Nature for Health and Wellbeing:

A review of the evidence

Royal Botanic Gardens Victoria

Title

Nature for health and wellbeing – A review of the evidence

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1 Executive summary

This review was commissioned by Royal Botanic Gardens Victoria (RBGV) to better understand and harness global studies in regard to the relationship between nature, health and wellbeing. It has a particular focus on adult mental health. It comprised a desktop scan of contemporary research literature as well as relevant policy documents.

A rapidly growing body of research provides evidence that time spent in nature is good for us – physically, mentally and emotionally. It lowers stress which impacts on our health in many complex ways, changing our mood as well as the way our nervous, endocrine and immune systems function. There is also growing evidence that women and men experience and respond to urban green space in different ways and that we gain different benefits at different life stages.

> Time spent in nature is good for us – physically, mentally and emotionally.

Leading health and environmental researchers agree that there is robust evidence that nature experiences increase psychological wellbeing and reduce the risk factors and burden of some mental illnesses. It has also been demonstrated that for people with mental illness living in urban areas, physical activity in green space may be particularly beneficial.

Increased access to green space has impacts on community health and wellbeing. It is associated with greater social interactions and increased social cohesion. The research also shows that increased access to green space may well be linked to reductions in neighbourhood crime, violence, and aggression. There is increasing evidence that the health benefits linked with access to green space may be strongest among the lowest socioeconomic groups.

Studies have found that green spaces may play an important role in enhancing community resilience and helping communities cope with natural disasters and extreme weather events. In response to the emergence of COVID-19 we have seen an increase in people visiting parks and gardens, but the biggest impact has been the increase in active gardening. It will be interesting to see future research results from studies undertaken during this period.

Research in hospitals and formal care settings has also found that access to natural landscapes, through nature experiences or even views of nature, can reduce stress and improve clinical outcomes. There is a considerable body of evidence of the benefits of active gardening, particularly for older people, including within community garden settings. Studies evaluating the benefits of gardening-based interventions for adults experiencing mental health difficulties report a range of impacts on symptoms including reduced depression and anxiety.

The quality of the green space impacts health and wellbeing outcomes. Research findings indicate that in a neighbourhood setting the quality of green space is more relevant to mental health outcomes, than the quantity of green space. Landscapes comprised of spacious peaceful gardens with historical and cultural associations and a richness of natural species have been found to be particularly restorative.

> The quality of green space is more relevant to mental health outcomes, than the quantity of green space.

Recent research has provided insights into the amount of time spent in nature that is needed to generate health and wellbeing benefits. It has been found that spending at least two hours in nature per week is associated with self-reports of being in good health or having high wellbeing. There is evidence that frequent visits to green spaces are associated with lower levels of perceived stress and cortisol levels and that a dose of as little as 10–20 minutes sitting or walking in green spaces can reduce stress, anger, anxiety.

The material in this review presents a range of implications and opportunities for RBGV. It has important implications for communication of the benefits of time in nature leading to possible new partnerships, public programming as well as for enhanced learning and participation opportunities. An increased profile and programming of the health and wellbeing benefits of the Melbourne and Cranbourne Gardens has the potential to broaden audiences and opportunities for engagement. The review identifies that more studies are needed to investigate the relationship between **visits** to urban green spaces and mental health.

2 Introduction

Royal Botanic Gardens Victoria is in a unique position to meet the human need for nature to improve health and wellbeing.

Royal Botanic Gardens Victoria is in a unique position to meet the human need for nature. It comprises two outstanding garden environments, the Melbourne Gardens and Cranbourne Gardens that have the potential to be recognised as centres for community health and wellbeing as well as for environmental health. An increased profile and curated programming of the health and wellbeing benefits of these two special environments has the potential to broaden audiences and opportunities for engagement.

This review was commissioned by Royal Botanic Gardens of Victoria to better understand and harness global studies and thought leadership in regard to the relationship between nature, health and wellbeing. Its aim is to support future planning and research for the Gardens' engagement efforts and activities.

3 Research scope and methodology

The goal of this desktop scan of literature was to summarise key themes from relevant contemporary research literature (2005 and onwards) as well as related policy frameworks and reports. The brief for this paper specified that the material reviewed focus primarily on mental health outcomes for young adults (19 – 24 years), adults (24 – 64 years) and seniors (65+) as well as community outcomes for specific groups including women, economically disadvantaged populations and disaster recovery from trauma. This scan covers a very broad area, global in reach and while essential to the work and purpose of the Gardens, the indigenous focus is only glanced upon here, the stories and experiences in relation to indigenous health and wellbeing are covered in a separate RBGV paper.

The pace of nature–health research is expanding dramatically, with new research being published daily. The literature reviewed here represents a snapshot in time. For instance searching the 'Web of Science' https://clarivate.com/webofsciencegroup/solutions/web-of-science/ on just one term "greenspace and health" yielded the following:

2009 – 2011	listed 24 research reports
2012 – 2015	listed 57 research reports
2016 – 2019	listed 208 research reports

The author of this paper is a research consultant, not an academic in this field, accordingly this review is not a systematic literature review. Nonetheless the author has read broadly across relevant academic literature and government policy documents. To ensure that this refers to the highest quality research it relies on several highly respected and thorough research summaries and systematic literature reviews, addressing these issues, These include: *Nature and Health* (Hartig et al., 2014), *Urban Green Spaces and Health Review* (WHO, 2016), *Gardening as a mental health intervention: a review* (Clatworthy et al., 2013), *Nature and mental health: An ecosystem service perspective* (Bratman et al 2019) and to capture an Australian perspective: *Quality Green Public Open Space Supporting Health, Wellbeing and Biodiversity: A Literature Review*. – Davern, M., Farrar, A., Kendal, D. & Giles-Corti, B., (Davern et al., 2017).

These literature reviews considered a mix of qualitative, quantitative, academic research from diverse fields and disciplines Including randomised controlled designs and longitudinal studies. On the whole the papers reviewed were published in English 2013 onwards. They in turn may have cited earlier studies. The research considered was from a range of disciplines – urban planning, geography, sociology, public health, social psychology, social epidemiology, environmental psychology, just to list a few. Many appeared in journals concerned with public health, psychology or environmental planning.

The range of policy documents reviewed included recent key health and environment department documents from Australian Federal Govt and State governments. Key European, US and UK documents were also considered.

The search of the academic literature was primarily conducted across Google scholar and Webofscience. A selection of the most cited articles and studies are referred to in this report. The many key words, topics and fields searched included: Green space & health; urban parks; green infrastructure; urban forests; nature experience and health; Shinrin-yoku; Improving Health and Wellness through Access to Nature; ecohealth, restorative environments and health; environmental psychology; social ecology; eco-psychology; eco-therapy; nature–based health interventions; green prescriptions and green exercise.

Methodical challenge for researchers

Research across the fields of nature for health and wellbeing has been undertaken within different scientific paradigms. As Terry Hartig of Uppsala University, Sweden states "For some moving from partial evidence to evidence-based recommendations regarding nature contact is a thorny problem" (Hartig et al., 2014, p. 220). This is because different methodologies are used to measure health and wellbeing outcomes. Where some studies look to measure mortality and morbidity (eg. Cardiovascular Disease) or persistent psychological changes and physiological markers (eg. Cortisol levels) or academic performance others measure subjective wellbeing (eg. Self reported happiness), self-reported health, changes in emotional states. Interview based methodologies and self reported subjective wellbeing measures, while highly respected in the social sciences are not necessarily regarded as rigorous by some other disciplines.

Some researchers argue that the observational nature of much of the existing research limits its validity and that randomised clinical trials, the gold standard for evaluating health outcomes, are needed to prove a causal link between nature and certain health outcomes. The work of Roe et al. (2013) and others has however led to wide acceptance of cortisol measures as "objective" measures of stress in some studies.

The majority of the research reported here explores health outcomes from visual stimulus and lab tests. In the last few years there has been an increase in studies involving direct study of 'Nature experiences'. This is possibly the result of a growing number of cross disciplinary teams and research labs such as the European Centre for Environment and Human Health, https://www.ecehh.org/ in the UK.

Current methodological and conceptual advances are feeding the expansion of the field; old and new topics are being studied with a range of approaches and new tools. As Hartig states "beliefs about stress-reducing effects of park visits are widespread and long-standing but experimental testing of such effects is a relatively recent activity" (Hartig et al., 2014, p. 210). New technology is impacting this field. A range of researchers, initially eg. Aspinall et al., (2015) are increasingly using wearable electroencephalography (EEG) devices to record and demonstrate the effects of walking in a green space on brain activity. These indicate an association with enhanced relaxation and restoration. Importantly the availability of open data sources have enabled correlations, for instance, that combine vegetation data layers, urban land use maps, and large-scale health data sets, such as county-level health records to examine how changes in vegetation may influence human health.

4 Definition of key terms

Nature

Bratman et al (2014) state that "in general, by nature we mean areas containing elements of living systems that include plants and nonhuman animals across a range of scales and degrees of human management, from a small urban park through to relatively "pristine wilderness" (cited in Frumkin et al, 2017) . "Nature" is defined by the Victorian Department of Environment, Land, Water and Planning (DELWP) in Biodiversity 2037 as "any green open spaces and water bodies that support living things... [including] highly modified or constructed landscapes through to pristine wilderness areas" (DELWP, 2017 p. 63).

There is a significant body of literature that that calls into question the distinction between humans and nature implied in these definitions. Many scholars from Val Plumwood to Bruno Latour and Timothy Morton "remind us that viewing the natural world as separated from humans is not only ethically problematic but empirically false" (Alberro, 2020). Our recent experiences with both COVID-19 and climate change confirm this world view but to date the vast majority of the literature in the "nature for health and wellbeing" field uses the more traditional definitions of "nature" as defined above.

Health

The World Health Organisation (WHO) provides a range of commonly used definitions in this field. The WHO definition of "health" is "A complete state of physical, mental and social wellbeing and not merely the absence of disease or infirmity" (WHO, 2014).

Mental health

"Mental health" is defined by the WHO as; "A state of well-being in which an individual realises his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community". Conceived in this way, mental health encompasses (i) the absence of mental illness and (ii) the presence of psychological wellbeing (WHO, 2014).

Wellbeing

The OECD considers subjective "wellbeing" to be "good mental states, including all of the various evaluations, positive and negative, that people make of their lives and the affective reactions of people to their experiences" (OECD, 2013 p. 10). Wellbeing is usually conceptualised as some combination of positive affective states such as happiness (the hedonic perspective) and functioning with optimal effectiveness in individual and social life (the eudaimonic perspective) (Deci & Ryan, 2008).

Urban green space

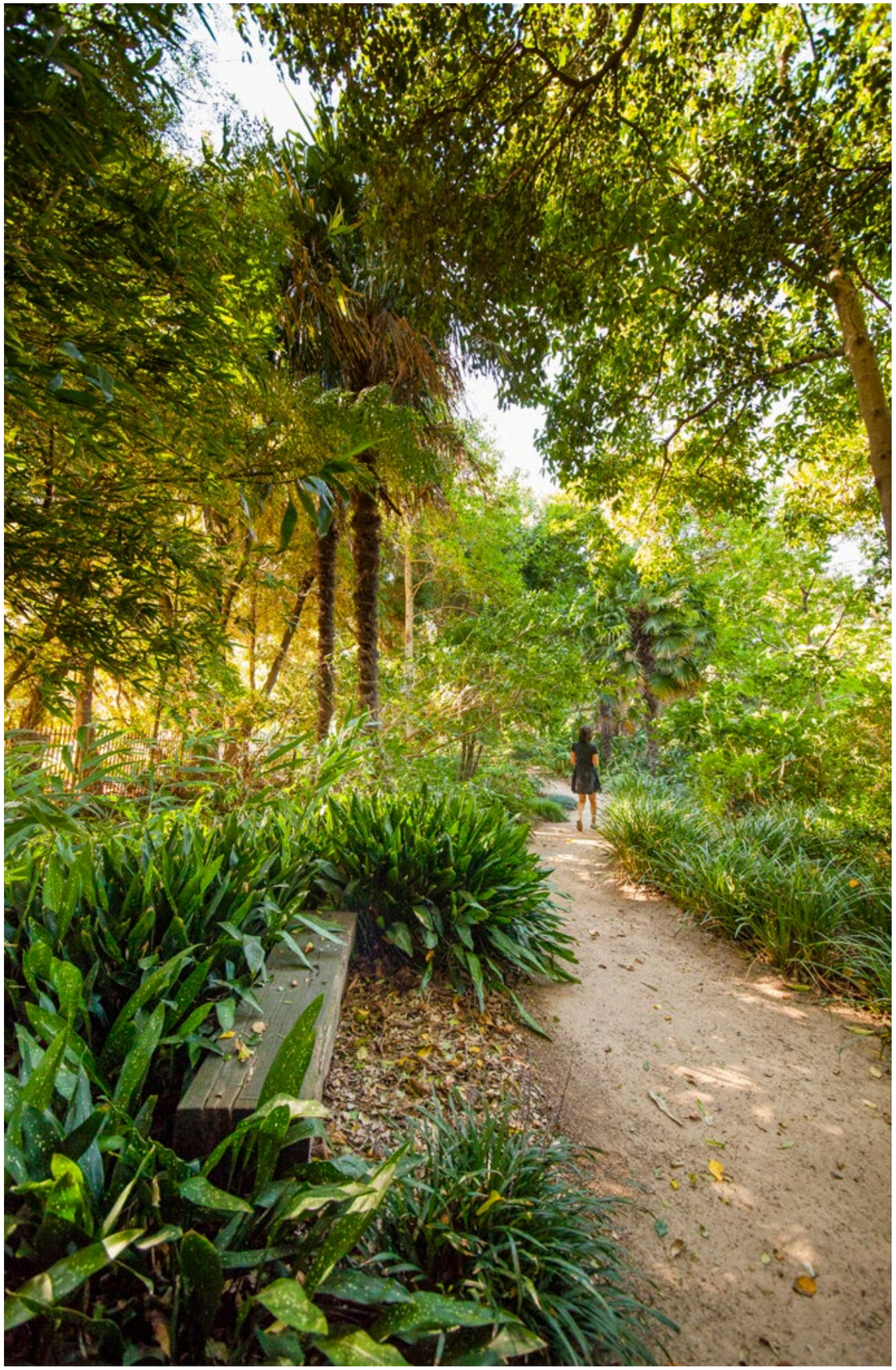
The WHO describes "urban green space" as "public green areas used predominantly for recreation such as gardens, zoos, parks, and suburban natural areas and forests, or green areas bordered by urban areas that are managed or used for recreational purposes" (WHO, 2016 p. 64). Accordingly, this report uses the term "urban green space" to describe the RBGV environments at Melbourne Gardens and Cranbourne Gardens. The term "gardens" tends to be used in the literature to describe domestic gardens and active gardening spaces such as community gardens. Veale & Kendall (2019) use the term "place-based nature experiences" to describe those that occur in more formalised and typically protected environments such as botanic gardens, national and marine parks" (Veale & Kendal, 2020, p. 1).

Nature therapy

Miyazaki et al. (2015) define Nature therapy as "a set of practices aimed at achieving 'preventive medical effects' through exposure to natural stimuli that render a state of physiological relaxation and boost the weakened immune functions to prevent diseases". The Japanese term Shinrin-yoku means "taking in the forest atmosphere through all of our senses"- sight, smell, sound, touch and taste. Shinrin-yoku is usually translated as "forest bathing". Forest therapy is defined as a shinrin-yoku effect.

Nature deficit disorder

Richard Louv coined the term "nature-deficit disorder" in 2005 as not being a medical diagnosis, but a way to "describe the human costs of alienation from nature: diminished use of the senses, attention difficulties, higher rates of physical and emotional illnesses, a rising rate of myopia, child and adult obesity, Vitamin D deficiency, and other maladies" (Louv, Oct 20, 2019).



5 Individual health impacts

5.1 Physical health

A growing body of literature indicates that there is, in general, a positive relationship between greener environments and physical health. The WHO (2016) indicates that the research suggests four principal and interacting pathways through which nature or green space may contribute to physical health:

— improved air quality,

— enhanced physical activity,

— stress reduction, and

— greater social cohesion.

Air quality benefits provided by green space are particularly relevant due to the relationship between air pollution and respiratory illnesses. Nowak and others (2014) calculated that in 2010, trees removed 17.4 million tons of air pollution across the United States, which prevented 850 human deaths and 670,000 cases of acute respiratory symptoms (U.S. Dept. of Ag., 2018). Yet as Kendal et al. (2016) indicate there has been less clear findings from research investigating the links between respiratory health and vegetation/ canopy cover in urban areas. "Vegetation can also increase pollutants by emitting volatile organic compounds (VOCs) that can contribute to ozone and carbon monoxide formation. However, due to the high degree of uncertainty in atmospheric modelling, it is not clear whether ozone formation from VOC emissions for these species is greater than ozone removal or prevention" (U.S. Dept. of Ag., 2018 p. 4). In some circumstances, the allergenic role of trees may eclipse their ability to improve health by reducing air contaminants.

Links to increased activity levels

The evidence indicates that urban green space is associated with increased physical activity leading to improved fitness and reduced obesity as well as improved sleep and cardiovascular health. Kathryn Bowen in Kendal et al. (2016) highlights a number of studies showing that higher levels of green space have been associated with lower levels of obesity. Davern et al. (2017) also note evidence from a range of authors including Maas, Verheij et al. (2009) and Astell-Burt, Mitchell et al. (2014) that "access to and use of green public open space appears protective of several diseases including chronic heart disease, respiratory tract infection, asthma, migraine and severe headaches, vertigo, acute urinary tract infection and diabetes mellitus (type 2 diabetes)" (Davern et al., 2017 p. 12).

The WHO (2016, p. 4) cite several studies in various countries that have demonstrated that recreational walking, increased physical activity and reduced sedentary time were associated with access to, and use of, green spaces in working age adults, children and senior citizens (Astell-Burt et al., 2013; Schipperijn et al., 2013; Lachowycz and Jones, 2014; Sugiyama et al., 2014; James et al., 2015). Interestingly Terry Hartig Uppsala University, Sweden and colleagues indicates that recent evidence suggests that the health benefits of increased physical activity are largest among those who were initially doing the least (Hartig et al., 2014, p. 214).

Stress reduction

There are consistent findings, that as many of us instinctively feel, green space is associated with reduced stress. Stress is associated with sleep loss, supressed immune system, stroke, diabetes, high blood pressure and cardiovascular disease (Wolf and Robbins, 2015 cited in Davern, et.al., 2017). Stress triggers[1] a combination of signals from both hormones and nerves, causes our adrenal glands to release hormones, including adrenaline and cortisol.

Much of the research evidence regarding green space reducing stress in the past relied on self-reported change in emotional states. More recently cortisol measurement combined with blood pressure measurement and subjective wellbeing health measures have become key measurement tools in this field. Overexposure to cortisol and other stress hormones has been linked to increased heart disease, weight gain and anxiety and depression, as well as focus and concentration difficulties. As Roe et al (2013) indicate cortisol is about more than just stress. This steroid hormone is made in adrenal glands. Most of the cells in our bodies have cortisol receptors that use cortisol for a variety of functions, including; blood sugar regulation, inflammation reduction, metabolism regulation and memory formulation.

Cortisol measurement combined with blood pressure and subjective wellbeing health measures have become key measurement tools in this field.

1 As your body perceives stress, your adrenal glands make and release the hormone cortisol into your bloodstream. Often called the "stress hormone," cortisol causes an increase in your heart rate and blood pressure. It's your natural "flight or fight" response that has kept humans alive for thousands of years. Cortisol narrows the arteries, while another hormone, epinephrine, increases your heart rate. Working together, they force your blood to pump harder and faster as you confront and resolve the immediate threat. -Roe et al. (2013). Adrenaline increases your heart rate, elevates your blood pressure and boosts energy supplies. Cortisol, the primary stress hormone, increases sugars (glucose) in the bloodstream, enhances your brain's use of glucose and increases the availability of substances that repair tissues. https://www.tciheart.com/HealthLibrary)

"Evidence of psychoneuroendocrine responses to woodland environments are based on observed associations with lower concentrations of cortisol, lower pulse rate, lower blood pressure, greater parasympathetic nerve activity and lower sympathetic nerve activity when compared to city environments" (Lee et al., 2011; Park et al., 2007 cited in WHO, 2016, p. 4).

Social cohesion

The protective effects of social cohesion on health and wellbeing are well documented, so what role does green space play in social cohesion? In the Netherlands, de Vries et. al. (2013) found an association between the quantity and, even more strongly, the quality of streetscape greenery and perceived social cohesion at the neighbourhood scale. Conversely, a shortage of green space in the environment has been linked to feelings of loneliness and lack of social support (Maas et al. 2009a, Ward Thompson et al., 2016 cited in WHO, 2016).

"Green exercise"

"Green exercise" is defined as physical activity undertaken in green or natural environments (Barton & Pretty, 2010). This very broad term can refer to any form of exercise that takes place outside; walking, cycling, conservation work, horse riding, boating, fishing or playing football. Research shows that there are even greater health benefits when the positive impacts of nature are combined with physical exercise. It has been suggested as being more beneficial than other types of exercise (Marselle et al., 2013). For example, running in a park is associated with a more restorative experience when compared to the same exercise in an urban environment (Bodin and Hartig, 2003 cited in WHO, 2016, p. 6).

> There are even greater health benefits when the positive impacts of nature are combined with physical exercise.

Richard Mitchell's study of the Scottish population (Mitchell, 2013) concluded that physical activity in natural environments is associated with a reduction in the risk of poor mental health to a greater extent than physical activity in other environments. Mitchell also found that activity in different types of environments may promote different kinds of positive psychological response.

An important precondition for the use of natural environments for physical activity is individuals' (perceived) safety (Jansson M, Fors H, Lindgren T, Wistro¨m B. 2013 cited in (Hartig et al., 2014, p. 214). There is evidence that disused, poorly maintained urban green space is experienced very differently to well maintained areas. Although green space generally is positively associated with feelings of safety, in dense urban areas enclosed green spaces may reduce such feelings (Hartig et al., 2014, p. 214). A qualitative analysis (McCormack et al., 2010) revealed that attributes of green spaces, such as safety, aesthetics, amenities, maintenance and proximity to home, are important for supporting physical activity outdoors.

Gary Veale and Dave Kendal (2020, p.38) in their 'Nature Connectedness Activity Level framework' (NCAL) suggest that 'being healthy and active' is the main reason that many people give for wanting to spend time in nature. Their research found that "some individuals play an important role in influencing and/or leading the everyday nature experiences of others" and that "those who most influence nature connectivity in others are already physically active people" (Veale & Kendal, 2019, p. 38).

Richard Mitchell, from Public Health and Health Policy, University of Glasgow states that "access to natural environments for physical activity should be protected and promoted as a contribution to protecting and improving population mental health." (Mitchell, 2013, p.1)

5.2 Mental health and wellbeing

There is now broad consensus about the role of nature on mental health and wellbeing from the leading health and environmental researchers in regard to nature, mental health and wellbeing. Gregory Bratman and 25 top researchers from across the globe have recently published a paper (July, 2019) containing two key 'consensus statements' that evidence supports an association between common types of nature experience and:

1. increased psychological wellbeing, and
2. a reduction of risk factors and burden of some types of mental illness
(Bratman et al., 2019 p. 23)

Studies of green spaces and health have demonstrated stronger evidence for mental health benefits, and for stress reduction, compared with other potential pathways to health (de Vries, 2010; Gascon et al., 2015 cited in WHO 2016 p. 9). For people with mental illness living in urban areas, physical activity in green space may be particularly beneficial (Roe and Aspinall, 2011 cited in WHO, 2016 p. 7). Davern et al. note that "there is convincing evidence from several studies that access to natural environments can help individuals to recover from acute stress and mental fatigue better than other environments" (Bodin and Hartig, 2003; van den Berg, van Poppel et al., 2016 cited in Davern et al. 2017, p. 13).

Davern et al. citing White, Alcock et al. (2013) and Sugiyama, Leslie et al. (2008) also conclude that "studies have demonstrated being in green spaces reduces frustration and distress and urban dwellers who perceived their neighbourhood to be greener were found to have better mental health than those who perceived their neighbourhood as less green" (Davern et al (2017, p. 13).

> Leading researchers agree that the evidence supports an association between nature experiences and:
>
> 1. increased psychological wellbeing, and
> 2. a reduction of risk factors and burden of some types of mental illness

Green space has long been associated with stress reduction, but much evidence until the early 2000's relied on self-reported health measures[2], or experiments in artificially controlled environmental conditions. A pivotal study by the University of Exeter Medical School (White et al. 2013) took this to a larger scale. They drew on 18 years of data from over 10,000 participants to explore the self-reported psychological health of individuals over time and the relationship between urban green space, wellbeing and mental distress. After controlling for other factors such as income, employment, marital status, health, and housing, they found that, on average, people reported higher levels of well-being and lower levels of mental distress when living in greener urban areas. They explained that "living in an area with higher levels of green space was associated with improvements in our wellbeing indicators roughly equal to a third of that gained from being married, or a tenth as large as being employed vs. unemployed" (ECEHH, 2013).

> 10,000 people over 18 years reported higher levels of wellbeing and lower levels of mental distress when living in greener urban areas.

More studies are exploring what cortisol markers tell us. Long-term activation of the stress-response system and overexposure to cortisol and other stress hormones disrupts many body processes. Ward Thompson et el (2012) studied chronic stress in urban neighbourhoods. They established that salivary cortisol can act as a biomarker for variation in stress levels and that unsupervised, salivary cortisol sampling within the domestic setting could be achieved. WHO (2016, p. 4) citing Roe et al., (2013) and Ward Thompson et al., (2012) describe that they used the diurnal cortisol pattern as a biomarker of chronic stress and demonstrated that exposure to green space reduces chronic stress in adults living in deprived urban neighbourhoods. "Results indicate significant relationships between self-reported stress ($P < 0.01$), diurnal patterns of cortisol secretion ($P < 0.05$), and quantity of green space in the living environment" (Ward Thompson et al., 2012, p. 221).

These and other studies have found that higher amounts of green space in a neighbourhood are associated with lower levels of cortisol and that these levels drop through the day. On the other hand, lower amounts of green space in a neighbourhood are associated with higher cortisol levels and that these levels drop less through the day (Roe et al., 2013). Similar relationships between green space and stress reduction have been also been shown using hair cortisol as a biomarker of chronic stress. The WHO (2016, p. 5) cite van den Berg & Custer (2011) when indicating that cortisol measures have also demonstrated the stress reducing effects of gardening suggesting that such activities in green space may be particularly restorative.

What about visits to green spaces rather than residential proximity?

Many studies have found that people living in environments with more green space report better mental health than those with less green space. However, the association between **visits** to green space and mental health has seldom been studied. Two studies, Grahn and Stigsdotter, 2003 ; Stigsdotter et al., 2010 cited in van den Berg et al., 2016, p. 83), showed that both a larger number of visits and more time spent per week in green space was significantly associated with lower levels of perceived stress.

Magdalena Van den Berg, Amsterdam University Medical Centre and colleagues explored the association between time spent in green spaces by 'purposeful visits' and perceived mental health and vitality in four different European cities, and to what extent gender, age, level of education, attitude towards nature and childhood nature experience moderate these associations. Data was gathered using a questionnaire in four European cities, Barcelona Spain, Stoke-on-Trent UK, Doetinchem, Netherlands and Kaunas, Lithuania. The data showed significant positive associations between time spent visiting green spaces and mental health and vitality across all four cities. "The findings confirmed their hypothesis that more time spent in green space is associated with higher scores on mental health and vitality scales, independent of cultural and climatic contexts" (van den Berg et al., 2016, Abstract).

> Time spent in green space is associated with higher scores on mental health and vitality scales, independent of cultural and climatic contexts.

2 Self-reported measures might include: depression (self-disparaging; dispirited, gloomy, blue; convinced that life has no meaning or value; pessimistic about the future; unable to experience enjoyment or satisfaction; unable to become interested or involved), anxiety (apprehensive, panicky; trembly, shaky; aware of dryness of the mouth, breathing difficulties, pounding of the heart, sweatiness of the palms; worried about performance and possible loss of control) and stress (over-aroused, tense; unable to relax; touchy, easily upset; irritable; easily startled; nervy, jumpy, fidgety; intolerant of interruption or delay).

A range of studies are now using wearable electroencephalography (EEG) to measure brain activity to record the effects of walking in different environments. Researchers in environmental psychology, Peter Aspinall et al. monitored participants on 25 min walks through three different areas of Edinburgh. The areas included an urban shopping street, a path through green space and a street in a busy commercial district. The results showed evidence of lower frustration, engagement and arousal, and higher meditation when moving into the green space; and higher engagement when moving out of it. This lower engagement and arousal might be what allows for attention restoration, encouraging a more open, meditative mindset (Aspinall et al., 2015).

There is also evidence that ruminative processes and the functioning of the subgenual prefrontal cortex may also be a key factor in the link between green space and mental health and wellbeing. Bratman et al. (2010) investigated whether nature experience would influence rumination (repetitive thought focused on negative aspects of the self), a known risk factor for mental illness, particularly depression. In another study Bratman et al. found that "participants who went on a 90-min walk through a natural environment reported lower levels of rumination and showed reduced neural activity in an area of the brain linked to risk for mental illness compared with those who walked through an urban environment" (Bratman et al., 2015, p. 8567).

The theoretical basis – how green space impacts on mental health

By what mechanisms might nature experience buffer against the development of mental illness?

> The biophilia hypothesis: humans have an innate need to affiliate with the natural environment within which they have evolved.

There are two main theories that attempt to explain the restorative psychological effects of interaction with green space:

— Attention Restoration Theory

— Psycho-physiological stress reduction theory.

Both are psycho-evolutionary theories, based on the biophilia hypothesis, which postulates that humans have an innate need to affiliate with the natural environment within which they have evolved (Wilson, 1984). Both theories suggest that interaction with the natural environment serve a restorative function but through different mechanisms.

The theories are explained below by Clatworthy et al. (2013, p. 215)

> "Attention restoration theory is primarily concerned with cognitive functioning. Kaplan and Kaplan (1989) suggest that people have two types of attention: directed attention (requiring effort, e.g. when we problem solve) and fascination (non-goal oriented and effortless attention). They propose that directed attention is a limited resource that can be overloaded (causing stress) and that people need to use the alternative system — fascination — to restore it. Fascination is thought to be dominant in natural environments, such as gardens, where there are captivating stimuli to hold attention.... Gardens often have three further qualities suggested to contribute to a restorative environment: being away (allowing a person to mentally and physically move to a different space), extent (providing a sense of being connected to a larger world) and compatibility (the ability of an environment to meet the needs and interests of the person) (Kaplan and Kaplan, 1989)."

There is also evidence that the restorative quality of green space may be particularly relevant to people experiencing mental health difficulties, as cognitive problems such as poor attention, memory and problem-solving ability are commonly reported symptoms associated with mental distress (Adhemar, 2008 cited in Clatworthy et al., 2013, p. 215).

> "While Kaplan's model is concerned with the restorative effect of nature on cognitive functioning, Ulrich's (1983) psycho-physiological stress reduction theory is primarily concerned with the effect of nature on emotional and physiological functioning. He suggests that we are predisposed to find (non-threatening) natural stimuli relaxing, and that exposure to these stimuli has an immediate impact on affect and triggers a parasympathetic nervous system response leading to feelings of enhanced wellbeing and relaxation. Again, there is considerable experimental evidence to support this theory. For example, using measures of affect and physiological functioning (e.g. heart rate, skin conductance), people recovered more quickly and completely from a stressful event (watching a distressing film) when viewing images of natural rather than urban environments (Ulrich et al., 1991)" (Clatworthy et al., 2013, p. 215).

6 Impact on community health and wellbeing

6.1 Social cohesion

The research indicates that in a neighbourhood setting "there is growing evidence that access to green space enhances social cohesion (Lee and Maheswaran, 2011) which is likely to result from enhanced local interactions" (Davern et al., 2017, p. 15). Hartig et al. (2014) considered that "Unlike physical activity, the environmental correlates of social cohesion have received little research attention" to date. But considered that "generally, the few studies available suggest a positive relationship between social cohesion and natural environments" (Hartig et al., 2014, p. 215).

Visits to urban green space is often a social activity. Public programming and education visits in green settings are undertaken in groups. Most casual visits are taken with others, in groups of families, friends and pets. Dog walking in green space plays an important social role for some. "Dogs, like children, are 'social lubricants' and as people walk their dogs, they get to know their neighbours and other dog owners, with evidence that dog owners tend to have higher levels of social capital than others (Wood, GilesCorti et al., 2005)" (Davern, et al., 2017, p. 16).

A "shortage of green space in the environment has been linked to feelings of loneliness and lack of social support (Maas et al., 2009a, Ward Thompson et al., 2016). Various types of urban green space have been shown to facilitate social networking and promote social inclusion in children and adolescents (Seeland et al., 2009)" (WHO, 2016, p.5). Yet social wellbeing may not be beneficially affected if the green space is perceived as unsafe or where people engage in antisocial behaviour.

6.2 Violence & crime reduction

Some research has shown that increased access to green space may well be linked to reductions in neighbourhood crime, violence, and aggression.

Ming Kuo, Univerity of Illinois and colleague William Sullivan studied how access to nature influences crime and conflict resolution among residents of a Chicago public housing estate in one of the 10 poorest neighbourhoods in the US (Kuo & Sullivan, 2001). Kuo thought this provided an ideal laboratory for studying the "green effect," because occupants are randomly assigned to flats, some of which have grass and trees nearby. They found that those who lived with no immediate view of or access to nature reported a greater number of aggressive, including violent, conflicts with partners or children than their peers who lived near trees and grass. The researchers then looked at two years of crime statistics related to this estate. After controlling for other factors, they found that crime rates were highest for flats with little or no proximity to nature. Identical flats with views of grass and trees were associated with significantly less crime. Kuo & Sullivan found that roughly 7% of the variation in crime that can't be accounted for by other factors can be accounted for by the amount of trees. On the other hand, some research has demonstrated perceived fear increases when vegetation reduces sightlines in urban areas that could be used for concealment. Donovan & Prestemon, (2010) also found that smaller, view-obstructing trees are associated with increased crime, whereas larger trees are associated with reduced crime.

There is also some evidence that greening of vacant lots in disadvantaged neighbourhoods can reduce crime. Branas et al, (2018) conducted a citywide trial in Philadelphia to "restore blighted vacant land: and its effects on violence, crime, and fear." After "cleaning and greening" of neighbourhoods below the poverty line they found a 29% decrease in gun violence and 22% decrease in burglaries" (Branas et al., 2018, p. 2946).

6.3 Eco-anxiety, disaster recovery

"Urban green space may play an important role in enhancing community resilience and helping communities cope with natural disasters and extreme weather events". (WHO, 2016 p. 20, citing Tidball & Krasny (2014).

Eco-anxiety or climate anxiety was defined by the American Psychological Association in 2017 as "a chronic fear of environmental doom."It is a sense of anxiety primarily based on the current and predicted future state of the environment because of human-induced climate change. Studies have found that anxiety over climate change is a growing phenomenon. Ironically, one of the best antidotes for that might be a dose of green space. (Robbins, Jan 9 2020).

Glenn Albrecht introduced the term "solastalgia"[3] to describe an element of eco-anxiety. Solastalgia is what happens when you remain in the same locality, but that sense of "home", that sense of place, is lost through the destruction of the landscape; "It is the homesickness you have when you are still at home" (Albrecht 2008). "The intense desire to be organically connected to living landscapes is, in part, a desire to overcome solastalgia by finding an earthly home in connection with other living things on this Earth" (Albrecht, 2006 cited in Marche, 2017).

While climate change affects all Australians, the impact is likely to be most severe on those already disadvantaged and vulnerable. Ernest Hunter points out that many indigenous communities are particularly impacted by climate change because of their close relationship to land (Hunter, 2009). "For those with a close relationship to the land, their identity is linked to not only its physical features but uses and knowledge of it. The loss of local knowledge, or traditional ecological knowledge, may be a key trigger for ecological grief" (Yin, 2018).

3 "Solasta" contains the sense both of "solace" and "desolation." Where nostalgia describes a longing for another place and another time

The scope of this evidence review has not identified significant peer reviewed research indicating the impact of contact with nature as a way to address eco-anxiety, although the theme is clearly a subject of growing interest. On the other hand, there is respected advice in the psychiatric community suggesting that environmental action can be beneficial. Ruzek suggests that one step to dealing with eco-anxiety is to increase the availability of contact with nature. "More time spent interacting with nature can improve health and lower stress via several mechanisms including exposure to better air quality, increased exercise, the calming effects of natural environments, and increased social cohesion" (Ruzek, 2020). As Sara L. Warber, professor of family medicine at the University of Michigan says, "If I am feeling depressed and anxious and worried about the environment," "then one of the best things I can do is go out in nature" (Robbins, 2020).

Much of the literature on eco-anxiety is linked to that on disaster recovery. The key literature on the role of connection to nature in recovery from disaster is linked to recovery in war zones, after hurricanes Sandy and Katrina with a growing body of literature on literature on bushfire recovery.

Keith Tidball & Marianne Krasny of Cornell University in 'Greening in the Red Zone' (Tidball & Kransky, 2014) assert that creation of and access to green spaces improves resilience and recovery in systems disrupted by violent conflict or disaster. They come to the view that "We're compelled to affiliate with nature, which comes to the fore with urgency in times of crisis, because we associate nature with the healing aspects of hope and optimism" (cited in Randall, 2020). A research team led by Lisa Gibbs of the University of Melbourne and others report related findings in bushfire recovery. "Self-reported attachment to the natural environment appeared ... to have a protective effect in terms of life satisfaction, mental health outcomes, resilience, posttraumatic growth and community attachment" (Gibbs et al., 2016, P. 19).

Research undertaken following Hurricane Sandy found that "community gardens functioned as multi-purpose community refuges which hosted meaningful and restorative greening practices and developed supportive communities" (Chan et al., 2015, p. 625). There is also evidence that community gardens played an important role in Christchurch, New Zealand, following the 2010/11 Canterbury Earthquakes (Shimpo et al., 2019).

Covid-19 has also generated a lot of discussion about re-evaluation of what is important in the lives of people in many different societies. It has become anecdotally clear that time in nature is seen as especially crucial. "The novel coronavirus has forced us to re-evaluate the value of natural outdoor settings, a rare pause to a decades-old trend" (Smith, 2020). "In this time of crisis, we are seeing people across the country visit their parks to seek out exercise, community and healing" (S Muqueeth, cited in Randall, 2020). While there has been a significant increase in visits to local parks and gardens, the biggest impact has been the increase in active home gardening (Atkinson, 2020).

6.4 Community gardens – the act of gardening

Community gardens clearly incorporate and strengthen social ties. Gardening involves a broad range of physical exercise and also reduces stress. Cortisol measures demonstrate the stress reducing effects of active gardening (van den Berg & Custer, 2011). Community gardens also provide opportunities for people to interact with others. "They also enable people to engage in a meaningful activity, developing specific knowledge and skills. These social and occupational factors may play a key role in promoting a sense of belonging and enhancing social inclusion for people experiencing mental health difficulties" (Diamant and Waterhouse, 2010 cited in Clatworthy et al., 2013, p. 215).

Royal Botanic Garden Sydney's Community Greening programme, running since 2000, by 2018 it had involved almost 100,000 participants and established 627 community gardens. Truong et al., (2018) analysed the impact that this program had on the health and wellbeing of communities in social housing. "Nearly 80% of participants reported that community gardens have benefited their community. Important behavioural changes were observed, particularly in relation to health; participants were now eating vegetables and cooking healthy food more regularly since becoming active in a community garden. Participants also noted that gardening reduced anxiety and stress" (Smith and Harvey-Brown, 2018, p. 11).

It appears that gardening is particularly important to older people's wellbeing. In one study by van den Berg et al. (2010), "older allotment gardeners reported having more contacts with friends and felt less lonely than did nongardening neighbours in the same age category" (Hartig et al., 2014, p. 216).

6.5 Hospital and formal care settings

Melanie Davern, University of Melbourne and colleagues note that "Several studies have demonstrated that access to natural landscapes, through nature experiences or even views of nature, can assist physical healing (e.g. faster surgical recovery and patient healing) and are associated with higher pain thresholds in hospitals (Wolf and Robbins 2015)" (Davern et al., 2017, p. 13). As Wolf and Robbins explain "One hypothesis is that nature serves as a distraction that allows individuals to refocus cognitive effort, resulting in increased pain thresholds and tolerance as well as improved coping and healing (Ulrich, 1999). Another hypothesis posits that exposure to green attributes in hospitals helps to reduce cognitive stress levels (Kaplan and Kaplan 1982) which can be linked to negative health outcomes (Varni & Katz, 1998)" (Wolf and Robbins, 2015, p. 394).

This research has prompted some hospitals to establish healing gardens and provide horticulture therapy programs. "Well-designed hospital gardens not only provide restorative and pleasant nature views, but also can reduce stress and improve clinical outcomes through other mechanisms such as increasing access to social support and providing opportunities for positive escape from stressful clinical settings" (Ulrich, 2002 ,p. 9). For example, Khoo Teck Puat Hospital in Singapore is well known for its "biophilic design" (Choo, Jan 2, 2019). In 2018 Mardie Townsend and colleagues at Deakin University conducted a systematic review of access to green spaces in healthcare facilities (Weerasuriya et al., 2018). It highlighted the importance of incorporating green spaces into urban healthcare settings and "contributes to the evidence base accessible to designers, planners, policy makers and hospital administrators who aim to create and support health promoting settings" (Weerasuriya et al., 2018, Abstract).

Studies report that, in both adult day settings and nursing homes for those with dementia, there are positive correlations of wellbeing and enhanced competence following passive and active interaction with nature. "For instance, a formal systematic review found that the use of dementia gardens was associated with decreased agitation (Whear et al. 2014)" (Beyer et al., 2013, p. 28).

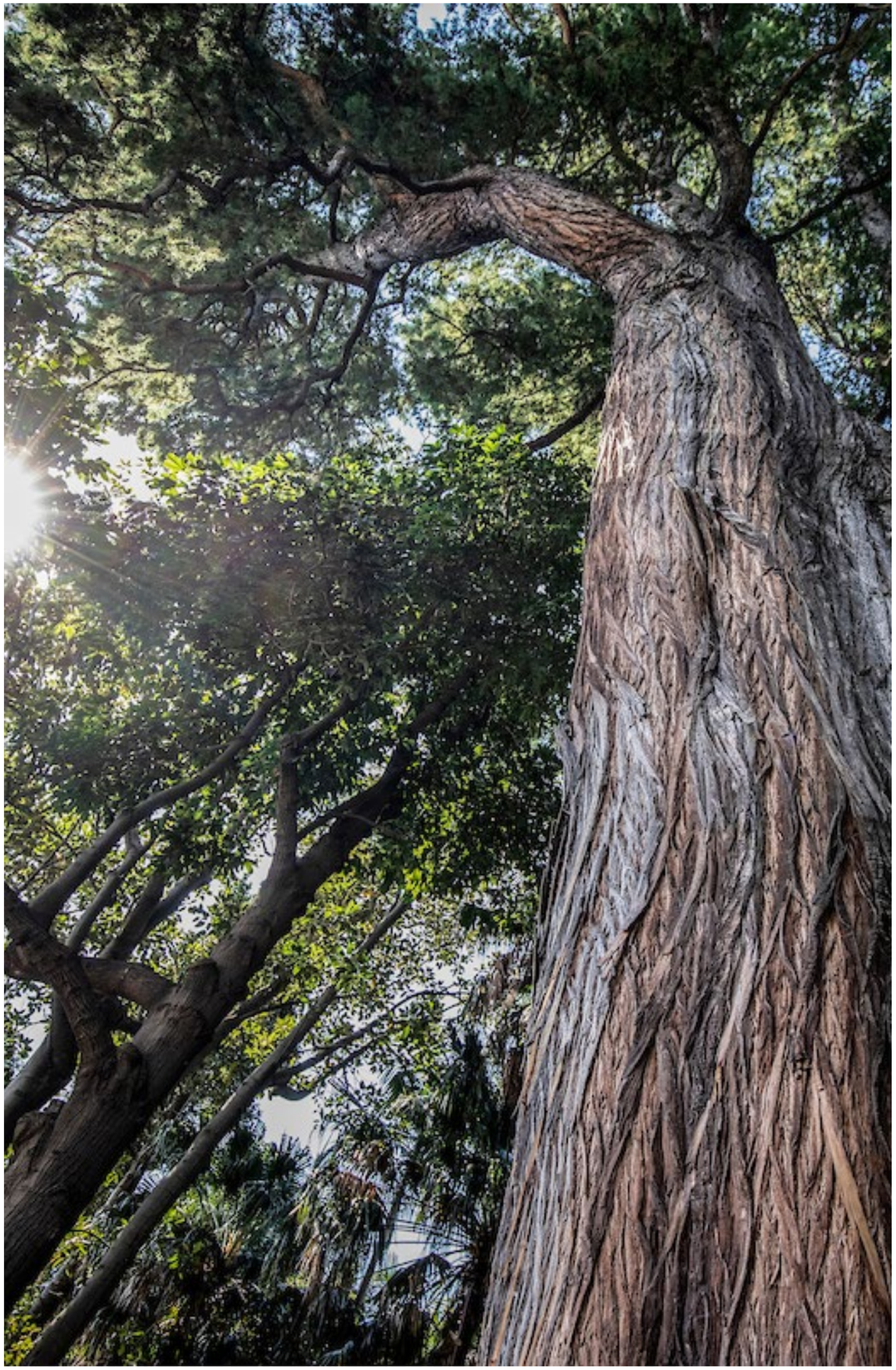
The RBGV and Regis Aged Care developed Victoria's first dedicated program for older Australians, *Branch Out– Experiences in the Gardens for the over 60s*. RBGV learning facilitators lead incursion workshops at Regis Aged Care facilities along with a public program for older people at both sites. In an initial program evaluation, it was found that residents of Regis aged care facilities were very positive about two incursions and one excursion to the RBGV Melbourne and Cranbourne gardens. Regis staff also were also positive about the experience for residents (Evaluating the Performance of the Regis Aged Care / RBGV Partnership, August 2019).

6.6 Nature based interventions, horticultural therapy

Horticultural therapy is defined by the American Horticultural Therapy Association as "the engagement of a person in gardening and plant-based activities, facilitated by a trained therapist, to achieve specific therapeutic treatment goals." These nature-based interventions (also called green care and ecotherapy) can be stand-alone organisations or be incorporated into other care settings.

Assessing horticultural therapy interventions can be challenging given the range of organisations delivering nature-based projects and services, the variety of terms and language used to describe their activity and benefits and the variation in delivery models which use different impact measures. Nonetheless "a systematic review of over 240 scientific studies found reliable evidence to support horticultural therapy as an intervention for a variety of conditions, from cerebral palsy to schizophrenia" (Annerstedt and Währborg. 2011 cited in Wolf et al., 2014). Some studies investigating the effects of nature and gardening on psychiatric patients displayed a range of results, from general mood improvement to impacts on specific illnesses (Wolf et al., 2014).

Jane Clatworthy and colleagues in their 2013 review *Gardening as a mental health intervention* concluded that "studies evaluating the benefits of gardening-based interventions for adults experiencing mental health difficulties reported positive effects of gardening as a mental health intervention for service users, including reduced symptoms of depression and anxiety. Participants described a range of benefits across emotional, social, vocational, physical and spiritual domains" (Clatworthy et al. 2013, p. 214). They state that "for people experiencing psychological distress, who may not feel able to meet the demands of the human world, sensory contact with the natural environment enables connection and communication on a simpler, safer level (Grahn et al., 2010; Adevi, 2012)" (Clatworthy et al., 2013, p. 216).



7 Impact on specific population groups

7.1 Women

"It is important to take gender into account when considering any associations between urban green space and health, since both physiological and psychological responses to green space may differ." (WHO, 2016, p 17).

There is growing evidence that women and men experience and respond to urban green space in different ways (Astell-Burt, Mitchell et al., 2014). The WHO (2016, p.16) cite a systematic review (Sreetheran & van den Bosch, 2014) summarising findings from many studies demonstrated that "women, through perceiving themselves to be more vulnerable, were more fearful in urban green spaces than men." Yet, the WHO (2016) also note that "Krenichyn's (2006) study of women's use of a large, green park in New York City found that they enjoyed exercise in the park compared to exercising in the street because of the beautiful scenery and its therapeutic or spiritual qualities. By contrast with the harassment (catcalls and male comments) experienced when exercising in the street, the park afforded a traffic-free environment where women felt freer to dress comfortably and less susceptible to unwelcome remarks. Thus, appropriately managed green space may offer women opportunities to be more physically active than in other urban contexts" (WHO, 2016, p.16).

> It is important not to assume uniform health benefits of urban green space for all population subgroups.

Elizabeth Richardson, Edinburgh University and Rich Mitchell "found that male cardiovascular disease and respiratory disease mortality rates decreased with increasing green space, but no significant associations were found for women" (Richardson & Mitchell, 2010, p. 11). They concluded that "it is important not to assume uniform health benefits of urban green space for all population subgroups." Additionally, urban green space measures that capture quality as well as quantity could be more suited to studying green space and health relationships for women" (Richardson & Mitchell, 2010, p. 2).

Parks Victoria research of 1000 people revealed that "82 per cent believe spending time in nature positively affects mental health, however alarmingly: 40 per cent of women visit a park six times a year or less with one in five (20 per cent) visiting a park less than once a year. More than one third (39 per cent) choose to mainly exercise indoors — at home, in a gym or another facility – when over 80 per cent would like to exercise outdoors more than they currently do" (Parks Victoria, 5 Sept, 2019).

There is considerable evidence of beneficial effects of access to green space for pregnant women. Specifically, "studies in Europe showed positive associations between access to nearby green space and both reduced blood pressure and reduced depression in pregnant women, with a stronger effect for reduced depression in disadvantaged groups" (WHO, 2016, p. 16).

7.2 Children and adolescents

There is a significant body of research exploring impact of nature experiences for children. While not the major focus of this paper the research indicates that access to green space might not only facilitate healthy development in childhood but also provide long-term health benefits through adulthood. "In general terms, if access to green space can stimulate the development of gross and fine motor skills as well as cognitive, emotional, social and physical development in children (Strife & Downey, 2009), then these may lead to better health and better ability to maintain healthy lifestyles in adulthood" (WHO 2016 p. 17).

Davern et al., note that other studies have demonstrated that "natural environments including green spaces in cities, provide children with unique opportunities such as risk taking, discovery, creativity, mastery and control, which strengthens sense of self, inspires basic emotional states (e.g. sense of wonder), and enhances psychological restoration. These are all thought to influence different aspects of cognitive development" (Bowler, Buyung-Ali et al. 2010 cited in Davern et al., 2017, p. 14).

There is also evidence that green space is linked to reduced problematic behaviour and reduced risk of Attention Deficit Hyperactivity Disorder (ADHD). In 2008 Ming Kuo, & Andrea Faber Taylor, studied children with ADHD that went on field trips in different environments. After the trips, researchers tested their concentration levels. Children with ADHD had significantly better concentration after a walk in a park than in an urban setting. The difference was comparable to what is achieved with standard ADHD medication, although Kuo noted that, it was unclear "how long the green effect will last" (University of Illinois, 13 Feb 2009). Other researcher has also identified reduced ADHD symptoms (Amoly et al., 2014). Veale and Kendal cite Tillman et al., (2018) when noting that "a review of the mental health benefits of teenagers' interactions with nature showed about half of published studies show positive benefits on emotional well-being and attention deficit disorder/hyperactivity disorders" (Veale & Kendal, 2020, Appendix 1, Lit Review p. 16)

7.3 Older adults

The various studies referring to "older adults" or "senior citizens" indicate that exposure to green spaces has been associated with a variety of outcomes. These outcomes relate to physical activity and mobility, mental health and wellbeing, social connections as well as to cognitive function and dementia. The existing literature suggests that neighbourhood open space may play an important role for older people in maintaining and enhancing their quality of life. Sjerp de Vries in a Dutch study of over 10,000 people correlating self-reported health and land-use data found that the amount of greenspace in the living environment of older people benefitted across a range of health indicators (de Vries et al., 2003).

The WHO, note that "Many older people find it very difficult to maintain moderate levels of physical activity; therefore, providing green spaces that encourage older people to be active, even if it is only at a light level, is important for public health" (WHO, 2016, p. 6).

Gary Veale and Dave Kendal, citing Bhatti (2006) indicate that "Older people have a particularly strong connection to nature through gardening, which becomes particularly important for people post-retirement, and loss of ability to garden is an important factor determining wellbeing of older people moving into aged care facilities" (Veale & Kendal 2019 Appendix 1, Lit Review, p. 16). They also found the experience of wildlife was important for older adults. "Older adults talked about particular animals, birds or plant species they interact with" (Veale & Kendal, 2019, p. 19).

A study by Thomas Astell-Burt, Rich Mitchell and Terry Hartig "revealed that there is variation in the association between green space and mental health across the life course and by gender". They found that "for men, the benefit of more green space emerged in early to mid-adulthood; among older women, a curvilinear association materialised wherein those with a moderate availability of green space had better mental health" (Astell-Burt et al., 2014, Abstract).

7.4 Lower socioeconomic groups

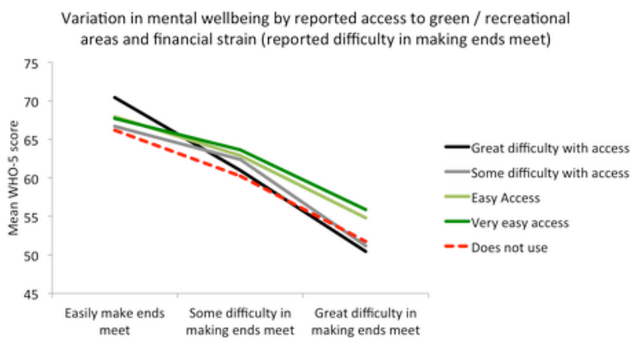
The literature regarding lower socioeconomic groups in different countries uses different terms from "deprived neighbourhoods" to "minority groups", with other studies focussing on ethnicity; "minority ethnic groups". Clearly these are not the same but are sometimes linked in the literature. Importantly there is evidence that "exposure to green space reduces chronic stress in adults living in deprived urban neighbourhoods" (WHO, 2016, p. 5). Catharine Ward Thompson and Jenny Roe, University of Edinburgh, for instance found evidence from salivary cortisol patterns that more green space is linked to less stress in "deprived communities" (Thompson et al. 2012; Roe et al., 2013).

> Exposure to green space reduces chronic stress in adults living in deprived urban neighbourhoods.

Rich Mitchell, University of Glasgow, also found that socioeconomic inequality in mental wellbeing was 40% narrower among respondents reporting good access to green space, compared with those with poorer access (Mitchell et al., 2015). The researchers used data from the 2012 European Quality of Life Survey, covering 21,294 urban residents in 34 nations, looking at relationships between reported mental wellbeing, (captured by the WHO-5 Well-being index), level of financial strain and available green areas, financial services, transport, and cultural facilities. The mental health gaps narrowed only in those areas with access to recreational and green facilities, though the research doesn't show a causal link. This evidence could show that "urban green space may be 'equigenic' i.e. that the health benefits linked with access to green space may be strongest among the lowest socioeconomic groups, including minority ethnic groups" (WHO, 2016, p. 18).

Physical environments that promote good health might be important to reduce socioeconomic health inequalities. Mitchell states that "If societies cannot, or will not, narrow socioeconomic inequality, research should explore the so-called equigenic environments – those that can disrupt the usual conversion of socioeconomic inequality to health inequality. This large, international, observational study suggests that access to recreational/ green areas may offer such a disruption"[4] (Mitchell et al., 2015, Abstract)

4 The graph below shows mean mental wellbeing score (a higher number is better mental wellbeing), by reported financial strain, for each level of reported access to green / recreational areas. The gradient in mental health (i.e. the difference in health between those with better and worse financial circumstances) gets shallower as reported access to green / recreational areas improves. In fact, inequality in mental wellbeing among those with the best access to recreational / green areas was about 40% less than those with the worst access. https://cresh.org.uk/2015/04/21/more-reasons-to-think-green-space-may-be-equigenic-a-new-study-of-34-european-nations/



7.5 People with disabilities

Much of the literature relating to people with disabilities and green urban space focuses on access issues for people with mobility disabilities, horticultural therapy and "therapeutic landscapes". Because the disability sector has very varied issues and needs, the research tends to be small studies into specific groups such as "children with autism" or "people with learning disabilities". The large research studies might include a small representation of people with disabilities, but it is surprising how little of the mainstream literature refers to disability.

On the whole the literature consists of specific program evaluations. For example, a small study undertaken by Alberta Parks with supported nature activities it was found that "Inclusion in nature for both caregivers and adults with disabilities holds promise as an activity that can support mental wellbeing through reimagining and equalising of relationships and one's experience of self in the physical environment" (Jakubec et. al. 2016, p. 214).

Lisa Stafford and Claudia Baldwin, Queensland University of Technology in a review of the literature on research relating to walkable neighbourhoods find that an analysis of the methods used to determine neighbourhood walkability indicates that research into everyday walking is significantly underdeveloped, especially in the lives of people of diverse ages and abilities. They suggest that the failure to address diversity in current research has potentially resulted in practices and guidelines that perpetuate the exclusion of spatially marginalised groups (Stafford & Baldwin, 2017). On the other hand, an empirical survey of the Isle of Mainau, located on Lake Constance in Southern Germany, shows that people with officially recognised disabilities feel stigmatised by green space that is specially designed for "visitors with handicaps" (Seeland & Nicole, 2006, Abstract).

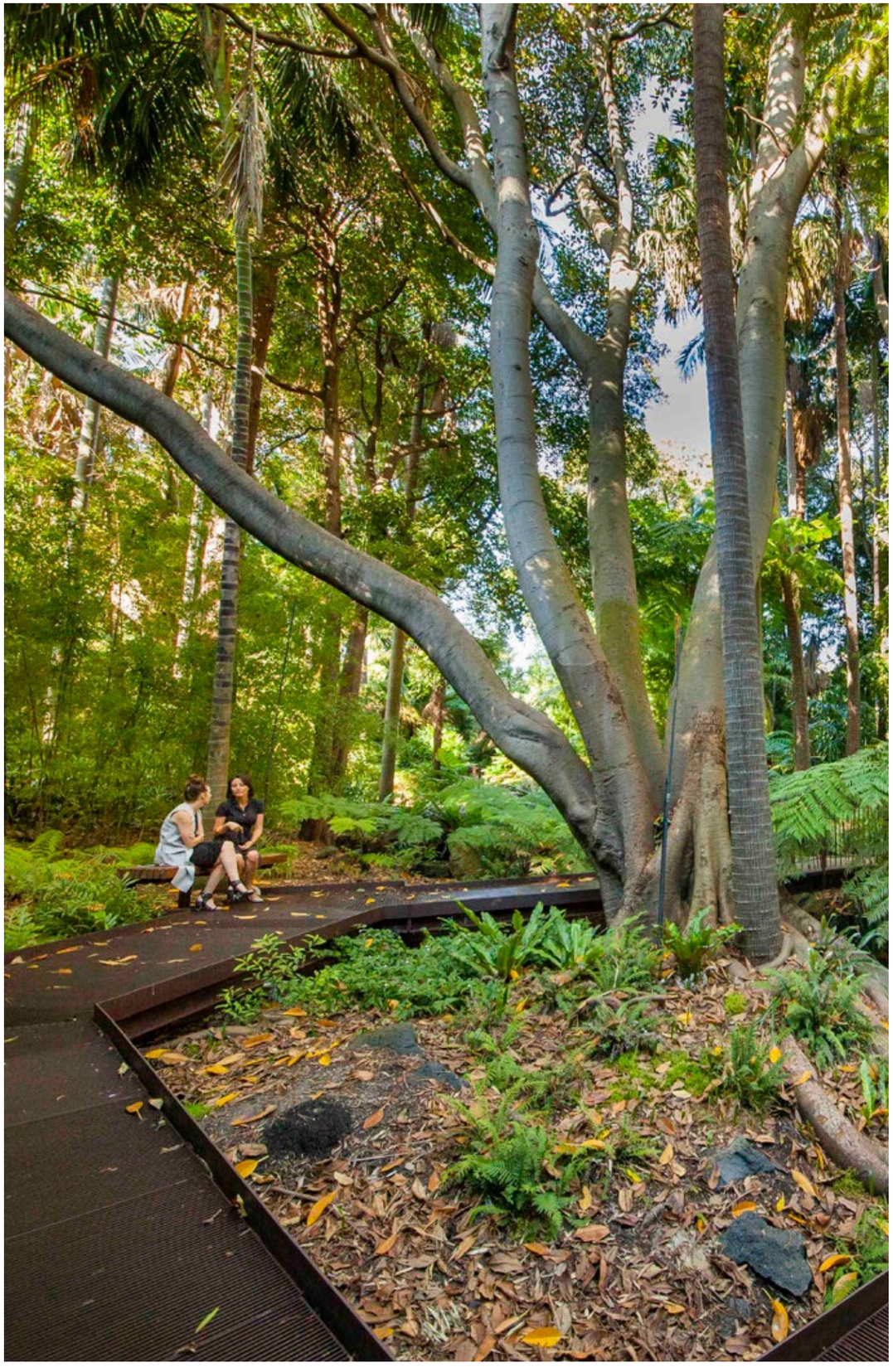
In a literature review relating to *Therapeutic Landscapes and Environments* Bell et al. (2018) note that "There is something about the ongoing power of particular 'third'[5] places to act as nodes of wellness, precisely because of their open, mobile and connective value for multiple uses and users; a positive affective capacity uncovered in practice and immersion, in memory and identity formation" (Bell et al., 2017, p.21).

Stafford & Baldwin (2017) indicate that unfortunately studies have often only examined one marginalised group at a time. This makes "synthesis difficult and time consuming for the planner to interpret their needs in practice. Hurdles to translate research and knowledge to practice are a problem that perpetuates physical and social barriers" (Stafford & Baldwin, 2017, p.25).

7.6 Indigenous Australians

"Indigenous Australians experience an increased burden of serious mental health problems by comparison to non- Indigenous Australians" (Hunter, 2009, p. 447). For indigenous communities, health can be regarded as a balance between physical, mental, emotional, cultural and spiritual health. Connection to country supports mental and spiritual well-being. As previously mentioned, the indigenous experience is mentioned only briefly here. The stories and experiences in relation to health and wellbeing are covered in a separate RBGV commissioned paper. Much of the literature indicates that "there are opportunities to learn from Indigenous and local communities, which have multi-dimensional approaches to health and wellbeing including connection to country" (IUCN World Parks Congress, 2014, p. 8).

5 Third places is a term coined by sociologist Ray Oldenburgl and refers to places where people spend time between home ('first' place) and work ('second' place). They are locations where we exchange ideas, have a good time, and build relationships.



8 Impact of different environments

8.1 "Quality green space"

The literature demonstrates that the quality of green space has an impact on health and wellbeing outcomes.

"High quality green space is defined as having a comparatively high number of recreational attributes, out of a total of five assessed by experts, including qualities associated with historical and cultural associations, spaciousness, richness of natural species, peaceful qualities and wildness." (WHO, 2016, p. 6). Jacinta Francis, University of Western Australia and Billie Giles-Corti, RMIT University describe "Quality features of Public Open Space (not just green space) includes the presence of focal points such as the presence of trees, connected pathways and seating, nature, and the absences of litter and graffiti" (cited in Davern et al., 2017, p. 29). They demonstrated that the quality of public open spaces (including parks and gardens) in the neighbourhood is more relevant to mental health, than their quantity (Francis et al., 2012). "Residents of neighbourhoods with a high-quality green space had lower levels of psychosocial distress than those of neighbourhoods with a low-quality open space" (Francis, Giles-Corti et al. 2012; White, Alcock et al. 2013 cited in Davern et al., 2016 p.14).

The quality of public parks and gardens in the neighbourhood is more relevant to mental health, than their quantity.

In a laboratory environment Bin Jiang, University of Illinois and colleagues assessed the role of tree canopy density in self-reported stress recovery by showing study participants 3-D videos containing different levels of tree canopy in an urban environment. (Jiang et al., 2016) They found that higher levels of tree density were associated with greater self-reported stress reduction and positive impacts on stress as measured by salivary cortisol. Another study in the Netherlands conducted by Sjerp de Vries and colleagues investigated the quantity and quality of streetscape greenery based on a street audit, found both quantity and quality of streetscape greenery were related to perceived general health, acute health-related complaints, and mental health (de Vries et al., 2013).

8.2 Prospect (clear field of vision) and Refuge (places to hide).

Environments with long vistas, more or less open vegetation, trees and water (prospect) are less stressful than thickly forested (refuge) areas. It is deemed possible that these open environments are similar to the African landscapes in which humans evolved. Gatersleben and Andrews, University of Surrey, UK, conducted experiments to examine restoration in natural environments with different levels of accessibility, prospect (clear field of vision) and refuge (places to hide). Their "findings demonstrate that exposure to natural environments with high levels of prospect and low levels of refuge, is indeed restorative. However, exposure to environments low in prospect and high in refuge is not and may even further increase levels of stress and attention fatigue" (Gatersleben & Andrews, 2013, p. 1).

8.3 Water and sound

"Certain types of settings, such as places with abundant vegetation, calm or slow-moving water, savannah-like locations, and unthreatening wildlife, are more likely to be restorative." (U.S. Dept. of Ag., 2018, p. 14). Though there is limited research on the health impacts of water features or elements within green space, much of the literature implies there is a correlation, eg. "positive health effects are enhanced when green space includes the presence of water, or 'blue space" (U.S. Dept. of Ag., 2018, p. 2). A meta-analysis of changes in mental health before and after short-term exposure to outdoor exercise (Barton & Petty 2010) determined that "Every green environment improved both self-esteem and mood; the presence of water generated greater effects" (Barton & Petty, 2010, p. 3947).

It is possible that both the presence and sound of water play a stress reduction role. Natural sounds improve cognition, mood and general wellbeing (Benfield et. al. 2014). This is a concept the general public already accept and respond to. It's very easy to find recordings of relaxing nature sounds including running water, "babbling brooks" and abundant birdlife. "Sounds of nature played over headphones increase parasympathetic activation (Alvarsson et al., 2010). These sympathetic and parasympathetic effects drive the immune system's behaviour (for review, see Kenney & Ganta, 2014) with long-term health consequences." (Kuo, 2015, p. 2).

Peter Newman, Pennsylvania State University, with Davis Stack and others (Stack et. al, 2011) conducted a study of why people visit parks and what they do once they're there. Newman says "Listening is a huge part of that experience that people have out there. They want to hear the noises of wildlife; they want to hear the sounds of wind and water. And those are really important things for how they feel" (Klein, Dec 23 2016). In a noise reduction study at Muir Woods National Monument, they asked visitors to be quieter in one zone of the park, ie talk quietly and turn off mobile phones. The sound level in that zone decreased 3 dba, which equates to a reduction of approximately 1200 people (Stack et al., 2011). No people were limited from entering the zone; they were simply asked to be a little quieter.[6] (U.S. National Park Service, Jan 3, 2018). His team are now developing roadside noise gauges, similar to the blinking signs that tell you how fast your car is moving.

"Evidence also suggests that a well-designed urban green space can buffer the noise, or the negative perception of noise, emanating from non-natural sources, such as traffic, and provide relief from city noise" (WHO, 2016, p. 7).

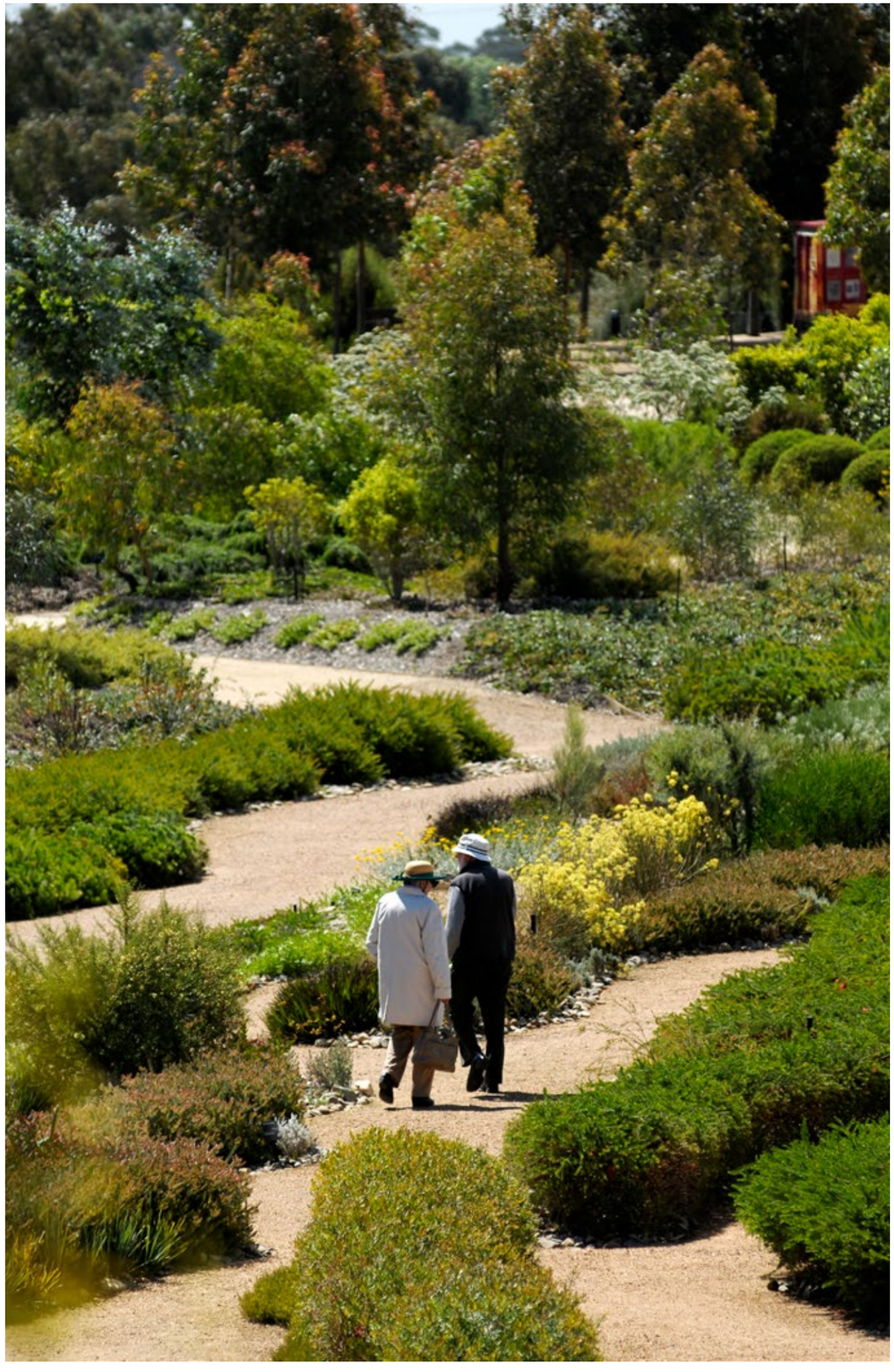
8.4 Reduction of the urban heat island effect and air quality

The location and the type of vegetation can influence the extent that green spaces mitigate the urban heat island effect. The urban heat island effect can be a serious health hazard during heat waves and extreme heat events. Increased daily temperatures can lead to increased heat-related deaths, illnesses, and hospitalisations, particularly during extreme heat periods in summer (Vutcovici et al., 2014).

Canadian public health scientist, Tara Zupanic examined various types and scales of green space and found that green space can provide cooler air at the park, neighbourhood, and city level. For example, green spaces that are connected and closely spaced can improve the flow of cool air through the city (Zupancic et al., 2015). "Every 10 percent increase in overall urban tree canopy generates a 0.6 degrees Centigrade reduction in ambient heat (Wolf, 2008)" (U.S. Dept. of Ag., 2018 p. 5). A study conducted by Diana Bowler of the Norwegian Institute for Nature Research also "suggested that parks may mitigate urban heat in wider surrounding urban areas, with data suggesting an effect up to 1 km from a park boundary (Bowler et al., 2010)" (WHO, 2016, p. 5). The inclusion of bodies of water within green space may offer greater cooling effects. (Völker et al., 2013).

The WHO referencing a range of studies note that "trees and other vegetation can decrease levels of air pollutants and reduce atmospheric carbon dioxide through carbon storage and sequestration (Liu and Li, 2012, Vailshery et al., 2013, Baró et al., 2014, Nowak et al., 2013). The U.S. Ag Department state that "The effect of vegetation on urban air quality depends on the vegetation itself, its position on the site, and overall landscape design, as well as the level of air pollution in the area. Since pollution is more concentrated at the source, vegetation is best planted close to the source. A recent review determined that vegetation should preferably be low and/or close to roads to reduce sediment and dust, for example (Janhäll 2015)". (U.S. Dept. of Ag., 2018, p.4). Hartig et al. note that "Green space provides; reduction of particulate matter (but in some circumstances, the allergenic role of trees may eclipse their ability to improve health by reducing air contaminants), increase in ozone and increase in aeroallergens."

6 "With one small change, you can make a big difference to a park's soundscape: Talk a little quieter the next time you visit a national park. By lowering your voice in parks, you greatly improve the soundscape. Now imagine if all park visitors did the same." https://www.nps.gov/subjects/sound/difference.htm



9 What's the prescribed dose? – time in nature

Recent research has provided insights into what amount of time in nature is needed to generate health and wellbeing benefits. Mathew White, University of Exeter and others, including Terry Hartig (White et al., 2019) examined associations between recreational nature contact and self-reported health and wellbeing. With response data from nearly 20,000 participants in the 2014/15 and 2015/16 Natural Environment Survey[7] they found that spending at least two hours in nature per week was strongly correlated with self-reports of being in good health or having high wellbeing. White said, "I was very surprised, to be honest. We had no idea that such a clear threshold of time per week would emerge from the data" (Akst, Oct 1, 2019).

Spending at least two hours in nature per week was strongly correlated with self-reports of being in good health or having high wellbeing.

They were further surprised to learn that "it didn't seem to matter how many trips to a park people took, so long as they got in their two hours per week. It could be a long visit one day, a couple of hour-long trips, three visits of 40 minutes, or four half-hour excursions. "They were the big categories that we were able to look at, and we found that it was exactly the same," says White (Akst, Oct 1, 2019). Thompson and Roe also demonstrated that "Frequent visits to green spaces have been associated with lower levels of perceived stress and cortisol levels" (Davern et al., 2017, p. 13).

Genevieve Meredith and a team from Cornell University (Meredith et al., 2020) recently published a scoping review indicating "that a dose of as little as 10–20 min sitting or walking in an array of green spaces can have a meaningful impact in reducing stress, anger, anxiety, and in increasing vigor, comfort, positive affect, and a sense of feeling refreshed. Identifying and utilizing nature as an upstream easy, cost-effective tool to prevent and/or combat stress can help society alleviate a substantial health burden that contributes to and exacerbates myriad other negative physiological and psychological conditions" (Meredith et al., 2020, p. 12)

7 The Department for Environment, Food & Rural Affairs (Defra) carries out an annual survey called Monitor of Engagement with the Natural Environment to gather data on how UK residents use their local public green spaces to guide policy decisions regarding land use. In the early 2010s, however, when White wanted to use the data to estimate what dose of nature was needed to show benefits to a person's health, Defra wasn't gathering information on health and wellbeing. So he and his colleagues asked the government to add a few questions to the survey, then waited a couple of years for the answers to roll in. https://www.the-scientist.com/notebook/time-in-nature-is-good-for-you-66484

10 Pathways
(mechanisms leading to health effects) linking urban green space to improved health and well-being

As discussed earlier in this paper, Terry Hartig et al. (2014) suggested four principal and interacting pathways through which nature or green space may contribute to health: improved air quality, enhanced physical activity, stress reduction and greater social cohesion.

The immune system

Ming Kuo (2015) recognising that there may be multiple pathways, suggests a central role for enhanced immune functioning as a key pathway. Reduced air pollution, increased physical activity and improved social ties may all occur with an increase in green spaces and are all associated with improved functioning of the immune system. The immune system has been implicated in depressive and anxiety disorders, as well as other mental and physical health problems.

Japanese studies have demonstrated associations between Shinrin-yoku and beneficial immune responses, including expression of anti-cancer proteins, Natural Killer cells (also known as NK cells).[8] (Li et al., 2008). NK cells play a major role in the host-rejection of both tumours and virally infected cells.

Shinrin-yoku is rooted in Shinto and Buddhist practices that promote the experience of nature through all five senses[9]. "The reported research findings associated with the healing components of Shinrin-yoku specifically hones in on the therapeutic effects on: (1) the immune system function (increase in natural killer cells/ cancer prevention); (2) cardiovascular system (hypertension/coronary artery disease); (3) the respiratory system (allergies and respiratory disease); (4) depression and anxiety (mood disorders and stress); (5) mental relaxation (Attention Deficit/Hyperactivity Disorder) and; (6) human feelings of 'awe' (increase in gratitude and selflessness)" (Hansen e al., 2017, p. 1).

Plants produce antimicrobial organic compounds called phytoncides – antimicrobial volatile organic compounds (VOC's). While some VOCs are dangerous to human health, there are others which reduce blood pressure, alter autonomic activity, and boost immune functioning, among other effects. Qing Li describes "a forest bathing trip involves visiting a forest for relaxation and recreation while breathing in volatile substances, called phytoncides (wood essential oils), which are antimicrobial volatile organic compounds derived from trees, such as a-pinene and limonene" (Li Q., 2010, p.9). Li suspects that "aerosols from the forests, inhaled during a walk, are behind elevated levels of NK cells in the immune system, which fight tumors and infections. A subsequent study, in which essential oils from cedars were emitted in a hotel room where people slept, also caused a significant spike in NK cells" (Robins, Jan 9, 2020).

There is increasing conjecture that NK cells as "a first defence against viral infections" may protect us from some viral infections. The International Nature and Forest Therapy Alliance (INFTA) have indicated that there is research indicating that some phytoncides have anti-viral properties (they cite Astani & Schnitzler, 2015 as an example).

Ming Kuo suggests that another immunological pathway may be through exposure to diverse microorganisms. Green spaces contain mycobacterium vaccae, a microorganism that appears to boost immune functioning (see Lowry et al., 2007 for review). Similarly, "environmental biodiversity has been proposed to play a key role in immune function via its effects on the microorganisms living on skin and in the gut, although the evidence for this is mixed" (Kuo, 2015).

8 "The Forrest Bathing trip significantly increased NK activity and the numbers of NK, perforin, granulysin, and granzyme AIB-expressing cells and significantly decreased the concentration of adrenaline in urine. The increased NK activity lasted for more than 7 days after the trip. In contrast, a city tourist visit did not increase NK activity, numbers of NK cells, nor the expression of selected intracellular anti-cancer proteins, and did not decrease the concentration of adrenaline in urine." – Hansen et al (2017) Shinrin-Yoku (Forest Bathing) and Nature Therapy: A State-of-the-Art Review

9 People can enjoy forest bathing with all five senses:
1. Sense of sight: green color, yellow color and red color, forest landscapes.
2. Sense of smell: forest fragrances from trees and flowers, such as pungent phytoncides.
3. Sense of hearing: forest sounds, birds singing and the breeze rustling in the leaves of the trees.
4. Sense of touch: touching trees, put your whole body in the forest atmosphere.
5. Sense of taste: eating foods and fruits from forests, taste the fresh air in forests.

11 Priorities for further research

"Unlike physical activity, the environmental correlates of social cohesion have received little research attention thus far. Generally, the few studies available suggest a positive relationship between social cohesion and natural environments" (Hartig et al., 2014, p.215). Hartig suggested that additional research with more rigorous study designs and objective measures of both nature and indicators of social cohesion are needed.

Research priorities identified by Bratman et al., 2019 include:

— running clinical trials that explicitly test the impacts of nature versus urban experience on psychological wellbeing and mental health.

— the use of prospective cohorts and ecological momentary assessment (EMA[10]) provides a valuable context for assessing associations of within-individual change in mental health with nature contact over time using large samples of participants.

Bratman et al emphasise that "It is essential that future research continues to specify and investigate underlying pathways and causal mechanisms to refine understanding of the relationships between the environment and human well-being" (Bratman et al., 2019, p. 3).

Peter Kahn, University of Washington is encouraged by the new focus on the subject but concerned that the growing interest in more contact with nature relies too much on only experiencing it visually. "That's important, but an impoverished view of what it means to interact with the natural world," he said that in future research designs "we need to deepen the forms of interaction with nature and make it more immersive" (Robins, Jan 9, 2020).

> There isn't a great deal of research that has centred around botanic gardens.

Van den Berg et al. (2016) stated that "More studies are needed to investigate the relationship between **visits** to green spaces and mental health" Paul Smith and Yvette Harvey-Brown, Botanic Gardens Conservation International (BGCI), state that there is a significant research opportunity here. "While there is a wealth of literature that shows a positive correlation between mental health and physical health, and access to plants and green spaces, there isn't a great deal of research that has centred around botanic gardens specifically." (Smith & Harvey-Brown, 2018, p. 11). Some researchers suggest that there is ongoing need to be more precise in describing the particular landscape qualities that are associated with health and wellbeing benefits.

With regard to bushfire recovery Karen Block and colleagues note that "there appears to be relatively little research directly exploring the role of the natural environment in mediating disaster experiences and recovery. While the importance of social and economic factors is undisputed, this paucity of attention is perhaps somewhat surprising given that destruction of natural environments is an almost inevitable sequel of natural disasters" (Block et al., 2019, p.4).

Besides investigating the relationship between visits to green space and mental health in general populations, it appears that more research is needed to identify which population subgroups benefit most from visits to green space. People may differ in use and perception of green spaces, e.g. being more or less sensitive to the potential mental benefits of green spaces, due to differences in socio-demographic and psychological factors. Some researchers suggest there is a need to identify less engaged groups and understand barriers to engagement in order to increase opportunities to connect with nature.

"Finally, variety between population subgroups in access to, use of, and responses to nature remains persistently underexplored. Spatial, social, economic, racial, cultural, and demographic differences in relationships between nature and health seem highly probable. It may be that relationships between nature and health are implicated in exacerbating or mitigating health inequalities between subgroups, for example. This potential should be thoroughly explored" (Hartig et al., 2014, p. 222).

10 EMA studies assess particular events in subjects' lives or assess subjects at periodic intervals, often by random time sampling, using technologies ranging from written diaries and telephones to electronic diaries and physiological sensors.

12 Policy context

The broadest policy context that covers Nature for Health and Wellbeing is to be found in the Sustainable development goals (SDG). SDG 11.7 states that: "By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities."

A scan of Australian policy documents indicates that there is not currently an Australian federal government statement on health and nature. *Australia's Long Term Health Plan* (2019 p. 12) states that "Mental health and suicide prevention are at the top of the Government's health priorities." But it does not include any specific reference to time spent in nature's potential role in this.

Most Australian states including Victoria have a 'nature and health' statement incorporating some general policy statements regarding benefits of nature for health and wellbeing (most developed between 2015 – 2017). On the whole these appear to be followed up by stronger policy statements and action plans from the relevant State environment departments or authorities (eg. in Victoria though DELWP and Parks Victoria) than by health department actions. The South Australian (SA) government appears to be the exception to this general trend. It has a robust integrated plan between their environment and health departments, supported by a Public Health Partner Authority agreement.

Parks Victoria initiated *Healthy Parks Healthy People* (HPHP) in 2008, since then programming has been adopted in some form by all States and Territories as well as internationally. The aim of HPHP is "to unlock the power of nature and parks for their preventative and restorative health and wellbeing benefits, while conserving biodiversity."

> Parks and gardens can be seen as 'health care centres' in their own right.

There are many policy responses regarding nature for health and wellbeing across the world. Many suggest possible roads that could be explored when influencing future policy development here. One that stands out from a scan of policy documents is the European Union (EU) report, *Health and Social Benefits of Nature and Biodiversity Protection, 2016* (Brink et al., 2016). This EU report captures some interesting policy ideas and processes that are also reflected in some US and UK policy documents. It states that parks can be seen as 'health care centres in their own right.' It suggests policy developments to be considered at a national, and city level and organisational level to support this. At the level of organisations, it suggests that "managers can take initiatives and cooperative actions – to promote the potential of nature parks as health hubs and preventative health care centres" (Brink et al., 2016, p. 16). It supports "promoting a robust policy and institutional framework that recognises and promotes the positive links between public health and nature and supports the uptake of nature–based health and social benefits at a broader scale." It sees that a key "way forward in realising the health and social benefits of nature will rely on advocates/champions promoting change and cooperation both with and between different stakeholder communities." (Brink et al., 2016, p. iii).

A useful international document outlining an interesting range of policy initiatives *A Guide to the Healthy Parks Healthy People Approach and Current Practices Proceedings from the Improving Health and Well–being: Healthy Parks Healthy People stream of the IUCN World Parks Congress 2014.* (Parks Victoria, U.S. National Park Service, 2014).

For details of Australian and European Union policies see: **Appendix – Policy Context**

13 Summary of learnings

A rapidly growing body of research provides evidence that time spent in urban green space is good for us – physically, mentally and emotionally. It has been found to lower stress which impacts on our health in many complex ways, changing our mood as well as the way our nervous, endocrine and immune systems function. The research shows that women and men experience and respond to urban green space in different ways and that we gain different benefits at different life stages. Access to green space can stimulate the development of gross and fine motor skills as well as cognitive, emotional, social and physical development in children. For older adults benefits of green space is associated with a variety of outcomes related to physical activity and mobility, mental health and wellbeing, social connections and to cognitive function and dementia.

Mental health

It is now clear that researchers agree that there is now robust evidence that nature experiences increase psychological wellbeing and reduce the risk factors and burden of some mental illnesses. The evidence indicates that time spent in green space is associated with higher scores on mental health and vitality scales, independent of cultural and climatic contexts. It has also been demonstrated that for people with mental illness living in urban areas, physical activity in green space may be particularly beneficial. And that studies evaluating the benefits of gardening–based interventions for adults experiencing mental health difficulties report a range of impacts on symptoms including reduced depression and anxiety.

Community impacts

Increased access to green space is associated with greater social interactions and increased social cohesion. Interestingly research shows that increased access to green space may well be linked to reductions in neighbourhood crime, violence, and aggression. There is also increasing evidence demonstrating that the health benefits linked with access to green space may be strongest among the lowest socioeconomic groups.

Studies have also found that green spaces play an important role in enhancing community resilience and helping communities cope with natural disasters and extreme weather events. There are clearly benefits of active gardening, particularly for older people, including within community garden settings. Research in hospitals and formal care settings has also found that access to natural landscapes, through nature experiences can reduce stress and improve clinical outcomes.

The quality of green space

It has been found that the quality of the green space impacts health and wellbeing outcomes. Research findings indicate that in a neighbourhood setting the quality of green space is more relevant to mental health outcomes, than the quantity of green space. It has been found that landscapes comprised of spacious peaceful gardens with historical and cultural associations and a richness of natural species have been found to be particularly restorative.

The Dose

Importantly for RBGV, research has found that spending at least two hours in nature per week is associated with self–reports of being in good health or having high wellbeing. There is also evidence that frequent visits to green spaces are associated with lower levels of perceived stress and cortisol levels and that a dose of as little as 10–20 min sitting or walking in green spaces can reduce stress, anger, anxiety.

Further research

While there is further research needed across a range of areas the ones that the RBGV might best be placed to address are that there hasn't been a great deal of research into health and wellbeing that has centred specifically around botanic gardens. There is also room for further research to investigate the relationship between **visits** to green spaces and mental health.

14 Conclusion

A rapidly growing body of research provides evidence that time spent in nature is good for us – physically, mentally and emotionally.

> There is more recently a consensus from leading researchers that nature experiences increase psychological wellbeing and reduce the risk factors and burden of some mental illnesses.

The research evidence and policy documents indicate a range of possible mechanisms for Royal Botanic Gardens Victoria – and public botanic gardens more broadly – to become recognised as centres for health and wellbeing as well as for environmental health.

The research literature and policy review point to many interesting implications and opportunities for RBGV. These range from new promotion and programming opportunities in the Gardens through to contributing to policy interventions at a State and Federal level.

Future actions for public gardens and programming teams

- awareness raising
- communication of the benefits of time in nature
- new partnerships and funding models
- additional staff training (e.g. for educators, guides and volunteers), leading to
- enhanced public programming as well as learning and participation activities

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16 Appendix Policy Context – Australia, European Union

The broadest policy context for covering Nature for Health and Wellbeing is to be found in the Sustainable development goals (SDG). SDG 11.7 states that: "By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities."

1. Australia

A scan of Australian policy documents indicates there is not currently an Australian federal government statement on health and nature. Further detailed drilling into all current federal government action plans might reveal some specific actions.

Australia's Long Term Health Plan (2019) p. 12 states that "Mental health and suicide prevention are at the top of the Government's health priorities." It does not include any reference to time in nature's potential role in this. The federal government is currently developing a National Preventive Health Strategy." (Australia's Long Term Health Plan 2019 p. 12). See: https://www1.health.gov.au/internet/main/publishing.nsf/Content/national-preventive-health-strategy Through Parks Australia the Australian Department of Agriculture, Water and the Environment appears to support *Healthy Parks Healthy People* https://www.environment.gov.au/topics/national-parks/associated-programs/healthy-parks-healthy-people

Parks Victoria initiated *Healthy Parks Healthy People* (HPHP) in 2008, since then programming has been adopted in some form by all States and Territories. It is described by Parks Victoria as "a global movement which is helping communities around the world realise the health and wellbeing benefits of spending time in parks and nature. Our aim is to unlock the power of nature and parks for their preventative and restorative health and wellbeing benefits, while conserving biodiversity." https://www.parks.vic.gov.au/healthy-parks-healthy-people A number of other initiatives (sometimes related to HPHP) appear across multiple States. These include Nature Play https://www.natureplay.org.au/ for children in Western Australia (WA), SA, Queensland (QLD) and Australian Capital Territory (ACT)

Most Australian States including Victoria have a 'nature and health' statements that incorporate some general policy statements regarding benefits of nature for health and wellbeing (most developed between 2015 – 2017). On the whole these appear to be followed up by stronger policy statements and action plans from the relevant State environment departments or authorities (eg. In Victoria though DELWP and Parks Victoria) than by health departments actions. The South Australian (SA) government appears to be the exception to this general trend. It has a robust integrated plan between their environment and health departments, supported by a Public Health Partner Authority agreement.

2. Victoria

The Victorian Memorandum for Health and Nature created in 2017. https://www.environment.vic.gov.au/biodiversity/victorian-memorandum-for-health-and-nature It is a joint Ministerial statement by Victorian Environment and Health Ministers. It states that, "The Victorian Government is committed to encouraging communities to interact more with nature, both in Victoria's parks and other open spaces, because being in nature is good for our health and is a highly cost-effective health improvement strategy. The benefits of being active in nature are recognised in the Government's key health and environment policy platforms: the *Victorian Public Health and Wellbeing Plan 2015 -19* and in *Protecting Victoria's Environment: Biodiversity 2037*." https://www.environment.vic.gov.au/biodiversity/biodiversity-plan It also states that "There are many opportunities for the health sector to build new collaborations with the environment and parks sectors to improve the health and wellbeing of our community through joint research, integrated policy and planning, and activating community-based health programs." "This includes development of new health and nature-focussed initiatives to encourage under-represented groups such as culturally diverse communities, people with disabilities and families from lower socio-economic backgrounds the opportunity to benefit."

The Hon. Lily D'Ambrosio MP opens *Protecting Victoria's Environment — Biodiversity 2037* (Bio 2037) with the statement that: "Our natural environment is not only beautiful, it is fundamental to the health and wellbeing of every Victorian" (Biodiversity 2037 p. 1). The document's key statement includes "Biodiversity delivers ecosystem services that are fundamental to the economic prosperity and the physical and mental health of all Victorians" (Biodiversity 2037 p. 8).

The policy refers to nature's preventative role: "Health benefits: visits to parks are estimated to save Victoria between $80 million and $200 million per year from avoidance of disease, mortality and lost productivity" (Biodiversity 2037 p. 5). "The health benefits experienced from contact with nature have been linked to increased work productivity, faster recovery rates from surgery, lowering blood pressure, mitigating the symptoms of hyperactivity disorder, mitigating disease, fewer medications, and a strengthened immune system" (Biodiversity 2037 p. 25). *Biodiversity 2037* also recognises that "Health and wellbeing are a fundamental concern of Victorian Traditional Owners — when Country is not maintained, health and wellbeing become compromised" (Biodiversity 2037 p. 25).

Priory 4. of *Biodiversity 2037* to be undertaken by government and (where appropriate) partners, is to "increase opportunities for all Victorians to have daily connections with nature."

"This includes to:

— Establish reliable baseline information about Victorians' current connection with the natural environment.

— Identify less engaged groups, and understand barriers to engagement in order to increase opportunities to connect with nature.

— Implement and promote programs to increase opportunities for people to connect with nature, including programs to get Traditional Owners out on Country.

— Promote opportunities for additional 'greening' in established urban areas through broadening standards for public open-space planning provisions, in the context of long-term change in population and community needs" (Biodiversity 2037 p. 57)

Melbourne Water's Healthy Waterways Strategy 2018 https://www.melbournewater.com.au/about/strategies-and-reports/healthy-waterways-strategy also recognises that "As well as protecting flows and water quality in waterways for environmental values, these actions keep water in the landscape and soils providing cooler, greener urban places, supporting public health and wellbeing. This will be increasingly important with increased and prolonged periods of heat expected from climate change" (Healthy Waterways 2018, p. 72). In addition, a recommendation from *Beyond Bushfires: Community Resilience and Recovery Final Report. 2016* https://mspgh.unimelb.edu.au/__data/assets/pdf_file/0008/3043187/Beyond-Bushfires-Final-Report-2016.pdf (Beyond Bushfires, 2016) regarding parks and recreation facilities is that "Local governments and Parks Victoria prioritise restoration of community parks and recreation facilities as an important post-disaster support to mental health and wellbeing" (Beyond Bushfires, 2016, p. 23).

The *Victorians Value Nature — Survey Results* (p. 74) recommends that "Policies and campaigns that focus on increasing connection to nature and spending time in nature could focus on gardens specifically, as opposed to national parks, which may suffer from greater accessibility barriers, particularly for those living in Melbourne. A focus on gardens might also overcome some of the commonly identified barriers to spending time in nature."

The current *Victorian public health and wellbeing plan 2019–2023* (Vic Public Health Plan 2019–23) https://www2.health.vic.gov.au/about/publications/policiesandguidelines/victorian-public-health-wellbeing-plan-2019-2023 mentions that "There is good evidence linking the natural environment with good physical health and psychological wellbeing" (Vic Public Plan 2019–23, p. 7). It also states that: "Improved access to parks and green and open spaces can support a range of activities. There is good evidence linking the natural environment with good physical health and psychological wellbeing (Australian Institute of Health and Welfare 2011)." It then refers to

"Four key principles of Victoria's 'healthy parks healthy people' (Parks Victoria 2015)

— the wellbeing of all societies depends on healthy ecosystems

— parks nurture healthy ecosystems

— contact with nature is essential for improving emotional, physical and spiritual health and wellbeing

— parks are fundamental to economic growth and to vibrant and healthy communities."

(Vic Public Health Plan 2019–23, p. 46–47).

In relation to increasing active living the *Victorian public health and wellbeing plan 2019–2023* states that "interaction with nature in Victoria's parks and open spaces and participation in sport and recreation make an important contribution to reducing chronic disease risk factors, increasing social inclusion and building strong communities" (Vic Public Health and Wellbeing Plan 2019–23, p. 29). It also states that "Encouraging this activity to occur in natural environments (including parks) can increase people's connection with nature and catalyse actions to conserve and protect our natural environments" (Vic Pub Health Plan 2019–23, p. 34). Accordingly, access to green space is listed under strategies to increase active living as – "Increase easy access to parks, open spaces and public spaces, with opportunities for physical activity where appropriate" (Vic Pub Health Plan 2019–23, p. 3).

3. City of Melbourne

The City of Melbourne states that it is "home to a world-renowned network of parks, gardens and streetscapes. These green layers contribute to Melbourne's status as one of the world's most liveable cities. Whilst much is heard about Melbourne's liveability, its biological diversity is less-often celebrated. Green spaces, rivers, and wetlands, and the biodiversity within them, play a vital role in maintaining people's health and wellbeing." https://www.melbourne.vic.gov.au/community/greening-the-city/urban-nature/Pages/urban-nature.aspx

4. South Australia

South Australia's *Healthy Parks Healthy People SA 2016 — 2021 framework – Making contact with nature, second nature* (SA Framework 2016–21) is a much more ambitious document. It opens with a joint Ministerial statement stating that "the scientific evidence unequivocally shows that spending time in nature is good for us – it improves our physical and mental health, it has positive effects on our ability to concentrate and learn, solve problems, think critically, and be creative. These concepts, of course, are not new. Aboriginal people have always understood that people and their environment are intrinsically connected, and that the health of one is dependent on the health of the other." The framework seeks "to promote contact with nature as an effective public health intervention tool, and as a vital asset for population mental health and wellbeing activities" (SA Framework 2016–21, p. 2).

This framework moves beyond promoting physical activity in parks. It "enables park and health authorities to work more closely together, and focus resources towards implementing innovative approaches to health and wellbeing." It is designed "to build relationships and cooperation between a broad range of stakeholders who understand the vital role of nature and parks in our daily lives, enriching our physical, psychological, social and spiritual health and wellbeing. It is supported by a Public Health Partner Authority agreement between the Department of Environment, Water and Natural Resources (DEWNR) and the Department for Health and Ageing (DHA)."

The SA Framework 2016–21 adopts a "socio-ecological approach to health encompasses the health of the whole individual, their environment and the whole community. It accounts for the interplay between all elements within human health (that is, biological, mental, social, environmental, spiritual, and economic) and considers broad ranging health determinants" (SA Framework 2016–21 p. 7). It outlines seven areas for action including: 1. Promoting physical activity in nature; 2. Mental health benefits of contact with nature; 3. Promoting the cultural value of Country for Aboriginal health and wellbeing; 4. Community health and wellbeing in a changing climate; 5. Childhood development and nature; 6. Green infrastructure in urban settings; and, 7. Biodiversity, conservation and human health. It then presents and cites evidence to support each of these priorities (SA Framework 2016–21 p. 13). This is then followed up with "Proposed opportunities for collaborative action" that require collaboration between multiple partners, address multiple focus areas and are evidence-based and/or contribute to new or existing evidence" (SA Framework 2016–21 p. 35). An example of one of the actions is the "development of a new 'Green agenda for mental health', reinforcing the role of nature and parks as clinically valid components within mental health promotion strategies." Another sees the encouragement of "suicide prevention and mental health programs that focus on using nature-based intervention." The SA Framework 2016–21 is followed up with a mental health Action Plan. *Healthy Parks Healthy People South Australia 2016–2021 Realising the mental health benefits of contact with nature* (SA HPHP Mental health Action plan) https://www.sahealth.sa.gov.au/wps/wcm/connect/98494f00404d8bd5aa21ebdeb8488407/Mental-health-benefits-nature+Final.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-98494f00404d8bd5aa21ebdeb8488407-n5ivr7a

5. Policy context and ideas from the European Union

There are many policy responses across the world, below is just one example that may suggest possible roads to explore to influence future policy development at a National, State Local and organisational level.

A Guide to the Healthy Parks Healthy People Approach and Current Practices Proceedings from the Improving Health and Well-being: Healthy Parks Healthy People stream of the IUCN World Parks Congress 2014, captures a range of international, perspectives, agreements and policy ideas. https://www.iucn.org/sites/dev/files/content/documents/improving-health-and-well-being-stream-report_0.pdf

The European Union presents some interesting policy ideas and processes. *The European Union report, Health and Social Benefits of Nature and Biodiversity Protection 2016*, (EU Health & Soc benefits, 2016) suggests that "Protected areas with national parks as their flagships can be health care centres in their own right, and park authorities across Europe increasingly integrate health and social benefits into nature policies and actions. An increasing number of collaborations are taking place with health and social sector organisations. There remains significant potential for scaling-up across Europe." This report also states that "The way forward in realising the health and social benefits of nature will rely on advocates/champions promoting change and cooperation both with and between different stakeholder communities" (EU Health & Soc benefits, 2016 p. iii).

The EU report outlines that:

— At the EU level — promoting effective implementation of EU biodiversity policy and integrating health-social-nature synergies across the different policy domains and financial mechanisms in order to improve policy coherence and EU added value. The implementation of the Water Framework Directive and Marine Strategy Framework Directive, the Paris Agreement on Climate Change and the Sustainable Development Goals (SDGs) will each provide wider frameworks for progress given the links between their objectives and nature-based solutions that can also offer health and social benefits.

— At the national level — promoting a robust policy and institutional framework that recognises and promotes the positive links between public health and nature and supports the uptake of nature based health and social benefits at a broader scale. Such a framework needs to be expanded across different sectors and it needs to ensure effective integration of different themes (e.g. heat stress, recreation, mental health, depression and respiratory disease) and policy areas (e.g. environment, health, education, spatial planning and transport).

— At the level of cities and regions — promoting strategies, plans and investments that take into account the health, social and wider benefits of nature, to meet the interests of their citizens.

— At the level of individual protected areas — managers can take initiatives and cooperative actions – to promote the potential of nature parks as health hubs.

— At the level of individual private businesses — there are many opportunities for entrepreneurial vanguard initiatives based on the nature/health link EU Health and Social Benefits of Nature and Biodiversity Protection (EU Health & Soc benefits, 2016 p. iii – iv).

The EU report sets out possible steps to realise the policy objectives, "Actions to enable and facilitate the further development of nature/health synergies at all levels would include mapping, modelling and assessments of ecosystem condition in relation to health and social needs, increased research into health-social-nature synergies and risks, the communication of the evidence of success, and engagement with communities to help facilitate access and use of the natural environment." The report also discusses training and investment, "Many of the 27,393 terrestrial and marine protected areas in the EU can be seen as potential preventive health care centres and arenas for social integration. To realise this will require investment in the site (e.g. infrastructure, quality), awareness raising, training (e.g. for guides and volunteers) and communication of the benefits beyond simple word of mouth" (EU Health & Soc benefits, 2016 p. iv).

Policy integration and policy coherence

The EU report states that "There is a need for a systematic integration of the health-social-nature links into policies, programmes and finance. This will require health and social issues to be reflected in nature policy, and nature issues into health and social policies (i.e. two-way policy integration), as well as all three issues being integrated into wider socio-economic policies given the links to jobs and growth. For policies, windows of opportunity include: policy reviews, multi-stakeholder engagement and partnerships are critical for improving the governance of health social-nature synergies" (EU Health & Soc benefits, 2016 p. 17).

Strengthening the knowledge base, Communication and awareness

"Improved communication helps, but often helps most if done by the right people, namely those who are perceived as being independent. It is therefore important to identify what analysis should be carried out, who undertakes the analysis and to whom it is communicated" (EU Health & Soc benefits, 2016 p. 19).

Champions and collaborations to make it happen

The report states that "Champions drive forward change and it is important to identify who these can and need to be and bring them on board. They could be public representatives with climate change strategies (i.e. EU or vanguard countries and cities), regions with regeneration ambitions, local citizen groups, doctors and hospitals, as well as Members of Parliament. In Stuttgart, the Lord Mayor helped drive the KlimaAtlas project and subsequent investment in greening the city. In Sweden, the Alnarp case included a wide range of champions from the region, including academia, medical practitioners, politicians and the farming community. This helped to create joint ownership of both the problem and the solution" (EU Health & Soc benefits, 2016 p. 20).

Economics

"The European Commission (European Union, 2015) calls for attention to ensuring sustainable urbanization through promoting nature-based solutions including provision of accessible green spaces. The economic importance of, and return on, investment in urban green space is a budgetary issue for urban planners, social services, and other professionals. Co-benefits of investment in green space may include enhanced economic competitiveness of cities, where quality of life is important for attracting and retaining a skilled workforce (KPMG, 2012a)" (WHO, 2016, p. 19).

There are many other policy examples and initiatives developed in the UK and US with mechanisms to build on and strengthen the important links between nature and health and wellbeing.

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