Landscape and Urban Planning 130 (2014) 89–103

Contents lists available at ScienceDirect

Landscape and Urban Planning

journal homepage: www.elsevier.com/locate/landurbplan

Research paper

Walking, hiking and running in parks: A multidisciplinary assessment of health and well-being benefits

Isabelle D. Wolf[a,b,*], Teresa Wohlfart[a,1]

[a] NSW National Parks and Wildlife Service, Office of Environment and Heritage, Department of Premier and Cabinet, Hurstville, NSW 2220, Australia
[b] Centre for Ecosystem Science, University of New South Wales, Sydney, NSW 2052, Australia

HIGHLIGHTS

- We assessed the benefits of physical park activity with a multi-disciplinary approach.
- Visitor surveys revealed improvements in numerous health and well-being indicators.
- Energy expenditure of park visitors was estimated based on GPS tracking trip data.
- Two different methods for energy expenditure estimation were trialled.
- Walkers, hikers, runners burned amounts of energy indicative of an active lifestyle.

ARTICLE INFO

Article history:
Received 13 September 2013
Received in revised form 2 June 2014
Accepted 11 June 2014

Keywords:
Public green space
National parks
GPS tracking
Physical activity
Walking
Health

ABSTRACT

As our populations become more urbanised, public green space will assume key functions in the promotion of the health and well-being of the populace. We assessed the beneficial outcomes of physical activities undertaken in Australian national parks using a questionnaire-based survey combined with GPS tracking of walkers, hikers, and runners. We estimated energy expenditure of park visitors based on GPS tracking trip data using two different estimation methods. Park visitors perceived considerable improvement in numerous health and well-being indicators; many of which increased with increasing activity levels. We found that hikers burned the greatest amount of net energy (916 kcal) as they preferred more difficult tracks with greater slopes, followed by runners (790 kcal) and walkers (450 kcal). For many walkers and hikers, physical activity was incidental to other activities such as sightseeing, socialising, and experiencing nature; such activities, thus, deserve highlighting when promoting attributes of parks and other public green spaces. GPS tracking allowed for sampling a broad population of park visitors at a participation rate of 80%, and the calculation of additional trip characteristics such as trip distance and velocity. Identifying health and well-being benefits via an inter-disciplinary approach using GPS tracking data to determine the intensity and spatio-temporal distributions of physical activity in relation to different park infrastructure is a promising area for attention to raise awareness of the direct benefits of visiting public green spaces.

1. Introduction

Public green spaces provide a significant opportunity for people to escape from their regular lives, daily routines, and stressful environments to re-energise and engage in outdoor activities (Bedimo-Rung, Mowen, & Cohen, 2005; Pryor, Carpenter, & Townsend, 2005). This is ever more important as a sedentary and indoor-centred lifestyle has become increasingly prevalent in the 21st century, leading towards the "nature-deficit disorder" of human beings (Louv, 2011). The importance of public green spaces for people's health and well-being was noted early in the 19th century when parks were first designed for recreational purposes, and landscape architects recognised the connection between natural areas and human health and well-being (Beveridge & Rocheleau, 1995). Experiencing recreational parks was thought to reduce stress levels and to provide the opportunity to socialise,

* Corresponding author at: Office of Environment and Heritage, Department of Premier and Cabinet, Bridge Street 43, Hurstville, NSW 2220, Australia.
Tel.: +61 4 0330 3550; fax: +61 2 9585 6601.
E-mail addresses: i.wolf@online.ms (I.D. Wolf), teresa.wohlfart@environment.nsw.gov.au (T. Wohlfart).
[1] Co-author.

http://dx.doi.org/10.1016/j.landurbplan.2014.06.006
0169-2046/

perform physical exercise, and breathe fresh air. These days, in densely populated urban and peri-urban areas, public green spaces often provide the only natural outdoor recreation space fulfilling an important function in promoting the general health of community members (Maas, Verheij, Groenewegen, De Vries, & Spreeuwenberg, 2006).

Health and well-being benefits can accrue in a number of ways when visiting public green spaces. The simple act of occupying or viewing nature may be beneficial, and assist in the maintenance of health (Pretty, Peacock, Sellens, & Griffin, 2005). These restorative effects of nature were ascribed to people's innate relationship with and need for nature known as "biophilia" (Nisbet, Zelenski, & Murphy, 2011). As well, physical activities in public green spaces can contribute considerably to health and well-being. The closer people live to a public park, for example, the more frequently they engage in the minimum recommended physical activity, and the less likely they are to be overweight (e.g., Coombes, Jones, & Hillsdon, 2010). Whilst public green spaces may provide a suitable location for physical activities, the incidental exposure to nature whilst performing these activities can have a synergistic effect (Hansmann, Hug, & Seeland, 2007). Pretty et al. (2005), for example, found that "green exercise" was more effective in improving cardiovascular and mental health than exercise in a non-natural environment. Conversely, spending time in nature increases incidental forms of physical activity whilst sightseeing or viewing flora and fauna (Buchner & Gobster, 2007), and such experiences can provide the initial incentive to visit parks (Maas & Verheij, 2007). Integrating incidental physical activity into daily life is a useful intervention against a sedentary lifestyle (Sallis, Bauman, & Pratt, 1998; Ziviani, Scott, & Wadley, 2006). This has typically been studied and promoted in contexts such as the commute to work or outdoor activities like gardening but deserves more attention in a parks' context.

Most research on parks and trails to date has instead investigated whether access and specific facilities are associated with physical activity. In contrast, few studies have focussed on the effects of physical activities in national parks on specific health parameters. This is surprising in that health parameters would be useful measurements, because they capture objective rather than stated or perceived effects. Li et al. (2011) for example demonstrated that a forest visit significantly reduced blood pressure and had beneficial effects on several metabolic parameters. Another study conducted in Japan demonstrated the positive effects of "forest bathing" on different physiological parameters (Park, Tsunetsugu, Kasetani, Kagawa, & Miyazaki, 2010). However, such physiological measures are difficult to obtain, and research typically relies on a pre-recruited sample of participants. In our study, we assessed both health and well-being outcomes, and evaluated a new approach to estimating energy expenditure during physical activity that allowed for sampling of a cross-section of visitors randomly intercepted along trails. Energy expenditure is a useful parameter as it captures the intensity of physical activity and is linked directly to numerous health outcomes (Hansmann et al., 2007).

Various ways have been recognised to measure energy expenditure due to physical activity, some restricted to laboratory environments, and others suitable for the field. Indirect calorimetry for example measures the heat released by oxidative processes of the body in respiration chambers or with portable devices and masks (Jequier, Acheson, & Schutz, 1987). Another form of indirect calorimetry involves measuring the amount of isotope in a free-living person's body fluids following the consumption of doubly-labelled water to determine CO_2 and consequently heat production (Schoeller, 1988). As there is a close relationship between heart rate and energy expenditure during exercise, heart rate measures allow an estimate of energy expenditure using portable armband devices (St-Onge, Mignault, Allison, & Rabasa-Lhoret, 2007) or "smart t-shirts" (Taczanowska et al., 2012). Other portable devices pick up people's movement or acceleration such as pedometers and accelerometers (Swartz et al., 2000). Whilst pedometers are more useful to determine overall walking activity, accelerometers provide meaningful measurements of energy expenditure (Ainslie, Reilly, & Westerterp, 2003). Finally, questionnaires and activity recall methods are available and appear especially valuable in large population-based studies (Ainslie et al., 2003). Participants in our study were tracked with GPS wristwatches whilst frequenting national park trails to collect trip data in substantially more detail than possible with questionnaires or activity recall. We expected that this non-obtrusive method would result in high participation rates. Trip data and additional participant data collected via questionnaires were integrated into two different methods for estimating energy expenditure: (1) "Metabolic Equivalent of Tasks" (MET) (Ainsworth et al., 2011), and (2) "Functions of energy costs for walking and running" (Ardigò, Saibene, & Minetti, 2003).

Although trails are known to be key facilities for physical activities in parks, there is minimal research describing trail use, amounts and intensity of activity, and motives for using trails (Kaczynski, Potwarka, & Saelens, 2008). In the present study, we focussed on visitors frequenting national park trails for walking, hiking, and running in New South Wales, Australia. The aims of this study were to determine the health and well-being benefits accruing to people from walking, hiking, and running along national park trails and to compare these against the invested effort. We incorporated gender and age-group into the analysis to discern the effect of participant demographics. A particular focus was on the discussion of the importance of incidental physical activity of visitors who come to parks for many reasons other or in addition to exercise. We collected data on socio-demographics, motivations and extent to which people engage in walking, hiking, or running in national parks to characterise the market. Finally, we discuss the methodological implications of using GPS tracking data for conversion into energy expenditure of park visitor activities using the two different methods for estimation.

2. Methods

2.1. Study area and trails

This study was conducted in the Blue Mountains National Park (BMNP) and Royal National Park (RNP) (Fig. 1). With 3.1 and 4.1 million domestic visits, respectively, BMNP and RNP were the two most visited national parks in New South Wales in 2012 (Roy Morgan Research, 2013). BMNP is part of the Greater Blue Mountains World Heritage Area, a UNESCO World Heritage Site that covers 1.03 million ha of land, which is known for its great biodiversity and important Aboriginal cultural sites. RNP was established in 1879, and is the second oldest national park in the world. It is one of Australia's Heritage-listed areas and covers 16,000 ha. The park provides a wide variety of microclimates due to small-scale topography and landforms, and therefore, supports a diverse flora and fauna.

Both parks furnish a wide variety of visitor experiences along an extensive system of recreational trails that provides access to cultural heritage sites of international significance, outstanding landscapes, and geological features. We selected a diverse set of trails classified into three grades (easy, moderate, hard/difficult). Classifications were synthesised from the Australian Walking Track Grading System, a popular BMNP hiking guide (Stuart, 2009), and from a comprehensive online hiking website for the area (Wildwalks, 2013). The grades reflect the level of track difficulty