could give me good advice about how to handle it				
There is at least one person I know whose advice I really trust				

Please answer each statement as honestly and candidly as you can what you are presently experiencing.

Please place an 'X' in the space to the right to indicate how much you agree with each statement.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I often feel a sense of oneness with the natural world around me					
I think of the natural world as a community to which I belong					
I recognise and appreciate the intelligence of other living organisms					
I often feel disconnected from nature					
When I think of my life, I imagine myself to be part of a larger cyclical process of living					
I often feel a kinship with animals and plants					
I feel as though I belong to the Earth as equally as it belongs to me					
I have a deep understanding of how my actions affect the natural world					
I often feel part of the web of life					
I feel that all inhabitants of Earth - human and nonhuman - share a common 'life force'					
Like a tree can be part of a forest, I feel embedded within the broader natural world					
When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature					
I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees					
My personal welfare is independent of the welfare of the natural world					

That was the last question. Congratulations! You have completed the second survey!

Thank you very much for your time!

Inactive Non-Group Walkers' T2 questionnaire

The T1 online questionnaire for Inactive Non-Group Walkers was very similar to the T1 questionnaire for Group Walkers, above. However, there were a two main differences. First, inactive WfH walkers were asked to complete a validation question before starting the T2 questionnaire. The text for the T2 validation question is as follows:

Before we begin, can you please clarify whether **you have taken part in a Walking for Health health walk since 10th October 2011**?

Health walks are characterised as free, organised group walks led by trained Walk Leaders

	I have **not** taken part in a health walk since 10 October 2011
	I have taken part in a health walk since 10 October 2011 – and it was a *Walking for Health* health walk
	I have taken part in a health walk since 10 October 2011 – and it was not a *Walking for Health* health walk
	I have taken part in a health walk since 10 October 2011 – but I don't know if it was a *Walking for Health* health walk or not

If you have taken part in a health walk since 10 October, **what was the name of this health walk group?**

Please write the name of the health walk group below.

If you do not remember the name of the health walk group, could you please write where you walked with this group.

Second, inactive participants T2 questionnaire asked whether the participant was a member of an outdoor walking group:

Have you walked with an outdoor walking group (such as the Ramblers Association or a local walking group) since 10 October 2011?

Please put an 'X' in one box to the left to indicate your answer.

	Yes
	No

If the participant answered yes, they were asked to answer the following items:

What is the name of outdoor walking group?

Please write the name of your walking group below.

When did you last walk with this walking group?

Please write the month in the space below.

Month	

Since 10 October 2011, *__on average__* how frequently did you walk with this outdoor walking group?

Please put an ‘X’ in one box to the left to indicate your answer.

	Daily
	4-6 Times a Week
	2-3 Times a Week
	Once a Week
	2-3 Times a Month
	Once a Month
	Never

Thinking of all the walks you have done with this walking group since 10 October 2011, *__on average__* how much time would you spend walking?

Please put an ‘X’ in one box to the left to indicate your answer.

	0 minutes
	15 minutes
	30 minutes
	45 minutes
	1 hour
	1 hour 15 minutes
	1 hour 30 minutes
	1 hour 45 minutes
	2 hours
	2 hours 15 minutes
	2 hours 30 minutes
	2 hours 45 minutes
	3 hours
	Greater than 3 hours

What is the __main__ type of environment you walk in with this group?

*Please put an ‘X’ in **__one__** box to the left that best describes the main walking environment*

	Natural and Semi-natural places (e.g. Country Park, Nature Reserve)
	Parks and Gardens (e.g. public gardens, formal parks)
	Green corridor (e.g. river path, cycleways, bridleways)
	Urban public space (e.g. streets, shopping centre, plaza)
	Outdoor sports facilities (e.g. school playing field, football pitch)
	Amenity green space (e.g. informal recreation ground, village greens)
	Allotments, Community gardens, Urban farms
	Farmland
	Coastal (e.g. seaside, estuary)
	Other (Please write in below):

Snowball sampled Non-Group Walkers' T2 questionnaire

The T2 online questionnaire for snowball sampled Non-Group Walkers was very similar to the T2 questionnaire for Group Walkers, above. However, there was one main differences. The T2 questionnaire for snowball sampled Non-Group Walkers did not contain questions about the frequency and duration of WfH walks. Instead, the T2 questionnaire for snowball sampled Non-Group Walkers asked a single item whether the participant had taken part in a group walk in the previous 13 weeks. If the participant had participated in a group walk in the previous 13 weeks, he or she was asked to describe their behaviour with this walking group. The items for the walking group behaviour were identical to those used in the Inactive Non-Group Walkers' T2 questionnaire, listed above.

Appendix E Time 1 Invitation email

Group Walkers' invitation email

Subject line: Your invitation to the *De Montfort University Well-being and Walking for Health* study

Dear {FIRST NAME},
You are invited to take part in a research study about the personal well-being of people who do and do not participate in Natural England's Walking for Health programme.

You have been invited to take part because:

1. You have gone on at least one Natural England Walking for Health walk in the past 6 months,
2. You indicated on your Outdoor Health Questionnaire that you were happy to be contacted for evaluation purposes, and
3. You gave an email address on your Outdoor Health Questionnaire.

Participation is open to individuals who are aged 18 years or older. Your involvement in this study is entirely voluntary. All data will be confidential and anonymous.

This study is being conducted as part of my PhD research at De Montfort University.
The research is funded by De Montfort University and supported by Natural England.
The study involves completing two online questionnaires: now and in 12 weeks time.
The questionnaire will take about 30 minutes to complete.
Individuals who complete both questionnaires have the chance to win **£150 worth of High Street Gift Vouchers**.
Additional information about the study can be found in the web link to the survey.
Follow this link to the Survey:
Take the Survey

Or copy and paste the URL below into your internet browser:
https://umichumhs.qualtrics.com/WRQualtricsSurveyEngine/?Q_SS=eRs1W69PLeWLNPu_8cQkNUEsQsQVU44&_=1

If you would prefer **not** to be contacted for any future evaluations of Walking for Health, please email Tim Fitches at Natural England at tim.fitches@naturalengland.org.uk.
If you have any questions please contact me at mmarselle@dmu.ac.uk or my research supervisor, Dr Katherine Irvine, at kirvine@dmu.ac.uk.

Thank you very much,
Melissa Marselle

Inactive Non-Group Walkers' Invitation email

Subject line: Invitation to be part of *De Montfort University's Well-being and Walking for Health* study

Dear ${m://FirstName},

I would like to invite you to help with a study about the personal well-being of people who have taken part in organised health walks. You have been invited to take part because:

* You took part in at least one *Walking for Health* health walk before January of this year (these walks may have a different name in your local area, but are characterised by being free organised group walks led by trained Walk Leaders).
* You indicated on the Outdoor Health Questionnaire (a form completed at your first health walk) that you were happy to be contacted for evaluation purposes.

The study involves completing two online questionnaires: now and in 12 weeks time. The questionnaire will take about 25 minutes to complete.

Individuals who complete both questionnaires have the chance to win **£150 worth of High Street Gift Vouchers**.

Your involvement in this study is entirely voluntary. All data will be confidential and anonymous.

This study is being conducted as part of my PhD research De Montfort University. The research is funded by De Montfort University and supported by Natural England as part of their national evaluation of *Walking for Health*.

If you would like to take part in the study please **follow this link to the Survey:** ${l://SurveyLink}

Or copy and paste the address below into your internet browser:${l://SurveyURL}

The survey is available to complete until 10 October 2011.

If you have further questions about the study, a list of Frequently Asked Questions (FAQs) can be found on the *Walking for Health* website here. You can also contact me at mmarselle@dmu.ac.uk or my research supervisor, Dr Katherine Irvine, at kirvine@dmu.ac.uk.

Thank you very much,
Melissa Marselle

To opt-out from these emails and future *Walking for Health* evaluations follow this link: **Unsubscribe**

Snowball sampled Non-Group Walkers' Invitation email

Subject: Your friend's invitation to the De Montfort University Well-being and Walking for Health study

Dear ${m://FirstName},

Thank you very much for your willingness to help us recruit a friend who does **not** participate in one of Natural England's Walking for Health schemes. This person will form part of the control group for the study. As a reminder, please identify someone who is **your same sex, within 10 years of your age, and lives near you**.

Below is the invitation email for your friend, asking them to take part in the study. Please forward this email to your friend. But please delete this top section of text that I am writing to you; it won't be important for them.

Individuals who form the control group will have the chance to win £150 worth of High Street Gift Vouchers from a *separate* prize draw.

Thank you. I would not be able to do this study without your help.

In appreciation,
Melissa

Dear friend of ${m://FirstName},

You are being invited to take part in a research study about the personal well-being of people who do and do not participate in Natural England's Walking for Health programme.

You have been invited to take part because:
1. You were referred by your friend, and
2. You do not participate in one of Natural England's Walking for Health schemes.

Participation is open to individuals who are aged 18 years or older. Your involvement in this study is entirely voluntary. All data will be confidential and anonymous.

The study is being conducted as part of my PhD research at De Montfort University. The research is funded by De Montfort University and supported by Natural England.

The study involves completing two online questionnaires: now and in 12 weeks time. The questionnaire will take about 30 minutes to complete.

Individuals who complete both questionnaires have the chance to win **£150 worth of High Street Gift Vouchers**.

Additional information about the study can be found in the web link to the survey.

Follow this link:
https://umichumhs.qualtrics.com/SE/?SID=SV_9GJg6wtydHnvz00

If you have any questions please contact me at mmarselle@dmu.ac.uk or my research supervisor, Dr Katherine Irvine, at kirvine@dmu.ac.uk

Thank you very much,
Melissa Marselle

Appendix F Time 1 Reminder email

Group Walkers' reminder email 1

Subject line: *De Montfort University Well-being and Walking for Health* study reminder email
Dear {FIRST NAME},
Recently, I sent you an invitation to take part in an important study about the personal well-being of people who participate in Natural England's Walking for Health programme. This is a reminder email asking you to consider taking part in the study.

For your convenience, a list of Frequently Asked Questions (FAQs) is included at the bottom of this email, and is also available on the Walking for Health website here.

You have been invited to take part because:

1. You have gone on at least one Natural England Walking for Health walk in the past 6 months,
2. You indicated on your Outdoor Health Questionnaire that you were happy to be contacted for evaluation purposes, and
3. You gave an email address on your Outdoor Health Questionnaire.

Participation is open to individuals who are aged 18 years or older. Your involvement in this study is entirely voluntary. All data will be confidential and anonymous.

This study is being conducted as part of my PhD research at De Montfort University.
The research is funded by De Montfort University and supported by Natural England as part of their national evaluation of Walking for Health.
The study involves completing two online questionnaires: now and in 12 weeks time.
The questionnaire will take about 30 minutes to complete.
Individuals who complete both questionnaires have the chance to win **£150 worth of High Street Gift Vouchers**.
Further information about the study can be found in the web link to the survey.
Follow this link to the Survey:
Take the Survey

If the above link does not work, copy and paste the URL below into your internet browser:
https://umichumhs.qualtrics.com/WRQualtricsSurveyEngine/?Q_SS=eRs1W69PLeWLNPu_8cQkNUEsQsQVU44&_=1

If you would prefer **not** to be contacted for any future evaluations of Walking for Health, please email Tim Fitches at Natural England at tim.fitches@naturalengland.org.uk.
If you have any questions please contact me at mmarselle@dmu.ac.uk or my research supervisor, Dr Katherine Irvine, at kirvine@dmu.ac.uk.

Thank you very much,
Melissa Marselle

Melissa Marselle
PhD Student
Institute of Energy and Sustainable Development
De Montfort University
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Telephone: 0116 255 1551 extension 6847
Website: http://www.iesd.dmu.ac.uk/staff/students/melissa_marselle.php

Inactive Non-Group Walkers' reminder email 1

Dear ${m://FirstName},

This is just a friendly reminder that your response to the *De Montfort University Well-being and Walking for Health* study is very important to our study.

Just to clarify, this survey is specifically for people who no longer take part in organised health walks. You are very welcome to take part in this study if you have **not** taken part in a *Walking for Health* health walk since 14 January of this year. I have had a number of queries about this – my apologies if it was not clear!

I am hoping that you would like to join the other participants who have already completed the survey (nearly 800 so far!). If you would like to take part, please complete the survey no later than 10th October.

If you would like to take part in the study please **follow this link to the Survey:**
${l://SurveyLink?d=Take the Survey}

Or copy and paste the Internet address below into your internet browser:${l://SurveyURL}

If you have any questions please contact me at mmarselle@dmu.ac.uk or my research supervisor, Dr Katherine Irvine, at kirvine@dmu.ac.uk.

With thanks,

Melissa Marselle

To opt-out from these emails and future *Walking for Health* evaluations follow this link: Unsubscribe

Appendix G Frequently Asked Questions

FAQs – Wellbeing and WfH study

What is the purpose of the study?
The study is exploring the personal well-being of people who do and do not currently take part in "Walking for Health" health walks.

What does the study involve?
The study involves completing two online questionnaires about your personal well-being. The two questionnaires are to be completed 12 weeks apart.

Individuals who complete both questionnaires will be entered into a prize draw to win £150 worth of High Street Gift Vouchers.

Why is this study important?
The physical benefits of walking in the countryside are well-known, but there has been much less research done into other aspects of well-being, which is what this study will explore.

By understanding these benefits, it helps us make a more effective case for continued investment in the natural environment and projects like Walking for Health.

Who is conducting the study?
The study is being carried out by Melissa Marselle, a PhD student from De Montfort University. The study is supervised by Katherine Irvine PhD, from De Montfort University, and Sara Warber MD, from the University of Michigan (USA). The research is funded by De Montfort University and supported by Natural England.

Where can I find out more about this study?
The De Montfort University Well-being and Walking for Health study has been advertised on this website.

Further information about the study is provided in the first page of the online questionnaire itself; please follow the survey link above. You can also contact the PhD student and her Research Supervisor using the contact details listed in the 'Who to contact?' section of the FAQs.

Who to contact?
If you have any questions about this project please feel free to discuss them with the PhD researcher, Melissa Marselle, on **0116 255 1551** extension **6847**, or email **mmarselle@dmu.ac.uk**.

You may also contact the research supervisor, Dr Katherine Irvine, on **0116 207 8711** or email **kirvine@dmu.ac.uk**.

Learn more about the research team by visiting the following websites:
www.iesd.dmu.ac.uk/staff/students/melissa_marselle.php for Melissa Marselle
www.iesd.dmu.ac.uk/staff/katherine_irvine.php for Katherine Irvine, PhD
www.med.umich.edu/umim/faculty/warber.htm for Sara Warber, MD

You can also **download these FAQs as a Word document**.

Who can take part?
Individuals who meet the following criteria have been invited to take part in the study:
* Have attended at least one "Walking for Health" health walk;
* Indicated on their Outdoor Health Questionnaire (recorded on the Walking for Health
Database) that he or she is happy to be contacted for evaluation purposes;
* Gave their email address on their Outdoor Health Questionnaire;
* Aged 18 years and above.
* Live in England.

I am a walk leader / co-ordinator - can I take part?
Yes. The study is investigating the personal well-being of people who do and do not currently take part in Walking for Health. You can take part if you have been on at least one "Walking for Health" health walk.

I have attended only one Walking for Health walk - can I take part?
Yes. You can take part if you have been on at least one "Walking for Health" health walk.

Why have I been contacted to take part in this survey?
You have been contacted because at some time in the past you attended a "Walking for Health" health walk in England. A "Walking for Health" health walk is a free group walk led by a Walk Leader.

Before you took part in your first Health Walk you were asked to complete a paper form called an Outdoor Health Questionnaire. The Outdoor Health Questionnaire asked for your contact details, health screening questions, how you found out about the walks, and so on. This information was recorded on Natural England's Walking for Health online database by your Health Walk group.

One of the final questions on the Outdoor Health Questionnaire is whether you are happy to be contacted to 'help us evaluate health walks' – our records show you ticked 'yes'.

Natural England have been working very closely with De Montfort University on this joint piece of research, which is part of Natural England's wider evaluation programme for Walking for Health. You were therefore invited to take part based on your response on your Outdoor Health Questionnaire. Read more about Walking for Health evaluation.

Where did you get my contact details?
Many local "Walking for Health" health walk schemes make use of a secure online database managed by Natural England, which they use to monitor and evaluate the success of their health walks.

At some point in the last few years (most likely when you first joined your walk scheme) you will have completed a short 'Outdoor Health Questionnaire' which asked for contact details, health screening questions, how you found out about the walks, and so on.

This information was recorded on the online database by your walk group.

Read more about the Walking for Health database.

I am cautious about clinking on the survey link – where does it go? Is it secure?
The survey link and URL take you to the online questionnaire. An online survey website, called Qualtrics, hosts the Well-being and Walking for Health survey.

Qualtrics is a popular research website for universities and major international brands. Learn more about Qualtrics.

Your details are securely held by Qualtrics. Qualtrics' privacy policy complies with the U.S. and E.U. Safe Harbour Framework regarding the collection, use and retention of personal information.

What will happen to the data?
Questionnaire responses will be linked to participants' Outdoor Health Questionnaire and walk history data held on the Walking for Health database. This will be analysed in order to understand if there is a relationship between walker's well-being and the number and duration of Walking for Health walks they attend.

All data will be handled in compliance with the Data Protection Act 1998. The research project meets De Montfort University's Human Research Ethics guidelines. No names or other personal details of participants will appear in any material (written, oral or otherwise) arising from the research.

How will the results be used and shared?
The results of this research will add to Natural England's **evidence base about Walking for Health**, as well as Ms. Marselle's PhD thesis. Research findings will be shared with the public through newspaper articles, academic papers and conference presentations.

A final report about the project will be circulated to all research participants at the end of the project.

I've never heard of Walking for Health. What is it?
Walking for Health is a nationwide project that provides support and structure to hundreds of local walk schemes that aim to get people walking in their local area.

You might have been on a Walking for Health walk without realising it!

Your local health walk is a part of Walking for Health. It has been running for over ten years, and is currently funded by the Department of Health and managed by Natural England.

Read more about Walking for Health

How can I find out which Walking for Health walk I attended?
You can search for "Walking for Health" health walks near you using the Walk Finder. There are hundreds of walks across England, under lots of different names – you might have been on a Walking for Health walk without realising it!

I've never heard of De Montfort University – who are they?
De Montfort University (DMU) is an internationally recognised teaching, learning and research university located in Leicester, with a well-respected research unit in the Institute of Energy and Sustainable Development. Read more about De Montfort University.

Is the database secure? Who else has access to my details?
Yes, the database is very secure. Your information can only be accessed by selected people from your local health walk scheme, and a small number of people at Natural England who manage the database.

Apart from our evaluation partners - such as De Montfort University (who treat your information with the utmost security and destroy it once they no longer need it) - we have not and will not share your details with anyone else.

I want my details taken off the Walking for Health database – what should I do?
Simply click on the "Unsubscribe" link at the bottom of your invitation email, then tick the box requesting to be removed from the database. Your request will then be processed accordingly.

The "Unsubscribe" link is:
https://umichumhs.qualtrics.com/SE/?SID=SV_eg0zACJ84Rod8hK

But don't forget that your local health walk group uses the database too, and removing your data means they won't be able to keep in touch with you or keep track of your walks as part of their own monitoring and evaluation.

I don't want to be contacted for any more Walking for Health evaluation – what should I do?
No problem, click on the "Unsubscribe" link at the bottom of your invitation email and tick the box requesting to be taken off our evaluation contact list. Your request will be processed accordingly.

The "Unsubscribe" link is:
https://umichumhs.qualtrics.com/SE/?SID=SV_eg0zACJ84Rod8hK

Which shops accept the gift vouchers offered in your prize draw?
The Love2Shop gift vouchers are accepted at 20,000 top UK stores. View the full list of stores that accept the Love2Shop gift vouchers here.

Can I download these FAQs?
http://www.walkingforhealth.org.uk/sites/default/files/WfH%20and%20Well-being%20FAQs%20Sept%202011.doc

Appendix H Time 1 Questionnaire 'Thank you" email

Subject: Thank you for taking part in the *De Montfort University Well-being and Walking for Health* study

All participants
Dear {FIRST NAME},
Thank you so much for completing the first online questionnaire for this study.

In about 12 weeks, I will send you an email to take the second and final online questionnaire. Individuals who complete both questionnaires have a chance to win **£150 worth of High Street Gift Vouchers**.
If you have any questions please contact me at mmarselle@dmu.ac.uk or my research supervisor, Dr Katherine Irvine, at kirvine@dmu.ac.uk.
Thank you very much for your help with this study.

In appreciation,
Melissa Marselle

Appendix I Advance notice email

Group Walkers' advance notice email

Subject Line: Part 2 of the De Montfort University Well-being and Walking for Health study

Dear {First Name},

Thank you for your help in August of this year with the *De Montfort University Well-being and Walking for Health study*.
As a reminder, the study is about the personal well-being of people who do and do not participate in *Walking for Health* health walks. As someone who takes part in such health walks, you kindly completed Part 1, an online survey about your personal well-being in August.
It is almost time for Part 2, the second, and final, online survey about your personal well-being.

On Monday 14th of November 2011, you will receive an email invitation from me entitled "Your invitation to Part 2 of the *De Montfort University Well-being and Walking for Health study*". This email will contain a link to the second online survey.

I do hope you will consider completing this second, and final, survey. By completing this survey, you will be entered into a prize draw for the chance to win **£150 worth of High Street Gift Vouchers**.

If you have any questions please contact me at mmarselle@dmu.ac.uk or my research supervisor, Dr Katherine Irvine, at kirvine@dmu.ac.uk.

With thanks,

Melissa Marselle

Non-Group Walkers' advance notice email

The Advance Notice email for Non-Group Walkers was the same as the Advance Notice email for Group Walkers, above. The only differences were the month the participant first helped with the study and the date the Time 2 Invitation Email would be sent out.

Appendix J Time 2 invitation email

Group Walkers' Time 2 invitation email

Subject line: Your invitation to Part 2 of the De Montfort University Well-being and Walking for Health study

Dear {First Name},

Thank you again for your help in August of this year with the first part of the *De Montfort University Well-being and Walking for Health study*. Here is your invitation to take part in the second, and final, part of the study.

Part 2 involves a second survey about your personal well-being since August. This survey is similar to the first survey you kindly completed in August. You are welcome to take part in this survey regardless of the number of health walks you may or may not have attended since the first survey.

Your involvement in this study is entirely voluntary. All data will be confidential and anonymous.

I do hope you consider completing this second, and final, survey. Your input is valuable to the evaluation of *Walking for Health* and for my PhD research. By completing this survey, you will be entered into a prize draw for the chance to win **£150 worth of High Street Gift Vouchers**.

This survey will take about 20-25 minutes of your time to complete. The survey is available to complete until Thursday 1st December 2011.

Follow this link to the Survey:
${l://SurveyLink?d=Take the Survey}

Or copy and paste the Internet address below into your Internet browser:
${l://SurveyURL}

If you have any questions please contact me at mmarselle@dmu.ac.uk or my research supervisor, Dr Katherine Irvine, at kirvine@dmu.ac.uk.

Thank you for your continued help with this important study.

Best regards,

Melissa Marselle

Follow the link to opt out of the second survey: ${l://OutputLink?d=Click here to unsubscribe}

Melissa Marselle
PhD Student
Institute of Energy and Sustainable Development
De Montfort University
Email: mmarselle@dmu.ac.uk
Telephone: 0116 255 1551 extension 6847
Website: http://www.iesd.dmu.ac.uk/staff/students/melissa_marselle.php

Inactive Non-Group Walkers' Time 2 invitation email

Non-Group Walkers' T2 Invitation email included the exact same text as the Group Walkers' T2 Invitation email above. The only difference was the month the participant completed the first questionnaire (T1) and the deadline date for the T2 questionnaire.

Snowball sampled Non-Group Walkers' Time 2 invitation email

Snowball sampled Non-Group Walkers' T2 Invitation email included the same text as the Group Walkers' T2 Invitation email, above. However, there were two differences. Firstly, the month the participant completed the first questionnaire (T1) and the deadline date for the T2 questionnaire were different. Secondly, the second paragraph was different and contained the following text:

As a reminder, this study is about the personal well-being of people who do and do not participate in *Walking for Health* health walks. As someone who has not taken part in such health walks, you kindly completed Part 1, an online survey about your personal well-being in August. Part 2 involves a second survey about your personal well-being since August.

Appendix K Time 2 Reminder email

Group Walkers' Time 2 reminder email 1

Subject line: Reminder - *De Montfort University Well-being and Walking for Health* study

Dear ${m://FirstName},

This is a friendly reminder that your response to the second, and final survey of the *De Montfort University Well-being and Walking for Health* study is very important.

This second survey is about your personal well-being since August. It is similar to the first survey you kindly completed in August. You are welcome to take part in this survey regardless of the number of health walks you may or may not have attended since the first survey.

Your involvement in this study is entirely voluntary. All data will be confidential and anonymous.

I do hope you consider completing this second, and final, survey. Your input is valuable to the evaluation of *Walking for Health* and for my PhD research. By completing this questionnaire, you will be entered into a prize draw for the chance to win **£150 of High Street Gift Vouchers**.

This survey will take about 20-25 minutes of your time to complete. The survey is available to complete until Thursday 1st December 2011.

Follow this link to the Survey:

${l://SurveyLink?d=Take the Survey}

Or copy and paste the Internet address below into your Internet browser:${l://SurveyURL}

If you have any questions please contact me at mmarselle@dmu.ac.uk or my research supervisor, Dr Katherine Irvine, at kirvine@dmu.ac.uk.

Thank you for your help in this important study.

Best regards,

Melissa Marselle

Follow the link to opt out of the second survey: ${l://OutputLink?d=Click here to unsubscribe}

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Melissa Marselle
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Non-Group Walkers' Time 2 reminder email 1

Subject line: Reminder - *De Montfort University Well-being and Walking for Health* study

Dear ${m://FirstName},

This is a friendly reminder that your response to the second, and final survey of the *De Montfort University Well-being and Walking for Health* study is very important.

This second survey is about your personal well-being. It is similar to the first survey you kindly completed in October. Your involvement in this study is entirely voluntary. All data will be confidential and anonymous.

By completing this questionnaire, you will be entered into a prize draw for the chance to win **£150 worth of High Street Gift Vouchers**.

This survey will take about 20-25 minutes of your time to complete. The survey is available to complete until Thursday 26th January 2012.

Follow this link to the Survey:

${l://SurveyLink?d=Take the Survey}

Or copy and paste the Internet address below into your Internet browser:${l://SurveyURL}

If you have any questions please contact me at mmarselle@dmu.ac.uk or my research supervisor, Dr Katherine Irvine, at kirvine@dmu.ac.uk.

Thank you for your help in this important study. Your input is valuable to the evaluation of health walks and for my PhD research.

Best regards,

Melissa Marselle

Follow the link to opt out of the second survey: ${l://OutputLink?d=Click here to unsubscribe}

Appendix L Time 2 Questionnaire 'Thank you" email

Group Walkers' T2 thank you email

Subject: Thank you for taking part in the *De Montfort University Well-being and Walking for Health* study
Dear {FIRST NAME},

Thank you so much for completing the second and final online questionnaire for this study.

This completes your participation in the *De Montfort University Well-being and Walking for Health* study.

To compensate you for your time, you will be entered into the study's prize draw for the chance to win **£150 worth of High Street Gift Vouchers**[1]**.** The prize draw will occur on 12 December[2].

I look forward to sending you a report on the study's research findings in late 2012.
If you have any questions, please contact me at mmarselle@dmu.ac.uk or my research supervisor, Dr Katherine Irvine, at kirvine@dmu.ac.uk.
Thank you very much for your help with this study. It would not have been possible without you.
In appreciation,
Melissa Marselle

[1] Only those participants who complete both online questionnaires will be entered into the prize draw. Partially completed questionnaires (over 50% data missing) will not count as a completed questionnaire and will not be eligible for the prize draw.
[2] The winner of the prize draw will be contacted by email on Monday 12 December 2011. Once the prize winner replies to this email with his or her postal address, the Gift Vouchers will be sent via recorded mail. The organisers reserve the right to hold a second draw if confirmation is not received from the winner before 12 January 2012.

Non-Group Walkers' T2 thank you email

The T2 thank you email for Non-Group Walkers was identical to the T2 thank you email for Group Walkers, above. The only difference was the date of the prize draw and the date to contact the prize draw winner.

Appendix M Correlations between outcome variables and all proposed mediators

Correlations of outcome variables with group walk and potential mediators for the matched *as treated* sample of GRIN participants.

Variables	T1 Mental well-being	T2 Mental well-being	T1 Positive affect	T2 Positive affect	T1 Depression^	T2 Depression^	T1 Negative affect^	T2 Negative affect^
Group Walk§	.092***	.111***	.065**	.156***	-.136***	-.172***	-.164***	-.137***
T1 Perceived Stress	-.714***	-.529***	-.531***	-.399***	.654***	.510***	.685***	.528***
T2 Perceived Stress	-.593***	-.679***	-.448***	-.584***	.561***	.696***	.606***	.732***
T1 Resiliency	.629***	.496***	.557***	.436***	-.441***	-.346***	-.431***	-.344***
T2 Resiliency	.615***	.629***	.561***	.593***	-.439***	-.460***	-.453***	-.465***
T1 Social Support	.433***	.326***	.356***	.254***	-.305***	-.213***	-.238***	-.221***
T2 Social Support	.439***	.420***	.381***	.370***	-.342***	-.317***	-.308***	-.322***
T1 Connectedness to Nature	.201***	.177***	.227***	.197***	-0.04	-.057*	-.036	-.050*
T2 Connectedness to Nature	.227***	.249***	.259***	.281***	-.066**	-.120***	-.074**	-.113***
T1 non-group walks	.137***	.141***	.162***	.167***	-.107***	-.126***	-.065**	-.068**
T2 non-group walks	.146***	.169***	.150***	.176***	-.113***	-.152***	-.103***	-.124***
T2 Physical Activity	.145***	.194***	.185***	.267***	-.099***	-.161***	-.071***	-.104***

Note. ^ = log-transformed variable. § = point bi-serial correlation. Pearson correlations were preformed for all other variables.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Appendix N Publication arising from this thesis

Marselle, M.R., Irvine, K.N., Warber, S.L. (2013). Walking for well-being: Are group walks in certain types of natural environments better for well-being than group walks in urban environments? *International Journal of Environmental Research and Public Health*, Special Issue Health Benefits of Nature, 10 (11), 5603-5628.